INTERNATIONAL SOCIETY FOR ANIMAL HYGIENE

9 th International Congress
in Animal Hygiene

17-21 August 1997, Helsinki, Finland

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Preface

Animal hygiene covers many important areas in animal production. Most of these have been discussed during the 9th International Congress in Animal Hygiene in Helsinki, Finland, from 17th to 21st of August, 1997. These proceedings give in two volumes an thorough overview of the current state and fields of interest of animal hygiene in some thirty countries all over the world.

The interaction between animals and their environment, including management, were discussed to find preventive methods against various bovine, swine and poultry problems. Due to the northern location of the Congress, cold housing and open housing of cattle and swine were a special focus for the discussion.

Animal welfare and economy are both very central aspects in modern animal production. The reader of these Proceedings can find both of these topics here. Animal waste management is one of the classical problems of animal hygiene, and the topic has been discussed in a session of its own. Animal hygienists understand the importance of animal production methods on food quality and hygiene - for example their central role in preventing human salmonellosis.

The free papers present many other interesting aspects of animal hygiene. The keeping of companion animals very often leads to problems where animal hygienists are the most qualified problem solvers. Mycotoxins, harmful rodents and insects, and the risks of pollution to animals and man are also part of the long list of ailments where animal hygienists are the best cure.

I am sure that this large collection of papers, more than 200 altogether, will convey to the reader an informative picture of animal hygiene. It will also tell that work is going on to meet the goal of the ISAH ‘97 Congress: “Healthy Animals, Sound Production Environment, Satisfied Consumer”.

Hannu Saloniemi
Editor

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The field of animal hygiene

The first International Congress in Animal Hygiene was held in Budapest, in 2 - 5 october 1973. The first president of the Society, professor Ferenc Kovács defined animal hygiene in his opening address in Budapest Congress as follows: ”The subjects of animal hygiene are the life functions of the annimal and the enviroment”.”In the statute of our society, accepted by the General Assembly in Leipzig on August 22, 1991, we can read: ”The field of animal hygiene includes the interactions between abiotic and biotic factors of environment and domestic animals, especially food animals, with the aim to prevent diseases and promote animal health and to ensure species-specific health and welfare needs of all such animals”. These definitions tell that animal hygiene covers many important fields in animal production. The effects of production environment and management on animal health, animal waste handling and risks of wastes, and feed hygiene have always been important objectives in the research work of animal hygiene.

Today, animal hygienists can give scientific answers and well founded opinions on issues like animal welfare and the ethics of animal production. We are also more and more aware of the economic effects of animal diseases and those of the preventive measures in disease control. On the other hand, animal hygiene has much to give to solving the problems of companion animal keeping. This is a new viewpoint which we will also discuss during this congress. The main concern of animal hygiene is animal production, but our principles to promote animal, environmental and human health can be applied to companion animals as well.

A short history

Animal hygiene has long traditions. Many veterinary universities, schools and faculties have had a professor chair in animal hygiene since the first half of this century. Scientific contacts have also been numerous and fruitful. In a serious loss for all scientific and human co-operation, Europe was divided after the Second World War to two different blocs. Discussion and meetings between scientists in animal hygiene across the border of the blocs were difficult for many years. From this standpoint, establishing a society for promoting co-operation between animal hygienists in all European countries was by no means an easy task. Still, some courageous men made this their goal. I will not name all the persons participating in the statutory meeting, but several of them have served our society as presidents, namely prof. Kovács from Budapest, Hungary, prof. Ivoš from Zagreb, Jugoslavia, prof. Willinger from Vienna, Austria, and prof. Rosocha from Košice, Czechoslovakia. I also wish to mention three more names from the list of that meeting, namely prof. Kalich from Munich, Germany, prof. Strauch from Stuttgart, Germany, and prof. Hojovec from Brno, Czechoslovakia. All of them are - or will be nominated during this Helsinki meeting - honorary members of the Society. I further wish to mention honorary member prof. Ekesbo from Skara *, the president of our Society from 1985 to 1988.

The International Society for Animal Hygiene has successfully served as a builder of bridges over national and political borders in Europe during the first seven Congresses of our Society. These Congresses were arranged on both sides of iron curtain, namely in Budapest, Zagreb, Vienna, strebske Pleso, Hannover, Skara, and Leipzig. In 1994, the Society was ready to go outside Europe, and the eighth Congress was held in St.Paul, USA. During the St.Paul meeting, new areas in Latin America became active members of the society, thanks to prof. Diesch. The first symposium in the region patronized by ISAH, conducted in Spanish, was held in Mexico City last year. Prof. Diesch will give an intesting lecture of the consequences of international trade and animal hygiene in Western Hemisphere. In this Congress, here in Helsinki, we have participants from all continents exept Australia. Animal hygiene is truly an international field of science.

Over the borders of science

The knowledge of animal hygiene is based on several ”basic sciences” such as microbiology, epidemiology, ethology, immunology, clinical chemistry etc. And, because one is working with animal health, one needs good knowledge in veterinary medicine as a whole. We as scientists know very well that it is much easier to talk about multi-disciplined science that to work on such area. One example is the international congresses. During these weeks, there has been a special congress in veterinary epidemiology and economics, and another in applied ethology. Many of the papers presented here in ISAH’97 congress would have been good papers for those congresses, too. If that is true, why do we need this kind of broad-field congress? My answer is that the science and the practical work also need a more overall view and more responsibility on the animal production problems on farm level. We animal hygienists have the knowledge and the will to take this responsibility. Herd health plans are a good example of that work in practice.

This kind of thinking demands very much from us as scientists and practical workers. We have to keep our knowledge up-to-date on many basic things, such as microbiology or epidemiology etc. And in addition to that, we have to know a lot about the changes in practical farming and animal management methods. International congresses in animal hygiene, like this ISAH’97, serve as an ongoing educational course for the participants on both basic science and practical levels. And, beside helping us to cross the borders in science, these congresses help us to cross the national borders, and to promote international co-operation.

The ninth Congress of ISAH

The main topic of ISAH’97 is *”Healthy Animals, Sound Production Environment, Satisfied Consumer”*. Through this, we want to stress all measures which keep farm animals, and also companion animals, healthy. This goal is equally important from the economic point of view and from animal welfare and animal protection point of view, and it is significant also from the food safety and human health point of view. We also underline the essential significance of production environment and other man-made factors in animal keeping on animal health.

In this Congress, the interaction between animals and their environment, including management, will be discussed to find preventive methods against various bovine, swine and poultry problems. The key note lectures, thirty-one short papers and fifty posters are presented. Due to the northern location of the Congress, cold housing and open housing of cattle and swine were a special focus for the discussion. Two key note lecturers, five short papers and six posters are presented of these problems.

Animal welfare and economy are both very central aspects in modern animal production. Animal waste management is one of the classical problems of animal hygiene, and the topic has been discussed in a session of its own. Animal hygienists understand the importance of animal production methods on food quality and hygiene - for example their central role in preventing human salmonellosis. These topics will be discussed by three key note lecturers, thirty short paper speakers and twenty-nine poster presentations.

Despite so many sessions covering different areas of annimal hygiene, the session for free papers grew to be the largest session of ISAH'97. A key note lecture about animal hygiene and small and companion animals, twelve short papers and twenty-seven poster presentations give a good view of the broad field of animal hygiene. In the Proceedings of this Congress, the reader will find full papers of ninety-one oral presentations and one hundred twenty-five posters. Professional excursions are also an essential part of this Congress.

In this connection, I want to give my warmest thanks to the members of organizing committee, to other coworkers and to the sponsors of ISAH'97. With their help the ninth International Congress in Animal Hygiene will be succesfull.

Animal hygiene serves consumer

Animal production industry, and our society as whole, are more and more in need of the skills of animal hygienists. The consumers have woken up to demand healthy, hihg quality food, and also to question the methods of food production. Animal welfare issues and enviromental protection are very often discussed in TV and newspapers in all countries.

We animal hygienists are experts on these questions. We serve consumers by helping farmers build their cow houses to promote animal health, or to handle the manure without risk to nature. We can help swine producers create an economically beneficial herd health program which also guarantees healthy meatnfor the consumer. As an example from Finland, I would like to present the quality programme for non-medicated pork introduced by one pig slaughterhouse companies. It includes the health classification of farrowing units and optimal housing and management in finishing units. The quality chain is based on scientifically proven knowledge of the epidemiology of major swine pathogens found in Finland, on investigations of effects of housing and management factors on swine health and on well organized data management through the production chain from breeder units, farrowing and finishing units to slaughter house. This new programme has proved to be profitable; production figures are good, the pigs are of excellent health, and the risk of antimicrobial residues has been eliminated. The quality programme fullfils all the basic goals of animal hygiene.

This is what we do every day, and I'm afraid, we do all this without making any noise of our work. Maybe we should tell more often and more loudly about our work and animal hygiene in the media. After all, animal hygiene is one of the key factors in solving the word's problems of increasing hunger and need for food.

The above mentioned aspects have made clear the benefits of our work on animal production and animal keeping. I am sure that animal hygiene will continue to have a very positive influence on animal health, environmental protection, and human health in the future as well. We have a great responsibility, and we want to work hard to show our talents in carrying this responsibility.

Animal Hygiene Needs in Western Hemisphere free Trade Agreements

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Summary

With the recent emerging of the North American Free Trade Agreement (NAFTA), the Andean Pact and the Mercosur in Latin America, veterinarians and other animal scientists in the Western Hemisphere have a major role in defining and evaluating technical health standards. This encompasses all aspects of animal hygiene to certify that animals and animal products meet quality assurance of trade criteria for free movement between countries in this hemisphere, and ultimately, globally in the World Trade Organization (WTO). A goal of uniform educational standards of professions among the countries will include veterinary medical colleges and post-doctoral training of professional school students and graduates in risk assessment and measurement of animal hygiene for certification. A great opportunity exists for the International Society for Animal Hygiene (ISAH) to expand its expertise globally in development and implementation of uniform and scientific acceptable standards among nations.

Key words: NAFTA. Requirements for veterinarians, Educational standards.

Introduction

With the 1995 implementation of the North American Free Trade Agreement (NAFTA) in the Western Hemisphere animal hygiene needs and standards are being defined and evaluated. The trade agreement aims at reducing and eliminating barriers of trade, investment and food services between the United States, Mexico and Canada. Likewise, the recent development of the Andean Pact and the Mercosur of South America, together with NAFTA, creates a major trade area of 658,8 million people. The goal is to merge the three regions into a Western Hemisphere free trade agreement. These agreements are linked to the World Trade Organization (WTO) now of more than 100 signatory countries. Europe unde the European Union (EU) and its many veterinarians, colleges and programs in animal hygiene have years of experience in developing and assessing technical standards for animals, animal products and other food for movement and safety.

Animal Hygiene

The term animal hygiene is not widely used in the Western Hemisphere. Its subject areas are more often defined under preventive medicine, public health and food safety. In an attempt to expand the global participation of veterinarians from the Western Hemisphere in animal hygiene, the 8th International Congress on Animal Hygiene, held in St. Paul, Minnesota in September, 1994, was titled: ”Enviromental and Management Systems for Total Animal Health Care”. Although the Congress was well supported by private professional and govermental agencies associated with veterinarians, the Congress was not well attended by veterinarians fro the United States or the Western Hemisphere. However, veterinarians and animal scientists from 33 countries participates. This was the first ISAH Congress held outside the European continent.

Veterinary Faculty of the Autonomas Metropolitan Univeristy of Mexico City presented an ISAH ”in-between” Seminar on Teaching of Animal Hygiene in October 1996.

Requirements for Veterinarians under NAFTA

Veterinarians (both public and private pracitioners) have a major role in a standardized and transparent risk assessment process that needs to include criteria for evaluating an exporting country´s veterinary infrastructure, including its disease recognition and control capablilities, surveillance and monitoring systems and animal import policies within NAFTA.

Within NAFTA a major change exists in the concept that all regions of a country must be free of the disease to allow exports. The Animal Plant Health Inspection Service (APHIS) of the United States Department of Agriculture creates under NAFTA concepts of different levels of risk that exist in regions of a country. Six levels of risk are identified from low to high. This allows trade movement of animals, related products, and germ plasm from a region free or with low risk, byt not necessarily from the entire country. Risk factors considered in developing these levels include:

- proximity of the are to infected areas;
- historical disease incidence within the area;
- vaccination policies and practices within areas;
- type of physical separation from higher risk areas;
- type of importation of animal and animal products from higher risk areas;
- disease surveillance within the area;
- disease control policies and resources within area;
- demography and infrastructure within area.

Highly trained veterinarians will have the major responsibility in surveillance, risk assessment, and determining quality assurance. In the United States the accreditation of private practicing veterinarians to participate with the govermental veterinarians and programs fulfill a major role in becoming the first line of defense on the farm in disease identification and surveillance in food producing animals. All of which directly or indirectly affects NAFTA and other trade agreements.

The United States and its territories have approximately 60,000 veterinarians of which only about 1000 are regulatory, govermental veterinarians. Therefore to maintain high standards of animal hygiene and food safety, the federally accredited private practitioner has a major responsibility in animal hygiene assessment and certification on present and future animal health and trade, of disease free animals and animal products.

Educational Standards for Health and Trade

With the implementation of the signed and developing trade agreements in the Western Hemisphere, the professions within the countries are taking action to determine and evaluate education of veterinarians, and other professions, based on the standards of the educational institutions. Respresentatives of veterinary profession and other professions of the three NAFTA countries have met in Mexico, the United States and most recently in Canada. The purpose is to ultimately establish uniform levels of standards and certification through accreditin educational institutions and licensure of its graduates.

The Council on Education of the American Veterinary medical Association evaluates and determines accreditation of 32 colleges and schools of veterinary medicine in the United States and Canada. Mexico has 31 colleges of veterinary medicine and are now actively establishing an evaluation system for its educational institutions and licensure of its graduates. There must ultimately be similas and uniform standards among the three countries.

Conclusion

With the needs and emphasis of free trade, uniform standards, certification of animal and animal products, and germ plasm, opportunities both present and future are excellent for veterinarians and associated technical professionals to insure a safe food supply, beginning at the farm level. Free trade agreements can enhance health and economics, and well-being of people. The veterinary medical educational institutions must have high standards of education and provide training in animal hygiene, risk assessment and surveillance. The Internation Society for Animal Hygiene, since its beginning in 1970 in Europe, has had a major impact. Though its members the ISAH must actively continue to pursue global expansion through research and education...and sharing of scientific findings to assist in establisment of criteria and improve animal hygiene standards for creating free trade among countries.

Animal housing and management – prevention of bovine diseases

ANIMAL HOUSING AND MANAGEMENT - PREVENTION OF BOVINE DISEASES

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General introduction

The most appropriate methods of disease prevention might be to alter the environment in order to affect the interaction between the host animal and the agent of disease (Martin *et al. 1987).* Agent can be defined as any infectious organism, or stress factor, which tends to shift the stable physiological status of an animal over to an unstable situation, defined as disease. Knowledge of good preventive methods is essential to succeed in modern animal production; particularly when the net income margin per unit is low. The objective of this paper is to present an overview of the housing and management methods, that are either documented or hypothesized to be of importance in the prevention of bovine diseases.

A. General goals of animal housing and management

Radostits et *al. (1994*) proposed three goals of environmental management in dairy herds to optimize health and performance by fine-tuning the delicate balance in agent-host-environment relationships. These three goals are:

1: Reduce the absolute number of pathogens in environment,
2*:* Reduce the potential for contact between the pathogens and the cows or heifers and
3: Minimize the detrimental effects of the environment on the animals, which may alter host defence mechanisms.

In addition, a fourth goal could be to optimise feed intake to meet the nutritional requirements of the animal for appropriate health and resistance to disease.

A. 1.Reducing the absolute number of pathogens

The housing and management systems utilized should reduce the possibility of introducing animals harbouring pathogens, and effectively remove or minimize the shedding of these pathogens into the environment. The simplest way to achieve this objective is to have a closed herd. However, if the herd is open, there is a great need for effective detection systems (diagnostic tools), restriction of animal introduction, quarantine before full contact with the herd, and effective cleanup or segregation if a pathogen is introduced. Modern housing systems should be constructed, such that quarantine and segregation for new animals is possible and convenient.

Prevalent bovine pathogens such as mastitis-causing organism are more affected by factors like humidity, thermal conditions, ventilation and cleanliness. Reduction in the transmission of pathogens is also affected by the handling and harvesting of animal products and excretions. The interaction of housing and demand for hygienic measures for personnel (employees, veterinarians, consultants, visitors, etc) is important. In other words, the housing should include an appropriate cleaning room, warm/cold water, facilities for changing of clothes etc.

A. 2.Reducing the contacts between the pathogen and the animal

Contamination of the environment with potential pathogens results from infected carrier animals, or organisms previously shed. The risk of infection is determined by number of susceptible animals and the probability of adequate contact (Reed-Frostmodel) (Martin *et al.,* 1987). The stocking density and the number of animals kept in one location are the most important factors that determine animal to animal contact. Contact through feed, water and manure should also be kept in mind. The most important factors are the animal density, group size, loose-housing versus tie-stalls, milking machine equipment (robotic milking versus milking parlour with several units) and feeding stations. Awareness of animal movement between groups is also important.

A.3.Minimize the detrimental effects of the environment on the animals.

Cow comfort has three distinct aspects that can have important effect on health and productivity:

- **Thermal comfort,** involves features like temperature, ventilation, humidity, condensation, chilling and heat stress. Elevated temperature and humidity improves the microbial growth and, thus, increases the microbial challenge to the animals. In addition, the bovine metabolism can be altered such that resistance to microbial invasion is decreased. Chilling or heat stress are two examples.
- **Physical comfort is due** to factors that have impact through housing construction interfering with resting, feeding, getting-up and lying-down. Physical discomfort can be exuberated by space restriction causing trauma; especially in locations to the extremities and teats. The bedding softness is important to avoid any kind of circulatory disturbances due to large body weight applied at different body pressure points. The most important physical components are bedding type, bedding placement, length and width of stalls, manger size, and height of the brisket board.
- **Behavioural comfort** involves factors related to the animals ability to carry out necessary biological functions, such as walking, lying down, getting up, expression of oestrus, parturition and socialization. It should also be stressed that group dynamics are of considerable importance.

A.4. Optimise feed intake to meet the nutritional requirement

The discrepancy between lactation demands and the capacity for dry matter intake for a cow are well known (Radostits *et al.,* 1994). Animal housing should, therefore, be constructed in a way to meet this challenge. Grouping of animals according to lactation stage, as well as ease of access to feed, should favour meeting nutritional demands. Restricted feeding times or overcrowding in the feeding area are detrimental to meeting the nutrient requirements of early lactation. It is also important to recognize that dairy cows in certain periods of lactation need appropriate restriction of feed intake. Therefore, appropriate grouping of animals is essential.

Water is also an important component, very often is overlooked. The position of watering devices is important both for cleanliness of the water, and the hygienic condition of the bedding. In tie-stall systems, it should be stressed that the functionality of watering devices should be checked regularly. In loose-housing systems, it is important to avoid stress such as heavy traffic close to the water area. On pasture, the hygienic conditions in and around the water place is important as well. Other aspects of nutrient requirements and nutritional management are also of utmost importance, but are beyond the scope of this review.

B. Specific diseases in relation to housing and management

Important diseases connected to housing include: mastitis, teat injuries, lameness, calf problems, metabolic diseases, behavioural disorders and pest controls.

B.1.Mastitis

The essential goal in prevention of mastitis is to limit the contamination of the area around the teat canal with potential pathogens, prevent forces able to transport bacteria from outside to inside the teat canal, and to enhance the resistance mechanisms of the cow.

B.1.1. Housing type: Comparing different housing system, it is apparent that certain type of loose-housing system has better udder health results than tie-stalls (Bakken, 1988), especially with deep litter bedding (Ekesbo, 1966). However, from new Norwegian research there is some indication that certain type of loose-housing system could be even worse than tie-stalls (Østerås, 1994). In addition, there is mounting evidence that the most common pathogen is changing from *S.aureus* to *E.coli;* in particular as herds change from tie-stall to loose-housing systems (Rendos *et al.*, 1975).

B.1.2. Replacement system: Several studies have illustrated an association between replacement heifer management systems and mastitis problems (Pettersen, 1981 Matzke *et al.* 1992; Østerås, 1994a). Raising heifers in groups has been shown to increase the risk of cross-suckling, and thus physical destruction of teat canal and reduced resistance to mastitis. Raising heifers on slatted floors also increases the risk of animals placing themselves outside the bedding area during rest in a loose-housing system (Kjaestad *et al.* 1994).

B.1.3.Housing construction: Several construction features have been shown to be associated with mastitis. These features include stall length, stall width, stall partition, bedding material, cow-trainers, manger configuration, and dung handling system (IDF, 1987). The mechanism behind all these measures is restriction of cows ability to conduct natural movement, representing a cause for physical disturbances, with resulting impact in the area around the teat canal opening. Some of these factors, if not all, could also have their impact on the general hygiene. Interestingly, the hygiene effect would result from opposite stall features to the effect of physical damage for stall length, stall width, cow-trainers, manger height and dung handling system. Thus, an optimal stall size, rather than a maximal size, should be preferred.

B.1.4.Litter type and usage: The literature is fairly consistent with respect to the importance of the amount of bedding in maintaining a good udder health. It is also fairly consistent that saw-dust and wood products can be a source of rapid multiplication of coliform bacteria, and specifically *Klebsiella* species (IDF, 1987). The hardness of floor could also be moderated by use of rubber mats or cow mattresses. Several studies have illustrated a benefit of these compared to concrete flooring.

B.l.S.Dung removal: Some research indicates an association between udder health and dung removal system (Bakken, 1982; Oltanacu *et al.* 1990). This could be associated with the wet manure handing systems which do not allow the use of bedding material like straw.

B.1.6. Milking routines/Milking machine: Different milking routines and milking machine design features are important in mastitis prevention (Østerås & Lund, 1988). Housing factors are important to facilitate the milking procedure. For example, loose-housing systems, usually utilize a milking parlour with a low pipeline. This could both facilitate the milking procedure, as well as improve functional construction of the milking machine. In loose-housing systems, it is very difficult to separate the effect of mastitis due to cows having free movement from the possible benefit of milking machine and milking procedure. Milking with more units will also decrease the possible contacts between animals during milking. On the other hand, use of robotic milking will maximise the number of possible contacts between animals.

B.1.7. Climate: In general, research indicates that temperature may interact with other predisposing conditions to exert an influence on mastitis (IDF 1987). For example, bacterial growth in bedding material has been shown to influence mastitis incidence, as well as the type of pathogen's isolated (Bramley & Neave, 1975; Newman & Kowalski, 1973). Ventilation and indoor climate is very often proposed as a cause for mastitis problems at herd level. However, there is very little documented evidence of this relationship in the literature according to IDF (1987). High humidity is likely the most important of the overall climatic factors.

B.1.8. Fly control: Summer mastitis illustrates the connection of fly habitats and fly control methods with the occurrence of mastitis. Flies will be able to destroy the defence mechanism by biting of skin in the teat area, as well as transfer of bacteria. The occurrence of flies will also be associated with climate through both humidity and temperature (IDF, 1987).

B.l.9.Noise: In the document of IDF (1987), noise is mentioned as a potential predisposing factor for mastitis. However, so far, there is no evidence of this association in the literature.

B.l.l0. Feeding: The IDF document (1987), refer to several feeding strategies associated with mastitis. Abrupt changes in feed, excessive feeding, unbalanced nutrition, improper calcium-phosphorus ratio, low-fibre ensiled feeds and diets high in vegetable wastes have all been linked with increase in mastitis. The mechanisms involved in this association could be either by changing the defence mechanism, or through an increased microbial load due to hygienic condition caused by diarrhea. It is also questioned whether the feeding of mastitis milk, or milk containing pathogenic bacteria, results in a transfer mechanism into heifer raising system, and thus be a link into heifer mastitis or mastitis in first carvers at freshening.

B.2. Teat injuries

Prevention of teat injuries is closely related to the prevention of mastitis; since teat injuries are very often followed by clinical mastitis. Construction which prohibits the cow from carrying out the physiological correct movements, especially when lying-down and rising in the resting area is of greatest importance. Such factors will be stall length, stall width, stall partitions, bedding material, cow-trainer, manger height, and dung handling systems as mentioned earlier. Also, feet or claw conditions will interfere in the same way and are documented to be associated to teat damage (Østerås & Lund, 1988 and Østerås *et al.* 1990). However, circulatory disturbances that result from improper milking procedures and faulty milking machine installation could also be very important risk factors for teat injuries (Østerås et al. l99O; Østerås et al. 1995). For example, the findings of less teat lesions in loose-housing systems could be confounded by the fact that loose-housing systems also have milking parlour with better vacuum conditions, which is connected to less teat damage (Hamann, et al. 1993)

B.3. Lameness

Lameness is an extremely important disease of dairy cattle in many countries (Rodostits *et al.,* 1994). Some of the foot lesions are due to nutritional or metabolic factors (Bergsten, 1994). However, most lameness is related to housing through the effect of the floor surface. For example, abrasive concrete floors, some slatted floors, and "rough" floor surface can contribute to traumatic injuries of the soles of dairy cattle (Rowlands et al., 1983; Bergsten, 1994). Claw and bone problems are often associated with the introduction of new concrete with rough structure and high alkalinity (Barnes, 1989). Stall hygiene is also important to prevent interdigital dermatitis and heel horn erosion. Cow-trainers are shown to have a preventive effect (Bergsten 1992)

B.4.Reproduction

The importance of detection of heat, and the cows ability to show heat signs, could be one of the reason why reproductive performance is much better in loosehousing compared to tie-stall system. Furthermore, cows having cow-trainers have worse reproductive performance compared to cows without electric trainers (Østerås, 1991). Other factors in the association between reproduction and housing include infectious diseases and feeding management.

B.5.Calf diseases

The most prevalent calf diseases are injuries, diarrhea and respiratory diseases. Injuries are more predominant in slatted-floor barns compared to floors covered with straw (Frankena *et al.,* 1992). Several studies have illustrated a better calf health performance using single calf hutches (Anderson & Bates, 1994; Heath, 1992 and Waltner-Toews *et al.* 1986a) This practice will decrease the individual pathogen load for calves compared to calves housed together with the adult livestock. However, Curtis *et al., (* 1993) showed that the use of calve hutches the two first weeks after birth tended to increase the risk of diarrhea. Calves raised in groups experienced an increased in the death rate due to infections with *Campylobacter jejuni* (Hagstad *et al.*, 1984). However, Hardmann *et al.,* (1991) showed that cleaning of feeding utilities, as well as other hygienic measures, were more important than the construction of the pens for the prevention of *Salmonella* infections in calves.

The feeding system could also be important in prevention of disease. Both the frequency (Curtis *et al.* 1993), and the type of feeding (Maatje *et al.* 1993) have been associated with increased disease. Common feeding nipples in pens increased the risk for infections.

B.6. Pest control

Fly and rat control is an integral part of having a closed herd, by reducing the possibility of introduction of pathogens down to an acceptable level. These animals could be vectors for *Salmonella spp., Leptospira spp.* etc. Keeping pests out of the housing system relies upon good hygiene and good garbage management. Overuse of rat poison or constantly need for fly control chemicals would also increase the risk of developing resistance. Good housing and management is an important tool for preventing these problems.

B.7.Behavioural problems

In loose-housing system, some cows seem to reject use of the bedding area and use the slatted floor as resting area. Some cows also develop the habit of suckling milk from other cows. In addition, fighting other cows away from the concentrate feeding station can be a problem (Kjaestad *et aL* 1994, BØe, 1993). Some of these habits could be prevented by correct housing construction, as well as the system of raising replacement heifers. Rejection of using the bedding area in loose-housing systems is decreased by using straw bedding for heifers (Colam-Ainsworth *et al.,* 1989)

B.8.Metabolic diseases

Ketosis is shown to be associated with restricted feeding frequency; as in stalls with feeding barrier compared to short stalls without feeding barriers (Gustafsson *et al.,* 1995). The same mechanism could be the reason why loose-housing system with automatic concentrate feeding stations shows lower frequency of ketosis than tie-stall operations.

Milk fever prevention is mostly done by correct feeding strategy of minerals. The latest literature has put some pressure on the importance of cation-anion balance, dietary calcium, manipulation of protein supply, importance of linoleic and linoleic acids, nematode infection and blood acetate level (Arney, 1994). Perhaps more related to housing is the finding of Waage (1985) that the most common complications to milk fever in dairy cows are leg muscle damage, and tendon rupture. This damage could be prevented by providing the cow with better comfort around the time of calving. Of utmost importance is to avoid edges or hard concrete floor, which can compress the blood vessels and thus compromise circulation.

C.Miscellaneous

Antibiotic residues have been found associated with milking in parlours (McEwen *et al.,* 1991). This is one example of concerns other than diseases in the connection between treatment of diseases and animal housing. These concerns are important for the product quality from dairy farms.

Manure handling, and the relevance to pathogen surveillance, will be more important as the herd size increases and the animal population concentrates in specific areas. A few papers indicate that the manure handling system with slurry, and thus little straw used, do not get aerobic fermentation and proper destruction of pathogens (Forshell, 1993). *Salmonella Dublin* survived only 5 days in separated urine. However, organisms were recovered for 6 years on dry cow faeces on different stall surface (Forshell & Ekesbo, 1996). In cold non-composted manure *Salmonella* species survived for approximately 200 days; while in composted cattle manure less than 7 days (Forshell & Ekesbo, 1993). Manure handling systems in relation to pathogens surveillance could be extremely important in the future. As indicated by a FAO report (Ekesbo, 1986) more research is needed in this field of study.

D.Aspects needing further investigation

D.l. Infectious diseases: Several areas of major concern for consumers have emerged. These concerns are the increasing occurrence of *Escherichia coli* 0157:H7 in humans, with a possible connection to cattle. There is also some concern about a possible connection between Johne's disease and Crohn's disease in humans (Mechor, 1997). In addition, there is much concern about Salmonellosis and Leptospirosis (Hartman *et al.*, 1989). In order to avoid consumer groups having any destructive impact on the marketing of animal products in the future, it is important to take such concern seriously. Consumer concerns should increase the demand for research on these hypothesized associations.

D.2. Production diseases: Mastitis is still an unsolved problem. Calf diseases and mortality are very high in many countries. Housing system that do not meet standard requirements should be scrutinized carefully. Regular use of antibiotics and/or disinfectants should be carefully monitored as a possible part of the evaluation process of development of resistant strains of microbes. Any possible connection between the high incidence of these diseases, and awareness of evolution of resistant strains of microbes and any housing or management system, should also be questioned in future research.

General conclusion

Efforts to construct animal housing that facilitate decreasing infectious disease and the use of drugs will also increase the consumers acceptance of cattle products. In the future, these initiatives will be more important as economics and structure of dairy production is changing throughout the world. Abundance of food (at least in the Western part of World) will make consumers more aware of the safety issues of the food they buy. Both the cost and food safety issue will put pressure on cattle housing and management systems.

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Effect of housing on animal behaviour, health and production of heifers in commercial dairy herds

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Summary

Since 1993 a series of experiments have been carried out in Denmark for developing alternatives to fully slatted floor systems for dairy heifers. All experiments were conducted on commercial dairy herds. Management in the herds were not changed except for feeding which were kept constant during the 20-22 weeks experimental period (November-April). The within herd experiment was repeated on a series of herds. The responses were measured in terms of live weight gain, resting and social behaviour, clinical examinations of heifers at the beginning and at the end of the experiment and data from hoof trimming. Results on the effects on: space allowance in fully slatted floor systems and in deep litter systems, the effects of access to a bedded lying area, as well as flock size and flock size composition are summarized in the paper.

Key words: experimental design, resting behaviour, social behaviour, digital disorders, weight gain.

Introduction

Loose housing systems with fully slatted floor has been a dominating housing systems for growing cattle in Scandinavia during the last three decades. In recent years, however, this system has been criticised for compromising animal welfare. A critique which has been supported by experiments carried out mainly on fattening bulls (Ingvardsen & Andersen 1993, Mossberg 1994). Very few experiments have been carried out with dairy heifers.

During four housing seasons (1993-97) a series of experiments have been carried out in Denmark analysing the effect of alternatives to fully slatted floor systems for dairy heifers. Experiments in the last three housing seasons were planned based on results of the experiment conducted in the previous year.

The purpose of this paper is to describe the experimental framework combining measurements of animal behaviour, health status and production in commercial herds and to summarise the results from these experiments.

Methods

The experiments were conducted in commercial Holstein-Frisian herds during 20-22 weeks (November - April). The involved dairy herds were selected based on their actual housing systems and the possibilities for establishing the treatment pens. Treatments were compared within herd and parallel on several herds.

A few non-experimental elements such as feeding and eating space were standardised across herds. Management, however, were changed as little as possible to maintain realistic circumstances.

Heifers were grouped according to weight (200-350 kg), age, and pregnancy status and randomly assigned to treatment. Behaviour were recorded during 24 hours using direct observations at the final stage of the experimental period. Health status in terms of clinical illness, skin lesions and other traumas were recorded for each heifer by a veterinarian at the beginning and the end of the experiment. Digital disorders, hoof quality and claw length were recorded by a hoof trimmer at the beginning and the end of the experiment. Production were recorded by a DIAS-technician in terms of feed intake during 24 hours per pen and live weight changes per heifer.

Results and discussion

In 1993/94 three experiments were conducted in 7 herds using 32 pens and 204 heifers (Hindhede et al. 1996, Jensen et al. 1995).

Space allowance in fully slatted floor systems. An increase from 1.5 m^2 to 3.0 m^2 per heifer increased weight gain by 31 % without changing the feed intake. Resting time was increased substantially and skin traumas tend to decrease. An analysis on milk production in first lactation indicated that also milk production was affected by space allowance for heifers in fully slatted systems (Mogensen et al. 1997a).

Access to bedded lying area. A comparison between 3.0 m^2 fully slatted area and 1.5 m^2 bedded area plus 1.5 m^2 slatted area showed no difference in weight gain and feed intake. Heel horn erosion was reduced and claw length was increased by access to bedding. The behavioural observations showed that the heifers had fewer problems in getting up and lying down on straw than on slatted floor. The heifers clearly preferred to lie down on straw. However, all heifers could not to lie down at the same time on a 1.5 m^2 bedded area.

Effect of flock size. An increase in flock size from 6 to 12 heifers in fully slatted floor pens with 1.5 m^2 per animal did not affect feed intake or live weight gain.

In 1994/95 two experiments were conducted in 5 herds using 18 pens and 90 heifers.

Effect of space allowance in deep bedded systems. Increasing the resting area from 1.8 m^2 to 2.7 m^2 or 3.6 m^2 increased daily gain and feed intake and decreased heel horn erosion. An increase from 2.7 m^2 to 3.6 m^2 did not cause any major changes in behaviour, health or production (Mogensen et al. 1997b).

Effect of different size straw bedded area in slatted floor systems. An increase of the straw bedded lying area from 1.8m^2 to 2.7 or 3.6m^2 increased the synchronisation of res-ting behaviour and decreased aggressive and abnormal behaviour (Nielsen et al. 1997).

Association between resting behaviour and live weight gain was estimated on data from 1993/94 and 1994/95. A hypothesis of reduced lying time and reduced gain for ligth (low ranking) heifers at low space allowance was only partly supported. The results indicate that the relation between resting behaviour and gain is not linear (Mogensen et al. 1997c).

In 1995/96 an experiment were conducted in 8 herds 24 pens and 160 heifers.

Effect of flock composition in deep beeding systems with two different feed rations. Small homogeneous groups of heavy (315 kg) or ligth (200 kg) heifers (5-6 heifers per pen) were compared with a mixed heterogeneous group (10 -12 heifers per pen). Silage/total mixed ration were compared with restricted concentrates plus straw ad libitum. Ligth heifers in the heterogeneous group had a lower daily gain than ligth heifers in a homogenous group fed concentrate plus straw. The behaviour observations indicated that the welfare of the light heifers were affected negatively in a large heterogeneous group compared to a small homogeneous group (Mogensen et al. 1997d).

The effect of flock composition based on the experiment conducted in 1995/96 can not be separated from a likely effect of flock size. In 1996/97 an experiment in 8 herds were therefore conducted looking at different flock composition at same flock size. This experiment is finalised in may 1997.

Discussion

Management vary conciderable between herds. As animal health and welfare effects are inflicted with management it is often relevant to study such effects in experiments within a herd in order to obtain realistic management conditions (Sørensen & Hindhede 1997). To allow a test for interaction between herd and treatment it is necessary to carry out the experiment parallel on several herds. The described concept for experimental studies of behaviour, health and production has proven to be feasible.

Our series of experiments has shown that fully slatted floor systems are inappropiate for dairy heifers. The welfare of heifers in fully slatted systems can be improved by offering a straw beeded lying. The straw beeded area, however, should be more than 1.8 m^2 per heifer.

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Critical points related to housing and management in control programmes for calf morbidity and mortality in French dairy herds

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Summary

Calf morbidity and mortality from 1 to 15 days were investigated in 236 dairy farms. Morbidity, mortality and mortality in diseased calves averaged respectively 17.4%, 3.1% and 18.9%. Critical points were identified by logistic regression. Risk factors with the highest effects were housing design allowing cross-contamination between calves and/or with older cattle, introduction of calves from other farms, colostrum feeding not aimed at an early intake, feeding mastitic milk, inadequate water supply, inadequate handling of diseased calves (kept with healthy calves, fed milk in case of diarrhea). Medical prevention in cows or calves had no protective effect in field use conditions.

Key words: dairy cattle, calf diseases, morbidity, mortality, risk

Introduction

Calf disease and mortality rates are high in different countries despite available control programs. Therefore effects in field conditions of housing and management are still studied (Curtis 1993, Olsson 1993, Perez 1990, Simensen 1982, Waltner-Toews 1986, Wells 1996). To improve calf health, it is necessary to provide farmers with information on risk resulting from poor management and on expected efficiency of control actions.

The objectives of this study were: (1) to quantify calf morbidity and mortality rates between 1 and 15 days in French dairy herds, (2) to describe herd status regarding previously evidenced risk factors and implementation of control actions of calves diseases and mortality and (3) to rank risk factors and control actions according to their explanatory power of the observed disease and mortality rates between 1 and 15 days.

Material and methods

A survey was carried out in 236 dairy farms in West of France in 1995/96. Calvings, disease incidence and mortality in calves between birth and 15 days were recorded by farmers and collected every month by vets or technicians. A questionnaire describing housing, calves management and farm characteristics was administered by specifically trained investigators during a farm visit. Incidence rates were calculated as below:

$$\mathrm{MB15} = \frac{\text{number of calves diseased between 1 and 15 days}}{\text{number of calves alive at 24h postpartum}}$$

$$\mathrm{MT15} = \frac{\text{number of calves dead between 1 and 15 days}}{\text{number of calves alive at 24h postpartum}}$$

$$\mathrm{MTD15} = \frac{\text{number of calves dead between 1 and 15 days}}{\text{number of calves diseased between 1 and 15 days}}$$

where:

MB15 = morbidity rate between 1 and 15 days,

MT15 = mortality rate between 1 and 15 days,

MTD15 = mortality rate in diseased calves between 1 and 15 days (calculated in 133 herds with at least 4 calves diseased or dead),

Multivariate logistic regression models were run to identify herd level variables associated with probability for a herd of experiencing MB15 (morbidity rate) or MTD15 (mortality rate in diseased calves) over 20%. Independent variables described calves housing in the first month, introduction of calves from other farms, dystocia, calving supervision and assistance, calving location, seasonal distribution of calvings, colostrum feeding, milk and water delivery, medical prevention in cows, medical prevention in calves, surveillance of calves, treatment of diseased calves (only in the MTD15 model) and herd characteristics (size, manpower, average milk yield). Relative risks (RR) were derivated from estimates of odds-ratios in final models.

Results and discussion

Morbidity and mortality rates showed large variations (table 1). As in other countries, French dairy farmers can improve calf health management and reduce associated losses.

Ranking based on both RR and frequency of the factors put forward housing design and use in the first month: contacts between calves of different ages, different origins, with diseased calves, or older cattle strongly increased risk of morbidity likely because of cross-contaminations.

Table 1: Calf morbidity and mortality rates in 236 dairy herds (in %)

	mean	s.d.	p_{25}	median	p_{75}	p_{90}
Morbidity 1-15 d	17.4	16.0	5.7	11.8	24.3	41.3
Mortality 1-15 d	3.1	4.4	0.0	1.7	4.2	8.8
Mortality of diseased calves 1-15d	18.9	23.9	0.0	11.1	25.0	80.0

p_n: n-th percentile

Effects of housing and management risk factors and control actions significantly associated with higher morbidity and mortality rates are quantified in tables 2 and 3.

Table 2: Critical points for calf morbidity between 1 and 15 days

	% herds	RR	95% CI	p
Calves housing in the first month (ref: individual)				
group pens after 1 week - age difference < 3 weeks	15.7	1.21	0.59-2.23	0.01
group pens after 1 week - age difference >=3 weeks	21.2	2.07	1.14-3.67	
group pens at birth - age difference < 3 weeks	11.0	0.74	0.29-1.62	
group pens at birth - age difference >= 3 weeks	16.5	2.38	1.37-4.06	
Calves tied in the first month (ref: no)	21.2	0.56	0.27-1.07	0.07
Risks of draught in calves housing (ref: no)	21.3	0.61	0.30-1.12	0.11
Calves in contact with older cattle (ref: no)	31.4	1.49	0.93-2.28	0.09
Introduction of calves from other farms (ref: no)				
seldom	20.8	1.52	0.89-2.36	0.18
regularly	7.6	1.56	0.71-2.54	
Cows calving on pasture (ref: <= 25%)				
25% to 50%	34.3	0.64	0.37-1.09	0.06
> 50%	22.9	1.26	0.73-2.10	
Cows calving indoors with the herd - loose housing (ref: < 20%)				
>= 20% cows calving on straw bedding lying area	47.0	0.63	0.39-1.01	0.11
>= 20% cows calving in cubicles	11.0	1.00	0.45-1.90	
Colostrum feeding (ref: provides regularly early intake)				
provides sometimes early intake	26.3	1.20	0.69-2.07	0.02
not aimed at early intake	39.0	2.51	1.31-5.10	
No 1st-milking colostrum if dam milked before calving (ref: some)	18.2	1.72	1.04-2.54	0.04
Colostrum feeding at night (ref: yes or calf kept with dam)				
sometimes colostrum during the night	11.4	0.98	0.43-1.85	0.01
no colostrum during the night	33.1	0.35	0.15-0.74	
Use of mastitic milk for calves feeding (ref: no)				
only for bull calves or older calves	54.9	1.83	1.05-3.36	0.07
for all calves	15.3	1.78	0.93-3.23	
Water supply (ref: drinkable water)				
no water supply	14.0	2.28	1.35-3.20	0.01
non drinkable water	7.2	1.87	0.93-2.75	
No vitamin to cows before calving (ref: regularly or at drying-off)	64.8	0.40	0.25-0.63	0.001
Navel disinfection at calving (ref: systematically)				
sometimes	12.7	1.55	0.79-2.65	0.13
never	42.0	0.77	0.47-1.25	
Sick not calves isolated from healthy calves (ref: yes)	71.1	2.00	1.13-3.77	0.01

Table 3: Critical points for mortality of diseased calves between 1 and 15 days

	% herds	RR	95% CI	p
Some calves don't receive any 1st-milking colostrum (ref: no)	18.2	1.90	0.98-3.10	0.05
Vitamins to calves (ref: no)	25.4	1.75	0.92-3.02	0.08
Medical prevention in calves for digestive disorders (ref: no)	11.0	2.52	0.78-3.75	0.05
Milk given to diarrheic calves (ref: no milk in case of diarrhea)	19.9	2.29	1.15-3.72	0.01
Grouped calvings (ref: <= 1/3 calvings in 2 consecutive months)				
1/3 to 1/2 calvings in 2 consecutive months	56.6	1.10	0.61-2.12	0.14
> 1/2 calvings in 2 consecutive months	15.3	2.46	0.9-6.26	

RR: relative risk, CI: confidence interval of RR, ref: reference class

Colostrum feeding was assessed considering possible immunity transfer. It played a major role if not aimed at an early intake (e.g. calf waits until next milking time irrespective of the hour of birth) independently of feeding method. Feeding calves with mastitic milk was widely used and associated to higher morbidity. Drinkable water was available to calves in most herds, but if not morbidity was increased. Feeding milk to diarrheic calves strongly increased mortality and was frequent. Calving management and dystocia had no impact on disorders occurring after 24h except calving location, maybe due to lower surveillance of calves born on pasture. Cow vaccination against E. coli or rota- coronavirus was used in 12.7% of the herds and wasn't associated with morbidity or mortality level. Higher morbidity or mortality associated to some preventive actions (navel disinfection, vitamins, medical prevention of diarrhea) suggest that these actions are used especially in problem herds. Mortality in diseased calves increased with herd size, and morbidity increased with proportion of 1st calvings. Risk associated to grouped calvings, herd size and factors such as colostrum feeding management may depend on manpower availability to care for calves.

Recommendations for control of calf morbidity and mortality are not yet comprehensively implemented and should focus first on housing and management risk factors with high effect. Critical points put forward 2 different possible control levels: prevention of disorder occurrence (morbidity), control of disease consequences (mortality in diseased calves).

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Validation of a new method of oestrus detection in daily dairy practice.

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Summary

Twentyone dairy farmers used a score table for oestrus detection during a period of three weeks. Oestruses were confirmed by testing for progesterone in milk. With the score table, an average detection rate of 47% was achieved as opposed to a level of 64% with normal oestrus observation. It is concluded that this new method might be to complicated to introduce in normal herd management, but as an additional aid it can have a positive effect.

Introduction

Oestrus detection in Dutch dairy herds is getting more difficult in recent years (van Eerdenburg et al. 1996). Complaints refer to decreasing numbers of cows showing heat properly and if they show heat signs, they do it during a shorter period. As artificial insemination (AI) is the most important way of fertilization, the farmer must be able to determine the right time for AI.

Several technical aids have been developed for the detection of oestrus. Although all technical devices have the benefit of low imput of labour, they may cost more than regular and intensive visual oestrus observations. Also the occurrence of false positive attentions is a major problem. With visual observations it is important to be aware of primary and secondary oestrous signs. Van Eerdenburg et al.(1996) marked nine of these oestrous signs with points, as is shown in Table 1. The distribution of the points is based on the frequency of expression during oestrus and di-oestrus. A cow that reaches the threshold of 50 points during two successive 30-minutes observations is assumed to be in oestrus. With this system Van Eerdenburg et al. (1996) detected 74% of the cows in oestrus, with zero false positive attentions. Their study was performed by specially for this task appointed and trained students on two farms. In the present study the scoring system is validated in daily dairy practice.

Table 1: Heat Detection Score Table

symptoms of oestrus	points
standing heat	100
being mounted but not standing	10
mounting (or attemping) other cow	35
mounting headside of other cow	45
resting with chin on other cow	15
sniffing the vulva of other cow	10
cajoling	3
restlessness	5
mucous vaginal discharge	3

The distribution of the points is based on the frequency of expression during oestrus and di-oestrus. A cow that reaches the threshold of 50 points during two successive 30-minutes observations is assumed to be in oestrus (after Van Eerdenburg et al., 1996)

Materials en methods

The oestrus detection rate was studied in 32 herds during 3 weeks of normal herd management and during 3 weeks with the heat-detection-table. Herds were selected on the basis of a questionaire that was sent to all dairy farms with a loose housing system in a region around Utrecht (the Netherlands). Selection criteria were herd size (between 40 and 120), calving interval (CI) (>395 days) and willingness to cooperate. In a visit of half an hour the farmers received more detailed information about the study, without giving precise information on the new method. During three weeks, they had to look at their cows in the way as they were used to, and record all animals in oestrus. In a second period of three weeks, they had to work with the new method. Five out of these 32 farms formed a control group. These farmers were asked, after they had taken part in the control period of three weeks, to do the same for another three weeks.

The farmers were asked to take milk samples every three days from the open cows that were > 30 days post partum, including the cows that were inseminated but not confirmed pregnant yet. The samples were stored at -20°C, until they were assayed for progesterone by RIA.

Results

Of the 27 farmers that started observing oestrus behaviour with the table, 21 returned data that were usable. In total 196 oestrusses were observed with the scoring table. In these only 48 standing heats were seen. The mean detection rate during normal visual observation by the farmer was 64%. The detection rate in the table period was 47%. Three farmers appreciated the score table and told us they would use it in the future. Most farmers said they got more aware about oestrous signs and importance of other signs besides standing when mounted and felt that this would improve their detection rate in the future. The most important objection of all farmers was, that two observations a day during half an hour, only observing the herd, is very long, especially if none of the cows is expressing any symptom of heat. The adviced moments of observation were after milking and feeding. In most herds this would be around 10 a.m and 8 p.m.. However, the observations were widely spread around these moments.

Dicussion

Three out of twenty-one farmers that were satisfied with the score table is a low score, especially if we take into account that all farmers were highly motivated. Besides the fact that the rate during the control period is rather high, the detection rate of 47% in the table-test period is far below the predicted rate of 74% as reported by Van Eerdenburg et al.(1996).

All farmers stated at questions in the questionaire that they, during normal management, take only 10 minutes a day for observing cows in oestrus, but they also observe their cows continuously during other tasks like feeding and cleaning cubicles. During the table-test periods, farmers frequently stated, that cows were seen in oestrus but not during one of the two observation periods. So these cows were recorded as missed, while in 'normal' management they would have been detected. The detection rate of 74% as reported by Van Eerdenburg et al.(1996) could only be achieved during twice a day 30 minutes observations shortly after milking and feeding. Reviewing the data that were returned by farmers, observations were often started on other moments than the advised periods. This might be an important reason for the low detection rates as can be derived from the data presented by Van Vliet and Van Eerdenburg (1996). Farmers had not been ordered to look at their cows shortly after milking and feeding because this might have disrupted normal herd management to much and they might not have cooporated in this study.

The conclusion must be that this score table used as strickly as in this study, is not a good device to use as a sole method for oestrus detection by farmers. Moreover, it appeared to be a problem to observe the herd on adviced moments and maybe also to do this during 30 minutes each observation period.

Nevertheless, this method can still be a valuable addition to normal oestrus management. Using the table, it is not needed to wait for standing heat before insemination.This can be important, since in only 46 out of 196 cows standing heat was observed. Some farmers said that occasionally, vage signs like restlessness are sufficient for them to decide to inseminate a cow, but there were also farmers who waited until they observed standing heat. Especially this last group might benefit from the score table.

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ENVIRONMENTAL RISK FACTORS ASSOCIATED WITH MASTITIS IN HEIFERS

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Summary

44,989 first parity cows from 2,711 randomly selected herds in Norway were used to identify risk factors for mastitis before calving, from calving to 5 days, between 6 to 30 days after calving, as well as having above 200,000 per ml in cow (composite) milk somatic cell count (CMSCC) at the first test day before 30 day of lactation. The overall herd variance in those parameters was small, ranging from 0.011 to 0.07. Thus, good predictability by herd level management factors could not be expected. Nevertheless, the most consistent risk factor was month of parity, having heifer in groups from 2 months until breeding (OR=1.13 to 1.21), and in tie-stalls from breeding to calving (OR=1.25 to 1.30).

Key words: Clinical mastitis, Somatic cell count, Heifers, Replacement system, Pasture, Calving month. Tie-stall, Loose-housing, Calf feeding.

Introduction

Mastitis is the most common disease in Norwegian Dairy Production. The proportional rate of clinical mastitis in 1995 was 46.7 per cent; 17.8% of dairy cows in their first lactation had been treated for clinical mastitis during 1995 (0steras & Tared, 1996). Mastitis in heifers would cause an important financial loss for farmers, causing dairy cows not to enter production, or having a loss in production. This study is an attempt to identify determinants for the distribution of mastitis between herds due to selected housing and management factors in the replacement system.

Material and methods

The material in this study comprised data from January 01 1993 to January 01 1996 in 3,155 randomly selected herds from the data list of all dairy herds delivering milk to the Norwegian Dairies Association in 1994 (N=25,654). Of these 165 had loose-housing and 2,990 tie-stall cow-sheds, 14.1% (n=444) were not enrolled in the animal recording system, 438 used tie-stalls and 6 loose-housing systems. Thus, the study consists of 2,711 herds.
These herds were surveyed for 173 environmental and cow identity variables by means of standard questionnaire filled in by District Veterinary Officers in Norway. Only variables related to replacement system and calving were used in this study. Data from the animal recording system covering these individual data: Date of birth, date of calving, lactation number, health recording, once monthly daily milk, CMSCC every or every second month and culling date.

44,989 female cattle had their first parity during the study period. Of these (2.2%) cows were excluded due to a recorded age at first calving less than 450 days or more than 1,054 days. Health data covering the first recording of a mastitis event for each cow (code 303 = acute/severe clinical mastitis or 304 = chronic clinical mastitis or 305=subclinical mastitis) were identified from the animal health card system.

Four different dependent variables for logistic regression were defined. MAST_0= 1, cows having mastitis before calving; MAST_5= 1, cows with mastitis from calving to 6 days after calving; MAST_30, cows with mastitis from day 5 after calving to day 30, and finally CEL_200=1, cows with CMSCC above 200,000 per ml at the first test within 30 days in lactation. The dependent variable consists only of cows having a new case for those conditions.

Results

Only 51 of 55,572 heifers who never calved had experienced a case of clinical mastitis (0.92 per 1,000 heifers). For those recorded with a calving, the risk rate of having mastitis before first calving day was 0.026 (1,183 out of 44,989 heifers), from calving to 6 days after the risk rate was O.068 (2,991 out of 43,806) and from 6 to 30 days the risk rate was 0.035 (1,347 out of 39,043). For cows having higher than 200,000 per ml in CMSCC at the first sampling within 30 days after calving (CEL_200) the risk rate was 0.252 (3,432 of 13,623).

The intra herd correlation (part of the total variance between animals explained by herd factors) was 0.029 for MAST_0; 0.048 for MAST_5; 0.018 for MAST_30 and 0.069 for CEL_200.

For all four classes of dependent variables there was a significant association to calving month. Compared to September (the month with lowest risk rate) the highest month for MAST_0 were: April (OR=1.48), August (OR=I.51) and November (OR=I.49); for MAST_5: May (OR=1.36) and August (OR=1.31); for MAST_30: May (OR=1.22) and August (OR=1.22); and for CEL_200: May (OR=1.32) and December (OR=0.85). From logistic regression analyses other risk factors being associated with the dependent variables in addition to calving month are presented in Table 1.

Table 1. Significant determinant factors for mastitis at different period of lactation.

Variable	Class (range)	MAST_0	MAST_5	MAST_30	CEL_200
Age at first calving	90 days	1.10**			
Practises for milk feeding in young calves	Bucket		1.00		
	Artificial teat		1.07		
	Combined		1.19***		
Calves from birth to 2 month of age	Separate	1.00	1.00		
	Groups	0.75**	0.79***		
	Combined	0.87*	0.92*		
Type of floor for calves up to 2 month	Solid		1.00		
	Slatted		1.25***		
Calves 2 months to breeding	Tie-stall		1.00	1.00	1.00
	Group		0.92*	1.21**	1.13*
	Combined		1.16***	1.13	0 98
Heifers from breeding to calving	Tie-stall	1.00	1.00	1.00	1.00
	Groups	0.75**	0.77**	0.80**	1.04
	Combined				0.87*
Heifer on pasture	Yes				1.00
	No				0 86$^{.07}$

*: p<0.05;** :<0.01 and*** :p<0.001

Conclusion

The results show that calving month is an important determinant for clinical mastitis as well as high CMSCC. The general trend for developing mastitis at calving is highest during late winter and early spring and also in July and August, while calving in the autumn usually gives better udder health. The summer peak is probably a result of summer mastitis. The risk of mastitis before calving increases with age at first calving. Heifer raised in groups from breeding to calving showed better udder health than those raised in tie-stalls, while those raised in groups from 2 month of age to breeding showed poor udder health, especially during the first lactation month. For mastitis around calving there is also an association to feeding practices in young calves. This probably indicates different biological mechanisms in relation between grouping and mastitis at different age.

These findings support the theory that some of the heifer mastitis is due to the wellknown summer mastitis complex and partly due to replacement system. The different direction of group rearing as a risk factor at different ages seems conflicting. However, grouping as a risk factor is consistent with other studies (Pettersen, 1981; Matzke *et al.* 1992 and Østerås *et al.,* 1994). The new hypotheses from this study could be that the period just after 2 months of age onward is the most critical period for suckling behaviour. Then grouping would be a risk factor, especially if feeding practices also promote suckling. The benefit of grouping from breeding to calving could be due to the benefit of socialization and/or exercise. The observed association to slatted floor for calves should be questioned. More refined studies have to be done to verify these hypotheses. The importance of the heifer replacement system to mastitis is highlighted.

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The effect of housing on the risk of respiratory disease in heifers during the first three months of life[1]

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Summary

The objective was to compare the risk factors for clinician- and caretaker-diagnosed respiratory disease with a prospective observational cohort study (410 heifers < 3 mo old) and with a nested matched case-control design (105 calves with pneumonia and their 59 control calves from the same initial population).

Housing calves mostly in the presence of adult cattle and failure of passive antibody transfer (IgG ≤ 1,200 mg/dl in calf serum) were risk factors for clinician-diagnosed pneumonia, whereas housing mostly alone in a hutch was associated with a decrease in the risk of developing caretaker-diagnosed pneumonia.

Caretaker- and clinician-diagnosed pneumonia had slightly different risk factors, which implies that studies using different definitions of pneumonia should be compared with caution. The practical implications are that more attention should be paid to proper housing conditions of the calves in order to reduce incidence of pneumonia, given the similar results in risk-factor analysis regardless of who made the diagnosis and regardless of the study design.

Keywords: pneumonia, calf, housing, hutch, failure of passive antibody transfer

Introduction

Cumulative incidence of respiratory disease in commercial dairy calves in North America varies from 6.5% diagnosed by the farmer (Sivula et al., 1992; Curtis et al., 1988) to 29% diagnosed by the veterinarian (Van Donkersgoed et al., 1993; Virtala et al., 1996), as reported in recent prospective follow-up studies. In Europe, the incidence appears to be lower (from 0.8% to 5.8%) (Olsson et al., 1993; Perez et al., 1990), as diagnosed by the caretaker or agricultural students, respectively.

The objective of this study was to evaluate and compare the risk factors for clinician- and caretaker-diagnosed respiratory disease in heifers during the first 3 mo of life.

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Material and methods

This was a prospective cohort study in which 410 heifers were followed for the first 3 mo of life through weekly clinical examinations by a veterinary clinician. The study was conducted from January 1990 to March 1991 in Ithaca, NY. With an initial questionnaire and during these weekly visits management data were collected. Additionally, a nested matched case-control study was used for 105 calves with pneumonia and their 59 herd- and age-matched (± 2 wk) control calves without pneumonia. Clinician-diagnosed respiratory disease was defined as: detection of abnormal clinical signs related to the respiratory tract. These included: inducible cough on tracheal massage, abnormal sounds on auscultation of the respiratory tract, high rectal temperature (>39.5 °C), depression, and a lack of involvement of other body systems that might explain the fever. An animal with symptoms of clinical pneumonia which the caretaker detected and treated, as marked in the treatment follow-up sheets, unless treatment was done at the clinician's advice, was defined as caretaker-diagnosed respiratory disease.

The risk factors for the development of pneumonia were studied using the SAS-macro glimmix (Wolfinger et al., 1993) with farm (in the cohort study) or herd- and age-matched group (in the nested matched case-control study) as a random effect. Originally, several variables (including first calf housing after the birth and the housing used for at least 50% of the follow-up period before contracting respiratory disease or the end of the study, contacts with different age groups of animals immediately after birth, most common exposure to a specific age group during the follow-up period, and number of housing changes during the follow-up period) were offered to the models.

Results

When predicting the risk of clinician-diagnosed pneumonia in a cohort study, failure of passive antibody transfer (FPT) was associated with a slight increase in the risk of developing pneumonia. Additionally, “housing mostly in the presence of adults” was associated with an increased risk of pneumonia. If “housing in a hutch” was used instead of “housing in the presence of adults”, its odds ratio (OR) was 0.5 (95% CI, 0.2 - 0.9). With a nested matched case-control approach, the effects of FPT and “housing in the presence of adults” were the same as in the previous model. If “housing in a hutch” was used instead of “housing in the presence of adults”, its effect was the opposite but it was not significant (*P* = 0.12). With caretaker-diagnosed pneumonia as the outcome, FPT was not associated with the risk of developing pneumonia. “Being primarily housed in a hutch” was associated with a decreased risk of pneumonia. If “housing in the presence of adults” was in the model instead of “housing in a hutch”, its OR was 1.9 (95% CI, 0.9 - 4.0; P = 0.11).

Discussion

Housing was an important protective (hutch) or contributory (housing in the presence of adults) risk factor regardless of who made the diagnosis and regardless of the study design. Previously, we showed that the case calves in this study had in transtracheal wash samples more *Mycoplasma* sp. isolations together with other microorganisms (bacteria or viruses) whereas the control calves had more solitary *Mycoplasma* sp. isolations (Virtala et al., 1996). The present results suggest that the adult cattle are the source of the other microorganisms. Calves that were housed alone in hutches were at a decreased risk. This could not be shown in the matched case-control design, because housing in hutch was a highly farm-specific factor and it was matched out. However, the effect of housing in the presence of adults could be seen even in the matched study, which indicates that within farms, the calves had differences in housing in this respect. The effect of different hutch systems was not studied, because there were too few observations for each hutch type.

In an epidemiologic study, risk factors can be collected at farm and individual-animal levels. If a risk-factor is applied at the farm level, but analysis is performed at the individual-animal level without controlling the farm effect in the analysis, the results could mistakenly indicate that a particular factor significantly predisposes the animal to disease.

Caretaker-diagnosed pneumonia was a slightly “different” disease when compared to clinician-diagnosed pneumonia, as indicated by somewhat different risk factors. The most important protective factor for caretaker-diagnosed pneumonia was previous antibiotic treatment. It may be that the “selection” criteria for diagnosing pneumonic calves was different; perhaps caretakers did not pay much attention to those calves that already had received antibiotics. Another possibility is that the previous treatments might have affected the course of the pneumonia so that they became subclinical to the caretaker but the clinician could still diagnose them.

Conclusions

Caution should be used when comparing and interpreting results of studies in which a caretaker vs. a clinician had diagnosed the pneumonia. The practical implications of this study are that more attention should be paid to the proper housing conditions of the calves, given the similar results in risk-factor analysis regardless of who made the diagnosis and regardless of the study design. Our result, however, should not be interpreted that any particular type of hutch is better than housing in the presence of adult cattle, because the effect of hutch type could not be studied.

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Roof ventilation in the prevention of pneumonia in fattening calves

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Summary

Deficient physiological and stable ventilation affects animal physiology and consequently the production results. These effects are particularly expressed in enhanced metabolism of the breeding domestic animals and represent a contributing factor to the development of respiratory distress and pneumonia. Systemic studies of the respiratory distress and microclimate have been carried out since 1960 in the biozones of the stables housing breeding cattle, located within the moderate continental climate zone. It has been shown that ventilation through an air channel is a suitable hygienic and prophylactic solution to the above problems.

Key words: roof ventilation, microclimatic stressors, pneumonia prevention, fattening cattle.

Introduction

Increased metabolism in the breeding domestic animals requires necessary fresh air to provide abundance of oxygen to the lungs and expiration of carbon dioxide.

Microclimatic stressors such as: elevated temperature and moisture, draught, noise and air pollutants (dust, ammonia, nitrogen and carbon compounds) along with other factors (social, nutritional, technological and microbial) are crucial in producing physiological stress. They are some of the stressors in the management and psyhology, of the pollutants and causative agents, in the vaccination and medicamentous treatments. Conditional diseases, poorer production yield and immunosuppression are their outcome, notably respiratory distress which develops particularly during the fattening period.

We have been carrying out for more than 30 years teamed systemic research and field studies.

Material nad methods

Having studied housing conditions, microclimate and health status of over 5,000 fattening calves and veals at 21 farm (Asaj 1967) has found that poor ventilation and overcrowded classical stables, along with an increased ammonia and moisture content, contribut to the development of respiratory infections and pneumonia.

The parameters for the stables in moderate continental climate zone have been proposed by (Asaj and Hrgović 1990).

Results

Table 1. Microclimatic data and compulsory slaughtering of beef cattle before and after overcrowding

	C.n.	m^2/A	m^3/A.	M.B.N.	NH_3 ‰V. and In.F.X	CO_2 %V. and	C.Sl.L. A.N. and In.F.X
B.O.	68	3.5	13.6	1160	0.003	0.20	4
A.O.	178	1.7	5.2	2.6X	2.3X	2.2X	2.5X

Abreviations:

B.O. - Before overcrowding
A.O. - After overcrowding
C.N. - Cattle number
A. - Animal
N. - Number
M.B.N. - Mesoph. bact. number
TV. - Per cent Volume - . ‰V - Pro mill V.
InF.X - Increasing factor X
C.Sl.L.A.N.- Compulsory slaughter lost animal number

Discussion and conclusions

Kralj et al.(1960) have given evidences on correlation between the increased losses and respiratory distress with pneumonia which occur in the fattening calves kept in classical stables with deficient ventilation, caused by overcrowding and resultant aggravated microclimate.

Observations in another animals besides calves:

The significance of deficient ventilation in prophylaxis of respiratory distress and pneumonia has been recorded in chick fattening in respiratory mycoplasmosis (Asaj 1967a). The diseases developed after the necessary ventilation of 2.8m^3 h kg had dropped by more than 50 %.

Kranjc (1984) analysed the effect of microclimatic conditions on the health status and growth of the fattening pigs kept under different conditions. He pointed out more frequent incidence of enzootic pneumonia and atrophic rhinitis during winter period, when air temperature in the stables increased after diminution the account of ventilation. In these instances the lowest oxygen content in the air amounted to about 16 % vol.

Asaj et al. (1983) after correction of ventilation and ceiling thermoisolation in premises with hog cage capacities on a hogbreeding farm in Croatia the total hog mortality of Glässer disease death percentage rate was reduce from 29 to 12.

Asaj et al. (1970) have shown that dust, microorganisms and amonia in the air of the poultry houses are microclimatic stressors to hens.

The occurence of conditional respiratory diseases facilitated by microclimatic stressors can be explained by the theory on adaptation syndrome (Selye 1937) and (Fraser 1975) who explains stress as reconciliation of physiological functions impaired by harmful environmental effects and poor management.

As a prophylactic measure against conditional infectious respiratory diseases with the resulting pneumonia, we recommend housing of fattening calves and veals in standardized stables with an stable roof ventilation air channel *(SRVAC).*

SRVAC (Supplements 1 and 2 - Asaj et al. 1988) based on empiric experiences in prevention of pneumonia in fattening calves could be a useful solution in praxis. *SRVAC* offers similar solution in a fully protected ventilated ridge (Lawrence 1994), where as natural ventilation on the stack-effect is not practicable for aerodynamic reasons for the chimneys smaller than 0.2 m^2 larger than 1.0 m^2 (Maton et al. 1985).

Acting as a wick *SRVAC* (a thermoinsulated channel having right angles, located along the roof ridge, supplied with the device for regulation of an opening and protection against precipitation and birds) exhaust the air from the biozone. It produces no draught and does not lift the air from the floor or underneath the slatted floor. This prevents microclimatic stress to the animals (thermal or from air pollutants) and provides sufficient fresh air. The *SRVAC* accounts for 2 % of the stable volume. Air comes through the thermoinsulated large windows on both sides of stable, accounting for 1/10 of the floor surface.

We believe that future belongst to ecological ventilation with the use of air filters.

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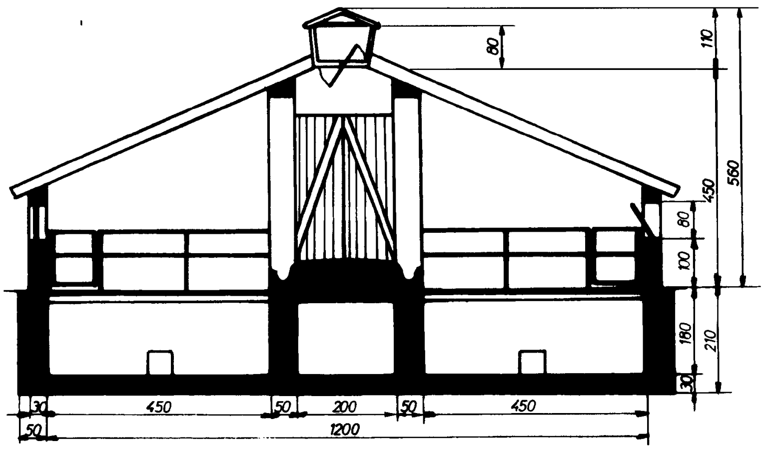
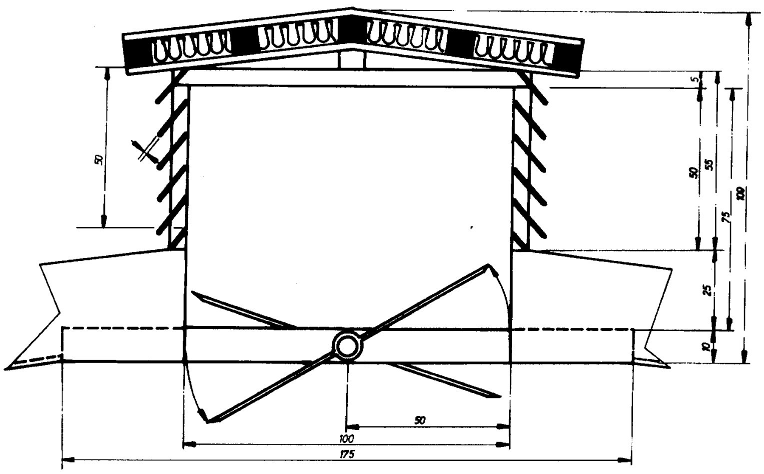
Supplement 1 Stable roof ventilation air channel in situ

Supplement 2 Stable roof ventilation air channel detail

Supplement 1 Stable roof ventilation air channel in situ



Supplement 1 Stable roof ventilation air channel in situ



Supplement 2 Stable roof ventilation air channel detail

Supplement 2 Stable roof ventilation air channel detail

The use of cow trainers in Norwegian dairy herds and the effect on health and milk quality

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Summary

The aim of this investigation was to see how the use of electric cow trainers influenced the health of dairy cows and the milk quality. A questionnaire, including questions about housing and use of cow trainer, was sent out to 583 Norwegian dairy herds chosen at random. Production data, milk quality and mean prevalence of different diseases for each herd were extracted from a central data base. 342 (81,0 %) of the herds with tied housing had cow trainers. 70.8 % of the herdsmen claimed that they removed the cow trainer from unhealthy cows or cows in heat, and 85.4 % answered that the turned of the power supply or removed the cow trainer during milking. The incidence rate for acute clinical mastitis was higher (0.31 vs. .0.29 incidences per cow), subclinical mastitis (0.243 vs. 0.189 incidences per cow), mastitis index (1301 vs. 1118) and the number of cows treated for teat tramp (0.05 vs. 0.034 per cow) were higher in herds with cow trainers than without cow trainers. However, none of these differences where significant due to the confounding variables milk yield, replacement rate etc). The proportion of milk samples with off flavour was higher ($P < 0.001$) in herds without cow trainers than in herds with cow trainers, 5.5 % vs. 2.8 %, and the biometric mean of colony-forming units was also higher ($P < 0.05$) in these herds, 5.4 vs. 4.5 CFU 1000/ml.

Introduction

The proportion of Norwegian Dairy herds using cow trainers have increased to around 70 % in 1985-89 (Østerås, 1991). In Sweden, only 4.7 % of the herds used cow trainers, whereas around 50 % of the herds in Denmark and probably more than 90 % in Switzerland. Sweden is the only country where the use of cow trainer is prohibited (from 1. January 1994), whereas the Norwegian and Swiss regulations give recommendations for the use of cow trainers.

The use of cow trainer improve the cleanliness of the standing and the cow (e.g. Bergsten and Petterson, 1992). However, both Simensen et al. (1988) and Oswald (1992) report that the power supply can be switched of for longer periods without any effect on the cleanliness.

The effect of cow trainers on the health of dairy cows is diverging. Bergsten and Petterson (1992) and Matzke et al. (1992) found a reduced incidence of mastitis in herds with cow trainers, whereas Østerås and Lund (1988) found no such effect. German research reports that the symptoms of cows in heat is weaker when using cow trainers.

The aim of this investigation was to see how the use of electric cow trainers influenced the health of dairy cows and the milk quality.

Materials and methods

In the autumn of 1993 a questionnaire was sent out to 583 Norwegian dairy herds chosen at random. Only herds with more than seven cows were included. The questionnaire included questions such as type of housing (tied or loose housing) type of stalls (long or short standing), the use of cow trainer, type of cow trainer etc. Production data, milk quality and mean prevalence of different diseases for each herd were extracted from a central data base.

Results and discussion

All together 445 (76.3 %) answered the questionnaire. Six of the herds were omitted due no delivery of milk in 1993. Our file then include 577 herds, of which 442 had responded to the questionnaire. Of the 442 herds, 422 had tethered cows in stanchion barns. More than 80 % of the herds used cow trainers (table 1).

Table 1. The use of cow trainer in herds with long and short standing.

Type of stall	Number of herds	Proportion of herds with cow trainer (%)
Long standing	248 (58.8 %)	75.4
Short standing	174 (41.2 %)	89.1
Total	422	81.0

Nearly 94 % of the cow trainers had been purchased from two main manufacturers in Norway. More than 40 farmers did not know which type of power supply that was used in their herd (the power supply is often bought separately), and the remaining dispersed on ten different manufacturer models. Experience suggest that many of the power supply units have an unnecessary high voltage.

In 70.8 % of the herds, the cow trainer was removed from unhealthy cows and cows in heat. In 35.1 % of the herds, the cow trainer was removed during milking, whereas in 50.3 % of the herds, only the power supply was turned of. Several herdsmen remarked that the cow trainer was removed from cows for a period before and during calving. The Norwegian regulations require that cow trainers should be removed from unhealthy cows, cows in heat and during milking. Thus, in many herds the practical use of cow trainers do not fulfil these requirements. More information to the herdsmen seems to be necessary. In 35.1 % of the herds, the cow trainer was removed during milking, These answers indicate that The power supply unit was turned off as a routine in periods of 1 - 2, 3 - 4 and more than 4 days a week in 12.0 %, 7.9 % and 20.9 % of the herds respectively.

Herds with cow trainers had a higher milk yield (6564 vs. 6222 kg per cow), larger herd size (13.9 vs. 11.8 dairy cows) and had a higher replacement rate (43.5 vs. 40.9 animals per 100 cows) than herds without cow trainers. The incidence rate for acute clinical and subclinical mastitis, the mastitis index and the number of cows treated for teat tramp were higher in herds with cow trainers than without cow trainers (table 2). However, none of these differences where significant due to the confounding variables like milk yield, replacement rate etc.

Table 2. The effect of cow trainer on mastitis and milk quality.

	Herds with cow trainer	Herds without cow trainer
Number of herds	342	80
Acute clinical mastitis (incidences per cow and year)	0.31	0.29
Subclinical mastitis (incidences per cow and year)	0.234	0.189
Mastitis index	1301	1118
Cows treated for teat tramp	0.05	0.034
Milk samples with off flavour (%)	5.5^{a}	2.8^{b}
Colony-forming units (CFU 1000/ml, biometric mean)	5.4^{c}	4.5^{d}

^{a,b} ($P < 0.001$), ^{c,d} $P < 0.05$

There are very many environmental factors that will influence the health of dairy cows (e.g. Østerås, 1991). A cautiously interpretation of the present results is that the use of cow trainer apparently do not represent an important health risks to dairy cows.

The proportion of milk samples with off flavour and the biometric mean of colony-forming units was significantly higher in herds without cow trainers than in herds with cow trainers (table 2). These results suggest that the improved cleanliness by the use of cow trainers (Bergsten and Pettersson, 1992), apparently also improve milk quality. However, there are alternative explanations. Herds with cow trainers could have had better milking routines, better milking machine installations or better housing.

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CATTLE HEALTH AND PUBLIC WELL-BEING IN FRONTIER AREAS OF THE BRAZILIAN AMAZON

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Summary

As preliminary results of a research program on animal production in agriculture frontier of Eastern Brazilian Amazon county of Uruará, the authors show the role of the cattle husbandry in the small holders production systems and the importance of animal health in the sustainability of agriculture frontier through the effects on the cattle productivity. As far as animal health, zoonose diseases, specially brucellosis, are a real critical problem because they are directly related to public well-being. A participative approach with a effective relationship between researchers and farmer organizations has allowed to carry out a zoonose control program and to develop actions towards the increasing of the cattle productivity, as the installation of small factories for processing mineral mixtures and a veterinary vaccination center.

Introduction

The present bovine spongiform encephalite disease out break in Europe rises the real problem of the relations between cattle health and public well-being. In developing countries, the systematic control and erradication programs carried out by veterinary service during the last forty years have allowed to reduce, and somes times to elliminate, the incidence of the zoonose diseases and thus to get rid of their main effects on public health. In the same time, many countries of the Third World have not had the financial resources and the political measures to realize equivalent control programs. So, in present time, the zoonoses continue to be a serious problem in many countries through the impacts in human health and cattle productivity.

Although being an old and always developed activity in the natural savannah of Brazilian Amazon, specially in Marajo island and in Low Amazon region, cattle husbandry is a new activity in the agriculture frontiers of Brazilian Amazon, whose colonization began at the end of the sixties. In the agriculture frontiers of South of Para and Paragominas region, cattle husbandry was the main land-use of this colonization through the creation of latifundium ranching farms. The colonization process was different in the Transamazonic region, where the production system was based on the annual crops (rice, corn, bean and cassava) for local human comsuption and perennial crops like cocoa, coffee and black pepper (Walker & Homma, 1995). However, in the last years, cattle husbandry exploitation has being increased, specially in small holders farms (Veiga & Tourrand, 1996).

The new interest of the Agricultural Research Center of Eastern Brazilian Amazon (EMBRAPA-CPATU) for the small holders production systems, called family agriculture, answered to a political concern in increasing the life conditions of rural people to stabilize the Amazon frontiers and to reduce the pression on the main rain forest in the world (Tourrand & Veiga, 1996). So, the control of animal diseases affecteding the cattle husbandry produtivity and the human health is an important factor in searching of the sustainable family agriculture. A research program about animal health began in 1995, and specific research program about zoonoses is planned for the end of 1997. Starting with a description of the role of cattle husbandry in the farming of small holders in the Transamazonic region and with the presentation of the first results obtained at the present time, this paper present the importance of animal health in the family agriculture, its main effects on public well-being and cattle productivity, specially brucelosis, and the veterinary control system elaborated by farmer organizations with local resources.

Material and methods

Three surveys were realized between 1994 and 1996 to see the importance of cattle husbandry in agricultural farming systems, to estimate the cattle productivity and to identify the main animal health problems. In the first survey, approximately 150 representative small holders farms were investigated through a questionnaire, where the main caracteristics of farming system were inquired. So, for each farm, informations on history, composition and organization of the family, annual and perennial crop systems and animal production systems are collected. This survey has allowed to accomplished a first diagnostic of the family agriculture in the Transamazonic region. A typology of the agricultural farming systems were elaborated with multivariable analysis. The second survey, which began at the end of 1995, comprises monthly visits to 20 representative farms of the precedent typology. In these farms, all the horned cattle have been identified with auricular rings and a cattle husbandry book help the farmer to record all the new events about his herd management, like birth, animal saling and purchasing, death and disease ocurrence, for example. During the monthly visit, these informations are recovered by a technician of the research program. They will allow to estimate the cattle productivity and the importance of the main management factors. Although the complete analysis of this second survey is not done yet, the preliminary results have shown the very high abortion rate and the importance of calf diseases. So, the third survey was carried out to estimate the incidence of brucellosis and, at the same time, the incidence of tuberculosis, specially in the production farms. A limited number of brucellosis tests were done by Sero-Agglutinin and Card Test. About 380 animals of nine farms were tested. For tuberculosis, the comparative subcutaneous test was used on aproximately 600 animals in the same farms.

As first results of these surveys, it was possible to begin somes development actions, which have been discussed in a collaborative research program including resarchers, farmer associations and public and private institutions.

Results and Discuss

1. Cattle husbandry is a relevant component of the farming systems

In a typical regional farm, the forestal reserve covers about 60 % of the area, showing that deforestation obeys the limit allowed by law which is 50 %. The low value of secondary vegetation (7 %) is the result of short or absence of fallow periods, once the pasture is established one or two years after the annual crops in the predominant pattern of land use. Therefore, the average proportion of area covered by pastures is 26 % of the total area, or 64 % of the deforested land, hightest value among all production system components. Annual and perennial crops cover about 3 % and 4 %, respectively. However, this result hides a great diversity of the properties and a regional trend, in which generally older farms, located closer the main road have higher percentage of open land than those more recent and located far in the secondary roads. In terms of frequency, the most important components of the production systems are: cattle ranching (99 %), annual crops (93 %), pigs and poultry raising (88 %) and perennial crops (80 %). So, diversification of production system plays an important role in familiar farms reducing risks of total losses, making better use of labour and getting better use of natural resources by integration of crops and animals, basis of integrated agriculture (Veiga & Hebette, 1992).

Approximately 76 % of small holders have horned cattle. In the other cases, farmers have pastures but not cattle yet, and most of them are planning to buy it soon. The herd size is from 10 to 25 heads by farm with an average of 20. In fact, 17 % of the farms have less than 10 heads and

37 % between 10 and 50 heads, meaning that half of the herds has less than 50 heads, featuring small production systems. On the other hand, only 5 % of the farms have more than 500 heads. The herd structure suggests that the aim of the systems is to sell calves between 7-8 and 18 months of age. Herd average composition is 9 cows, 1 bull, 4 heifers, 2 steers and 4 suckling calves. This composition confirms the trend of selling young animals.The genetic pattern of the herds suggests a production system based on milk production, (Tourrand *et al.,* 1997). In 39 % of the farms, zebu and European cross breeds predominate. Nelore breed dominant in the whole country, is present in 22 % of the farms. As this genetic group dominates in all large farms, which have 70-80 % of the cattle of the region, it can be concluded that Nelore is the most representative breed of the region population. However, European breeds like Holstein and Brown Schwitz and zebu breeds like Gir and Indubrasil are more common, in terms of frequency in the farms. About 60 % of small holders are running a milk production system, but only 12 % sell a part of this production (milk or cheese), the others use it for family consumption.

Beside its importance in the regional land use, the cattle husbandry have an important role in the economy of small hoder production systems. In the first place, in the Transamazonic region, household savings and milk production for family consumption are two basic roles of cattle husbandry in the family agriculture, according to Lhoste *et al.* (1993). Tourrand *et al.* (1996) observed a low cattle productivity, about U$ 40 per hectare and U$ 115 per cow, respectively. However, due to minor labour needs for cattle management, man power productivity appears to be higher when compared to other agricultural activities. The high flexibility in saling, compared to crop products, also contributes significantly to the strong cattle dynamic in the Transamazonic region and in whole Eastern Amazon (Hamelin, 1991 / Léna, 1992). An other function of cattle husbandry is the possibility to invest profits from others components of production systems. For example, profits from perennial crops represent the main source of capital for cattle purchasing in the small farms of the region. Several authors have already noticed this process, also with annual crops, in other agricultural frontiers of Eastern Amazon, like Southern Para (Reynal *et al,* 1995) and Bragantina region (Billot, 1995). However, in the Eastern Amazon, investments in cattle ranching are made to increase land value through the pasture establishment. Depending the farm location, one hectare of well established pasture worths from three to five times more than one hectare of fallow, and from five to ten times more than one hectare of natural forest. This difference in land value means that, in agricultural frontier, the pasture established in association to annual crops which cover its initial costs, is an investment of farmer labour. Thus, the great importance of cattle husbandry in small farms explains the interest of the farmers to improve its productivity.

2. Mineral nutrition and animal health are the two main cattle problems

The first survey showed the deficiency of mineral supplementation, in qualitative and quantitative terms. About 40 % of the farmers did not supply any mineral supplementation (Veiga *et al.*, 1989). Half of the farmers supply salt alone, and only 10 % use mineral mixtures which contain salt and others mineral ingredients. Generally, the mixtures are not appropriate to the local cattle needs (Veiga et al., 1996). For example, in approximately all mixtures, phosphorus is frequently very low, although it is the most deficient mineral element in soils and forages of Amazon basin. In the other hand, large quantities of mineral elements, not so deficient in the region, like sodium, chlorine and iron, were furnished. In fact, the percentage of the most expensive mineral elements are generally the lowest, and the percentage of the cheapest are mainly the highest. However, the mineral nutrition is directly related to cattle productivity in the region, particularly the reproduction rate, the growth of young animals, the resistance to diseases and the development of the heifers. Nevertheless, the main problem about mineral nutrition appears to be the lack knowledge of mineral cattle nutrition by the farmers. So, most of the farmers do not use any mineral supplementation or use inadequate commercial mixtures for the local conditions.

As far as animal health is concerned, the brucellosis appears to be one of the most critical diseases, since about 12 % of the tests have been positive, confirming the importance of this zoonose in the Transamazonic region, like in others regions of Eastern Amazon (Lau & Singh, 1986). The first results allow to estimate the abortion rate of about 10 %, and 33 % of farmers reported one or several cases of abortion occurrence in their farms. According to the farmers, cases of retention of fetal placenta are very common. It was not observed a higher frequence of chronic endometritis. In the same way, the cases of articular hygromas and arthritis are not very frequent. As dairy cattle comprises a large part of the sample, it is easy to understand the gravity of the brucelosis in human health in the Transmazonic region. However, the presence of the brucellosis in the region seems to be old, probably since the beginning of the colonization with the first entries of bovin cattle from the regions of the South of Brazil in the seventy years. Now, the high demand of dams and sires by the family agriculture involves a stronger bovine traffic into the regions, increases again the importation of not controlled animals from the South of the country, and so promotes the dissemination of brucellosis. Like the mineral nutrition, the lack of knowledge of brucellosis by the small farmers and the absence of correct vaccines, although Brazil being the second market of veterinary products in the world, explain the present importance of this disease in the Transamazonic region.

No case of tuberculosis has been detected in the tested samples of approximatly 600 adult bovines and in some slaughter-houses of the Transamazonic region, although this disease is common in bufaloes farms, specially in savannah ecosystems of Eastern Amazon, like Marajo Island. Among the others infectious diseases which occur in Transamazonic region, the aphthous fever and the symptomatic carbuncle are the more frequent.

During the surveys, it was observed that the colibacillosis and the salmonellosis, consequence of a gerally deficient hygienic conditions, are the main causes of calves death, whose the effect on cattle productivity is very critical considering the role of young animals in the small holders economy. Ticks are more frequent in dairy herds with a higher proportion of European blood, and rarely are controlled by the farmers. Toxics plants are of main concern, mainly *cafezinho* or *vick* (*Palicourea marcgravii*). About 62 % of the farmers consider this plant as the main cause of animal death, although a great part of them are not able to differ *cafezinho* from an other similar non-toxic plant. *Lantana* (*Lantana camara*) is an other toxic plant responsible of animal health problems, specially photosensibilization injuries.

3. Training and farmers organization are the priorities to improve animal health

Due to the absence of a mineral mixture adequat to the Transamazonic region avalaible in the local market and the possibility of making one with all appropriated ingredients bought directly from southern dealers, some farmers decided to install, with technical support of the project, two small factories for processing mineral mixture to satisfy the producers demand. In the same way, some effort is being done to train farmers through several workshops and field-days. After 18 months, the two main qualitative responses of mineral nutrition program reported by the farmers are the strong improvement of calves health and the reduction in the use of veterinary products.

After the first experience with the mineral nutrition, the associations of farmers decided to create and manage a veterinary vaccines center, also with technical support of researchers. Now, this center sales part of the necessary vaccines for the cattle of whole Transamazonic region. Like in the case of the mineral ingredients, the vaccines are bought from veterinary dealers of the South of Brazil. A rigid control of the temperature during the travel between the factory and the center, and during the stocking allow to keep the good quality of the vaccines. So, after five months, about 800 brucellosis vaccines and 5.000 aphthous fever vaccines were purchase by small holders. During the field-days and workshops about mineral nutrition, some time is reserved for topics on animal health, specially vaccination and basic calves cares.

A control program of the brucellosis was elaborated according to the ecomic conditions of the farmers and their associations. At first time, a booklet about brucellosis was written and distributed to the farmers (around 2.000 copies). During the meetings, after the discussion with the farmers about brucellosis, a program controling brucellosis is proposed and explained. Basicaly, a farmer has three possibilities of being grouped : A, B and C.

- In the group A, called the paradise, 1/ a brucellosis test will be done on all bovines of the farm, and the positive animal must be sold. 2/ The farmer will vaccine all the female calves between three and eight months old. 3/ All the bovines entering into the farm, will be negative tested, except the vaccined ones. This group is on the right way to be free of brucellosis.

- In the group B, called the purgatory, the farmer will follow the second and the third conditions, will vaccine all the female calves and will make a serious control with the animals entering into the herd. The farms of this group may be free of brucellosis in seven or eight years.

- In the group C, called the hell, the farmer will wait for better time the future to begin to attack the brucellosis problem. For this group, the bet of the control program is the pression of neighbours that will bind the farmer to choose quickly the A or B groups.

To improve this program, it is planed a control of the animals traffic along the Transamazonic road by the veterinary service, supported by the farmers organization and the city government.

Although the quality of this control program of brucellosis is not excellent, it presents some advantages, specially the low cost. An other positive aspect of this approach with a great involvement of the farmers associations is the relationship between the farmers and the researchers through a participative research approach. After these first experiences on mineral nutrition and veterinary vaccinations, it was decided to begin a large program about animal health and public well-being. This program will deal with the more common zoonoses in the region as brucellosis, rage, tuberculosis and leptospirosis, and the set of the transmissible diseases through the food products.

Conclusion

In Brazil, the second place in size of the cattle herd and amount of veterinary market, there is a large new-colonized regions in Amazon basin, called agriculture frontiers, where cattle husbandry presents at the same time a very strong dynamic and an critical absence of technical support by the public services. In theses regions, the deficiency in adoption of basic rules in animal health explain a part of the low cattle productivity and increase the risk of transmission to the human. Training of farmers about animal health and strenth of producers associations appear to be the unique possible solution without strong financial support.

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Studies on microclimate parametres of a cattle barn and on microscopic fungi and their biological traits

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Summary. The productivity of animals largely depends upon microclimate [2]. Microbiological contamination, ventilation, relative humidity, temperature, toxic gas (CO_2, NH_3, H_2S) are most significant. Hitherto, contamination of cattle barns by fungi as well as its relation with other microclimate parameters have been insufficiently studied in Lithuania. Few data are found in the foreign literature.

Keywords. Microclimate, microscopic fungi, toxicity, pathogenic, cattle barn.

Introduction. The maximum productivity of animals by consuming the least quantity of fodder and their protection against disseases are feasible when microclimate conditions in cattle barns are optimal.

In case microclimate parameters are not optimal a decrease in the weight increment of cattle constitutes from 20 to 30%, mortality of younger animals comprises from 5 to 40% and fodder [4] consumption exceeds from 10 to 30%.

Microbiological contamination of air is a significant microclimate parameter. Most of them are saprophytes. Also pathogenic microorganisms and mouldy fungi such as Penicillum, Aspergillus, Mucor, Actinomyces etc. [1] are frequently noted.

A total of more than 100.000 microscopic fungi species is known. Of them 500 species are pathogenic to humans and animals and more than 250 species can produce toxic metabolites [5].

Currently, veterinary and medical doctors, biologists, chemists, pharmaceutists in different countries are interested in mycosis caused by pathogenic mouldy fungi. They are detrimental for cattle breeding.

Particular attention is focused on mycotoxicosis. Mycotoxins are a secondary product of metabolism of mouldy fungi. They are very dangerous for humans and animals. Mycotoxins induce cancer, mutagenesis, teratogenesis, injure the human and animal immune system and cells and are typical of hepatotoxic and nephrotoxic attributes [1, 6]. Besides, economical losses are considerable since mycotoxins damage fodder and the curing of chronic mycotoxicosis is expensive.

The variety of fungi which are spread on different substrates were investigated for more than 30 years [3].

Since in Lithuania contamination of the air of cattle barns and aviaries by bacteria and fungi are insufficiently studied the objective of our research is to clarify the spreading of microscopic fungi. species in the air of cattle barns and aviaries, their biological traits and relation with other microclimate parameters.

In order to implement this goal the following tasks had to be solved.

1. To determine the species composition of fungi in the air of cattle barns.

2. To investigate the biological traits of fungi cultures grown and purified in the air of a cattle barn.

3. To ascertain the relation of the quantity of fungi in the air of a cattle barn with other microclimate parameters.

Material and methods. The object of investigation is a cattle barn of the experimental farm of the Lithuania Veterinary Academy. In the barn there are 100 cows.

The quantity of bacteria and fungi has been investigated by classical method of sedimentation.

For ascertainment of bacteria agar - agar of meat peptone has been applied. The cultures have been burned at 37 °C for 2 days and nights. The Tchapek and Sabur media have been used for determining microscopic fungi. The cultures have been burned at 25 ± 2 °C for 5-7 days and nights.

The colonies of microscopic fungi have been differentiated according to species with the aid of atlases created by different authors for recognizing fungi.

Pathogenic of microscopic fungi has been determined using white mice. In their abdomen 0.5 ml of fungi diaspore suspension has been injected.

Toxicity of fungi has been ascertained with the help of infusoria Stylonichia mytilus. Their vitality has been observed for 1 hour.

The concentration of toxic gas in the air of the cattle barn has been determined by calorimetric methods.

Results. In the cattle barn investigated there are 100 tied cows. The length of the barn is 64 m, the width - 10 m, the height - 2.86 m. There are 18.43 m^3 of air per cow. The barn is ventilated naturally and by draught - ventilation system installed in the ventilation pit.

Microclimate parameters of the barn in the period December, 1995 - April, 1996 are presented in the **Table**.

Table

Nr.	Microclimate parameters	The periods of investigation, months					
		95.12	96.01	96.02	96.03	96.04	average
1.	Air tempeature °C	12.2	11.5	8.5	14.5	14.5	12.2
2.	Relative humidity, %	78.5	89.0	89.0	71.0	90.0	83.5
3.	The speed of air movement, m/s	0.04	0.16	0.05	0.05	0.10	0.08
4.	Lighting, lx	10	19	40	30	21	24
5.	The quantity of CO_2, %	0.170	0.065	0.075	0.070	0.080	0.092
6.	The quantity of NH_3, mg/m^3	14.5	12.5	20.5	24.5	16.5	17.7
7.	The quantity of dust mg/m^3	0.55	0.28	0.50	0.32	1.70	0.67
8.	The quantity of bacteria per m^3	56445	77639	60554	98544	62572	71151
9.	The quantity of fungi per m^3	2956	4037	2775	7605	2667	4008

The data have been assessed according to the standard parameters of the optimum microclimate which are currently allowed in Lithuania. As seen from the data, only the concentration of CO_2 and dust does not exceed the standard. The relative air humidity, the speed of air movement and lighting do not meet the requirements in particular. Fluctuation of other microclimate parameters is negligible.

We are interested in the quantity of bacteria and fungi in the air of the cattle barn. The most significant contamination of the air in the cattle barn was observed in March. A total of 98.544 bacteria per 1m^3 of the air was found (70.000 bacteria per 1m^3 of the air are allowed). A slight increase in the quantity of bacteria was determined in January. The quantity of microscopic fungi ranged rather considerably. In December their quantity was least whilst in March largest. In the air of the cattle barn affirmative correlation between the quantity of bacteria and microscopic fungi was establisched.

While investigating biological traits of microscopic fungi significant diversity of species has been found. Over the period investigated even 36 fungi species have been isolated in the air of the cattle barn. Of them 12 species belong to Penicillum and 5 species to Aspergillus genus. Other microscopic fungi species comprise 52.8 % and these of Cladosporium and Trichoderma genera make up 5.7%

For investigation of pathogenic traits of microscopic fungi 11 species have been purified. Pathogenic fungi constitute 45.5%. A. flavus, A. niger, A. terreus are stemsof fungi of Aspergillus genus, which comprise even 27.3%. Scopuliarosis brevicaulis and Trichoderma horzianum comprise 9.1%.

A total of 13 fungi species have been purified for determinig toxic traits. Of them 61.5% are found to be toxic while 38.5% slightly toxic. Trichoderma horzianum and T. koningii are most toxic. Then follows Aspergillus repens, A. terreus, Paecelomyces vaiotic, Penicillum expansum.

Aspergillus flavus, Penicillum chermesinum, Cladosporium sphalospernium, A. fumigatus isolated from the air of the cattle barn are negligibly toxic.

Conclusions. In the air of the cattle barn the variety of fungi species is very significant, even 36 species have been found. Fungi of Penicillum, Aspergillus, Cladosporium and Trichoderma genera prevail.

A total of 11 fungi species have been isolated and purified in the air of the cattle barn. Of them 45.5% have been pathogenic. Aspergillus flavus, Aspergillus niger, Aspergillus terreus, Scopuliaropsis brevicaulis, Trichoderma horzianum are significantly pathogenic.

A total of 13 microscopic fungi species were typical of toxicity (toxic - 61.5 %, slightly toxic - 38.5%). Trichoderma koningii were considerably toxic.

For determination of the way of getting fungi in the air of the cattle barn microbiological investigation has been conducted on fodder. The microflora which has been grown is similar to that found in the air of the cattle barn.It indicates that the main micoscopic fungi mass gets into the air of the cattle barn through fodder and litter.

The quantity of microscopic fungi in the air of the cattle barrn correlated only with bacterial contamination. It demonstrates the general sanitary conditions of the cattle barn.

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Influence of some factors on subclinical mastitis incidence in cows at large farms

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Summary

Three breeds of cattle were the objects of our investigation. Ayrshire cows suffer less from mastitis than those of Kholmogor and brown Latvian breeds. Mastitis is characterized by high variability (more than 30 %). Mastitis frequency is greatly influenced by the age of cows. Young cows have sick rate lower than adult ones. This age particularity should be taken into account when mastitis heritability is considered. The season´s of the year influence to the mastitis resistance is less expressed. The winter season was the best at all farms. The "milkmaid" factor plays considerable role in common variability in mastitis incidence. The force of its influence is more often reliable and equals 6 %.

Introduction

Among the cows deseases at present time mastitis takes one of the first places. Mastitis frequency grows up with the herd size and productivity rise. Mastitis is registered everywhere and strikes 50 and more per cent of animals in a herd (L.K.Ernst et al. l979; U.Emanuelson,1987 et.al.). In spite of all measures taken in all countries mastitis still remains main source of losses in dairy cattle breeding. By D.F.Andrus et.al.(l975) mastitis is the second trait after milk yield that affects a year profit.

The mastitis sick rate depends on many factors which influence is not yet investigated good enough especially at large farms. In this paper results of long investigations on influence of different factors on mastitis incidence in cows of Ayrshire, Kholmogor, brown Latvian and some other breeds are presented.

Materials and methods

Monitoring of mastitis was carried out in large herds of Republic of Karelia (800-1200 cows), including the herd in sovkhos named after Zaitzev, which has been investigated for about 20 years persistently. At all farms stanchion housing of cows at standard cattle yards for 200-400 cows was used, in summer time for 110-120 days pasture keeping was used. The feeding level at different farms was similar and equaled 3700-4800 feed units (FU) per cow per year with the milk yield 3300-4500 kg. Milking was done three times a day. One master of machine milking serves 30-35 cows. On the whole about 23 thousands of cows were examined. Milk from each was tested for latent mastitis 4-7 times during the lactation period and clinical mastitis incidences were taken into account. Dimastine test was used for subclinical mastitis diagnostics; sedimentation test and electrophoresis were used to confirm diagnosis. Cows were considered healthy if they had not mastitis during lactation. Among factors influencing mastitis breed, the age of cows, season of the year, skill of milkmaid were taken into account.

Data and results

Cows of different breeds were characterized by different mastitis resistance (**table 1**).

Cows mastitis frequency **Table 1**.

Breed	Cows tested		C v, %
	total	share of infected,%	
Finnish Ayrshire cows (3 herds)	7382	12,3	31,3
Kholmogor	5610	17,6	37,4
brovn Latvian	508	33,1	47,0

It was found that sick rate of Ayrshire cows of finnish selection (12,3 %) was less than that of Kholmogor breed (17,6 %) and brown latvian (33,1 %). The variability of this trait is 31,3-47% and it means that udder health besides of genetic factors determined considerably by environmental factors.

Mastitis frequence is greatly influenced by the age of cows. In examined herds as well as for animals of other breeds, the sick rate frequence grows up with the age (**table 2**).

Mastitis frequency in cows of different ages **Table 2.**
(on an average by 7 herds. 1976-1989)

Number of lactation	Cows tested	including sick cows		Share of sick cows (%) of sick cows total
		total	%	
1	2596	142	5,5	7,6
2	2748	286	10,4	15,4
3	2261	354	15,7	19,0
4	1602	338	21,1	18,2
5	1185	289	24,4	15,5
6	760	191	25,1	10,3
7	422	121	28,7	6,5
8	459	140	30,5	7,5

On an average in seven herds from first to eighth lactation mastitis frequence grew up from 5,5 to 30,5 %. In comparison with first calvers the cows of the second lactation had sick rate highern l,9 times, of the third lactation-2.9 times, of the fourth one - 3,8 times, of the eight one and older - 5,5 times. In separate herds definite specifics of age variability was evident. Thus, the first calvers of the Ayrshire herd at the breeding farm "Sortavalsky" had sick rate 1,1 %, the cows of the second lactation - 4 %. During the forth lactation sick rate grew up to 12.6 %, during the seventh and older ones - to 15,5 - 20,8 %. In sovkhos "Bolshevik" with the same breed of cattle the young cows had the sick rate considerably higher than the ones at the breeding farm - 8,7 and 8,5 % accordingly for the first and second lactations. These differences were probably caused by the worse conditions of the younger animals rearing end consequently the low total resistance. At all farms great differences going out beyond limits of the nought hypothesis in mastitis resistance between cow groups of 1-2 carvings age and 3-7 carvings age were found.

Mastitis is less common in the winter and more common in the spring and summer (**table 3**).

Influence of season of year to mastitis sick rate in different herds **Table 3.**

Farm	Season of the year					
	winter		spring		summer	
	cows tested	share of cows infected. % tested	cows tested	share of cows infected. % tested	cows tested	share of cows infected. % tested
Breeding farm "Sortavalsky"	1189	2,7	566	9,2	588	5,3
Sovkhos "Bolshevik"	1281	8,9			1288	11,5
Breeding farm "Vedlozersky"	508	12,4	972	16,6	1229	13,7

At many farms the lower mastitis resistance is found in the spring and summer. However, it should be noted that in some years such seasonal prevalence is not evident. Published data on this are also contradictory.

Analysis on spreading of mastitis in cow groups served by different milkmaids was carried out to determine an influence of this factor. At breeding farm "Sortavalsky" within all the period of investigation not one cow affected by mastitis was found in 6 out of 34 groups while in 3 groups high sick rate exeeding 20 % was found. The differences between these groups are reliable ($p < 0,01$). At sovkhos "Bolshevik" within all the period of investigation no more than 1-2 cases of the illness of the udder was found in 8 best groups, while in 4 worst from 21 to 33 % of cows have had mastitis. Similar differences were found in other herds as well (table 4).

The influence force of the 'milkmaid´factor in the sick rate of cows in 3 herds was no high (n 2 = 0.06), yet reliable.

Mastitis sick rate in cows in groups, served different machine milking masters. **Table 4.**

Farm	Quantity of groups	Cows tested	Mastitis frequency in groups (min-max), %
Breeding farm "Sortavalsky"	34	1045	0,0..........22,9
Sovkhos "Bolshevik"	28	1015	2,6...........33,3
Breeding farm "Vedlozersky"	21	1134	12,2..........41,2
Sovkhos named after Zaitzev	12	693	11,6..........29,3
Breeging farm ”Megregsky”	19	1163	4,1...........24,6*

* on an average by one test

Conclusions

Ayrshire cattle is characterized by the higher mastitis resistance comparing to the other breeds of Republic of Karelia. It is evident that higher resistance of Ayrshire cows is due to better quality of udder as well as to higher concentration of additive genes which determine mastitis resistance. According to the published data not one cattle breed could be called mastitis free. P.Maden et.al.(N 987) note that the most of cattle breeds are subject to mastitis, but this does not exclude heredity factors influence on mastitis susceptibility.

In addition to the heredity such factors as cows age greatly influences variability of mastitis less often than the old ones. Greater predisposition of adult animals to mastitis can be explained by the weakening of the body defence characteristics including those of mamma, which is caused by intensive exploitation of animals during maximum milk yields as well as disbalancing of metabolic processes as they become older. Therefore the age factor registration when making mastitis resistance accessment and defining genetic parametres of this trait is compulsory.

Some influenceon mastitis incidence in cows shows a season of the year. In all herds the winter season is best for other seasons data are contradictory. This influence are caused not by the temperature factors, but most probably by the changing conditions of feeding and keeping, by seasoning in animal reproduction end by other reasons.

'Milkmaid' factor greatly influences the total variability in mastitis. Milkmaid skill improvement should be considered as an important factor in mastitis sick rate decrease in cows.

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Effect of feeding during dry period and body condition score at calving on calving ease and post partum health of dairy cows

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Summary

The aim of the study was to assess the effect of the level of feeding during the dry period, body condition score (BCS) at calving, and breed of cows on peripartum health problems and calving ease. The percentage of cows calving with assistance, with retained placenta and suffering milk fever, mastitis and endometritis was lowest when BCS is between 3 and 4. Both thin (BCS<3) and fat (BCS>4) cows had many more calving problems and were more susceptible to milk fever and mastitis, than cows with BCS 3 to 4 at calving time. Fat cows had more leg problems and ketosis than the thin cows. Fat Bulgarian Brown cows were more resistant to leg problems and have a tendency to suffer less from milk fever even at equal BCS and milk yield with White and Black cows. A high level of feeding during the dry period increased calving difficulties and milk fever, but not retained placenta, ketosis, mastitis, endometritis and leg problems compared to the low level of feeding when BCS at calving was the same.

Key words: level of feeding, body condition, breed of cows, peripartum diseases, calving problems

Introduction

It is known that body condition (BC) has a significant effect on production, reproduction and health (Threacher et al., 1986). However, it is not clear if the effect is the same when cows have reached certain BC during the second part of lactation or during the last 40 - 50 days before parturation. Responses of different breeds are also not known.

The aim of the study was to assess the effect of BCS on calving problems and post partum diseases of cows from two breeds and to compare response of cows with equal BCS when storage of fat takes place during lactation or during the dry period.

Materials and methods

The experiment was carried out with 806 multiparous dairy cows of two breeds: 596 Bulgarian Brown and 210 White and Black. All cows belonged to one large scale dairy unit of the Agricultural Experimental Station, Yambol. The milk yield was about 5000 kg per year for both breeds. The lactating cows were kept in stantion barns with a trough and water bowls. During the dry period cows were kept free in the barn with a yard and a fence line trough for feeding. The barn and yard were divided into two parts for housing two groups of cows. The first group was fed according to the feeding standard (Alexiev and Stoianov, 1984) and the second group received in addition 2 kg concentrate. Basic ration (forages) for all lactating cows were the same and concentrate was given according to milk production to cover energy and nutrient requirements. Diets changed depending on season of the year.

Live weight was measured at drying off, before parturation and 1, 15 and 30 days after calving. BC was scored at the time of weighing and every month during lactation. The body condition scoring system described by Todorov and Mitev (1994), which is similar to that used by MAFF (1986) was applied. All diseases were diagnosed by a veterinarian and recorded carefully. Calving with assistance was considered as difficult. Ketosis and mastitis were estimated by respective tests.

Results and discussion

The number of cows with BCS at calving <3.0, 3.0-3.5, 3.51-4.0, 4.01-4.5 and >4.5 were 92, 150, 290, 218 and 56 respectively. BCS at calving is related to loss of live weight (LW) and decrease of points of BCS during first month of lactation. For cows with BCS at calving <3.0, 3.0-3.5, 3.51-4, 4.01-4.5 and >4.5 loss of LW was 22, 23.6, 28.3, 33.6 and 36.5 kg respectively and points of BCS decreased by 0.57, 0.79, 0.99, 1.24 and 1.59 respectively.

The thin cows with BCS below 3 points more often had distocia, retained placenta, parturient paresis, mastitis and endometritis, compared to the cows calving in moderate BC between 3 and 4 BCS (figure 1). Dairy cows with BCS above 4.5 suffered much more from difficult calving, retained placenta, milk fever, ketosis and mastitis than the cows with BCS 3 to 4 at calving ($P<0.005$). The percentage of cows developing laminitis was also higher if BCS was above 4.5. Only endometritis was not related significantly to excess of fatness of the cows (figure 1).

There was not a significant difference in rate of occurrence of retained placenta, ketosis, mastitis, endometritis and leg problems between the cows fed at low or high energy level during the dry period but with equal BCS at calving time. However a higher percentage of the cows fed abundantly during the dry period calved with assistance, than cows from the group fed at a low level.

In this experiment there were small differences between the White and Black (Holstein) breed and the Bulgarian Brown breed (originating from Swiss Brown cattle) in response to the different body condition at calving. However, there was a tendency for there to be fewer cases of milk fever among fat Bulgarian Brown cows, than among White and Black, independently of the very small difference in milk yield of the two breeds in the experimental farm. The fat White and Black cows have significantly ($P<0.05$) more leg problems, compared to fat Bulgarian Brown cows (figure 1).

In conclusion, both very thin cows with BCS at calving <3 and fat cows with BCS >4 have much more calving problems and are more susceptible to diseases post partum, compared to cows with BCS between 3 and 4 at calving time. The level of feeding during the dry period and breed of cows have some impact on response to different BCS at calving.

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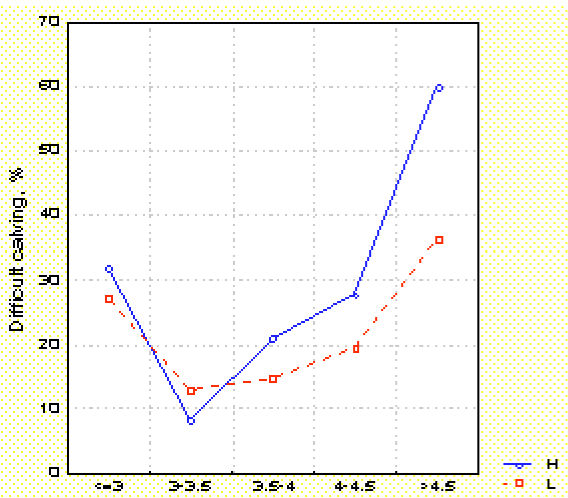
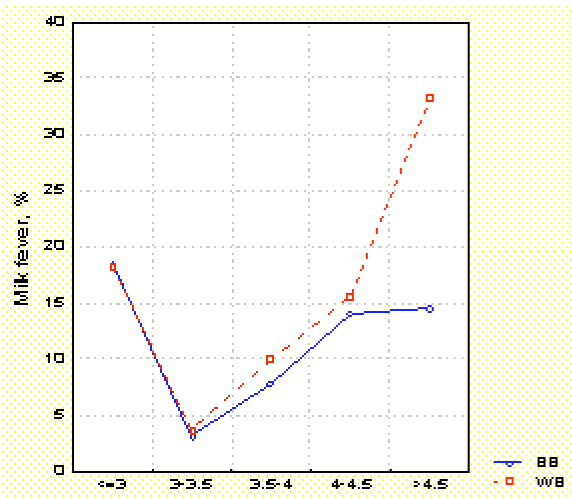
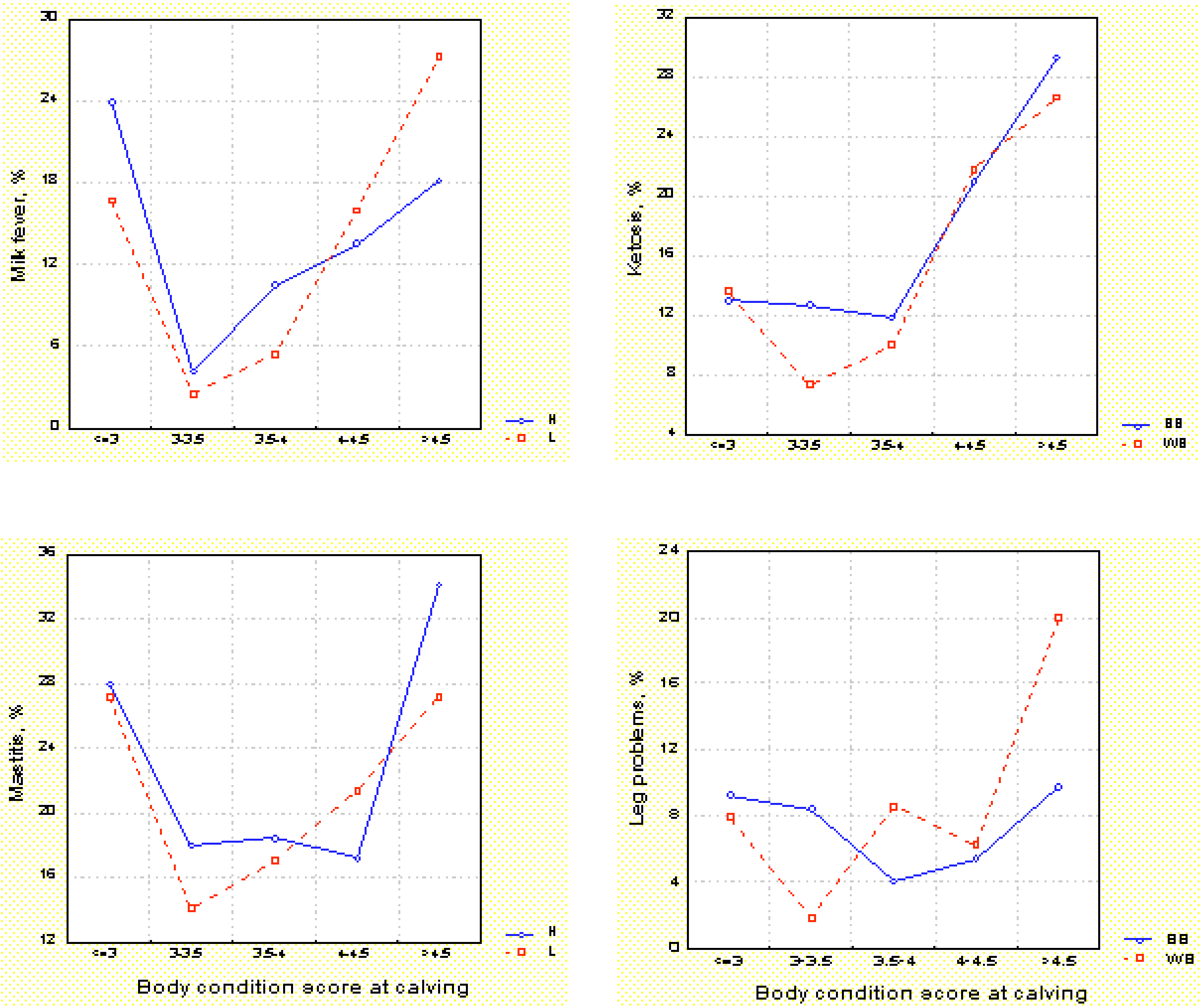
Figure 1. Effect of body condition score (BCS) at calving, level of feeding during dry period and breed of cows on peripartum health problems.

Figure continue

Level of feeding:	Breed of cows:
___High	___Bulgarian brown (BB)
---- Low	---- White and black (WB)







30
24
18
12
6
0
Milk fever, %
<=3
3-3.5
3.5-4
4-4.5
>4.5
H
L
32
28
24
20
16
12
8
4
Ketosis, %
<=3
3-3.5
3.5-4
4-4.5
>4.5
BB
WB
36
32
28
24
20
16
12
Mastitis, %
<=3
3-3.5
3.5-4
4-4.5
>4.5
H
L
Body condition score at calving
24
20
16
12
8
4
0
Leg problems, %
<=3
3-3.5
3.5-4
4-4.5
>4.5
BB
WB
Body condition score at calving

Comparative evaluation of two types of stall partition

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Summary

The comparative evaluation of two types of partition was carried out by investigating and evaluating their impact on tied dairy cattle's health, behaviour and cleanliness. There were 16 milking cows involved in experiments. The partitions were elastic straps made of nylon cloth and were named, according to their shape, as I and λ type of partitions. The partitions were placed either on one or on both sides of tied animals. Each pair of animals with their flanking animals on both sides was video recorded for 9 days and nights on end. The recorded tapes were analysed per each registered hour. The preliminary recordings were done with help of handmade data sheets, and were later statistically analysed by computer. The following characteristics were distinguished: point of time, standing and lying position, contacts with partitions during standing, lying down, lying and standing up, different disturbed behaviours, urination and defecation frequency and localisation. The results showed that for the λ type of partition it is immaterial whether it is between each or each second cow in keeping animals more effectively in the position perpendicular to the manger, avoiding disturbances from neighbouring cows, and thus keeping animals cleaner than the I type of partition. While testing the different types of partition on both sides of animal, most disturbances from neighbouring animals occurred from the side of the I type of partition. It was also concluded that animals behave more naturally, regarding the stall as a territory, if the λ types of partitions are on both sides. It could thus be concluded that the λ type of partition promotes behaviour and cleanliness and thereby health and is better adapted to its purpose for tied cattle than the I type of partition.

Key words: stall, I and λ type partition, tied dairy cattle, health, behaviour, cleanliness

Introduction

There are number of factors in a stanchion barn that have been shown to influence the cow's health and behaviour (e.g. Ekesbo 1966; Broom 1990). The aim of the practical examination and evaluation of housing systems and installations for the keeping of cattle is to evaluate them according to the capacity with which they meet the needs of the animals. For an objective judgement, ethological and veterinary medical criteria must be taken into account (Troxler and Oswald 1988). The partitions are meant to keep the tied animals perpendicular to the manger as much as possible, to avoid movements into the neighbouring stall and thus avoid disturbing of each other. Most common for both loose and tied housing systems are the wooden or metal L- or U-shape of partitions (Rajala 1990). There are no proper studies where the stall partition as a separate unit of the stall design is taken into the consideration from the animal's health, cleanliness and behaviour point of view.

The aim of the study was to evaluate comparatively the impact of type I and λ nylon partitions on the dairy cattle's health, cleanliness and behaviour and find out which of these two types of elastic partitions suits better for the tied dairy cattle.

Material and methods

The partitions were installed by the owner of the farm in the beginning of 1993. They partitions were elastic straps made of nylon cloth, divided into two parts. From the ceiling depended a thin strap 78-83 cm long in the I type and 88-90 cm long in the λ type. The breadth of the first part was 4 cm. The lower part was thicker. It's length was 140-145 cm for I type and 133-135 cm for λ type partition. The second part's breadth on both types was 10 cm.

Experiments were carried out on 16 milking cows. 8 cows were chosen from the row with I type of partitions and 8 cows from the row with λ type of partitions. The individuals were selected with regard to age, size, temperament, number of lactations, clinical health and earlier disease history. Of these animals, 15 were of the SRB (Swedish Red and White) breed and 1 of the SLB (Swedish Friesian) breed. When the study started the cows had either I or λ type of partitions between every second cow There were no partitions on the milking side of the cows.

The experimental part (video recordings) was carried out over 5 months. For each part of the study two adjacent cows were used as focal animals. The video recording took place with video cameras and infrared equipment. The time lapse method (Jensen, Algers, Ekesbo 1986) with one picture (shot) per second was used. The video recording time 9 days and nights per pair of animals was divided as follows: 3×24 h with partition, 3×24 h without partition and 3×24 h with partition again. In order to get additional material for comparison of I and λ type of partitions for milking cows one pair of focal cows from both rows of different type of partitions (between every second cow) were recorded as follows: 3×24 h without any type of partition, 3×24 h with the λ partition on both sides of the animals and 3×24 h with the I type partition on the milking side and the λ type partition on the other side of the cow.

Every videocassette was analysed per registered hour. The preliminary recordings were carried out with the help of special handmade data sheets, and were later analysed by computer. Within each hour the following standing and lying positions, in conformity with their direction to the manger, in minutes per 24 h were registered: parallel, 45 degrees and perpendicular to the manger. In order to compare the effect on the animals by different partitions, the analysis was carried out using and comparing the mean values for the average time spent in different positions. Besides standing and lying positions the contacts with partition during standing, lying (in minutes), standing up and lying down (in events) were registered. In addition different disturbances of the focal animals by neighbouring animals, unusual behaviours of focal animals and disturbances by man were registered. Urination and defecation events were registered separately in five different positions which were named as follows: into the gutter, half way into the gutter, on the own stall, between the own and the neighbouring cow's stall and on the neighbouring stall.

The cleanliness of stalls and focal animals was registered at regular visits after every three days and nights. In addition specific characteristics of focal and their adjacent animals' behaviour, influenced by replacement of animals, milking process and different management performances, were carefully observed.

Before starting the video recordings and during the video recording periods the pairs of focal animals were carefully examined from their clinical health point of view.

Statistical analysis was carried out using the Statistical Analysis Systems computer package. The used statistical methods were Spearman Rank correlation test, Wilcoxon Rank Sum test and Wilcoxon Signed Rank test (Statistical Analysis Systems Institute, Inc. 1985).

Results

Comparison of I and λ types of partition on one side of the cow. Cows accustomed to the λ type of partition chose more (especially during lying) the position perpendicular to the manger than cows accustomed to the I type of partition. Standing and lying positions parallel to the manger occurred rarely. The cows accustomed to the I type of partition had more contacts to the partition. The investigation of disturbed behaviours showed that cows accustomed to the I type of partition had more possibilities to disturb each other than cows accustomed to the λ type of partition.

Comparison of I and λ types of partition when partitions were on both sides of the cow. Cows accustomed to the λ type of partition were standing more in position perpendicular to the manger when λ partitions were on both sides of cows, compares to the combination of I + λ partitions. Cows accustomed to the λ type of partition showed more standing and lying positions perpendicular to the manger than cows accustomed to the I type of partition. There didn't occur any disturbing behaviours among cows accustomed to the λ type of partition during the periods with partitions.

Comparative study of urination and defecation. Comparison of I and λ types of partition from an animal cleanliness point of view indicates that cows accustomed to the I type of partitions on one side had more possibilities to pass by the partition and urinate or defecate on the neighbouring stall than cows accustomed to the λ type of partition.

Conclusions

For the λ type of partition it is irrespective if it is between each or between each second cow in keeping animals more effectively in their own stall and in the position perpendicular to the manger, consequently avoiding disturbances from neighbouring cows as well.

The λ type partition on both sides of the animal is the most effective to keep cows, and also young animals, against different kind of injuries, especially against injuries of the udder and legs.

The λ type partition facilitates faeces and urine expulsion to be dropped, except when cows were locked into the manger, into the gutter behind the animals to a greater extent, and thus keeps animals cleaner than the I type of partition.

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Influence of udder features and factors of milking on mastitis sick rate in cows

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Summary

Out of 13 studied udder measurements only one is connected with mastitis - that is the distance from udder bottom to the surface of land. Kholmogor cows with this distance less than 55 cm had sick rate 25,6 %, with 55-66 cm - 13,3 %, with 67 cm and ore - 8,3%. Ayrshire cows have mastitis in the rear udder more often than in the fore udder - 54,9 % to 45,1 %. Warts appearing on the teats of the udder are the predisposing factor to mastitis, sick rate reaching 30.8 % against 13,1% for cows of the same age without this anomaly. Fast milkers have mastitis more rarely (7,7 %) in comparison with hard milkers - sick rate 23,2 %. The cows with average intensity of milking of more than 2,0kg of milking per 1 min have the lowest sick rate, the cows of the same age with 1 kg or less per 1 min have the highest sick rate.

Introduction

In present conditions cow selection based on improvement of udder quality and machine milking adaptability with keeping normal state of mamma is getting special importance. It is known that mastitis resistance or predisposition are caused by some particularities of udder constitution and its functions. The purpose of this paper is investigation of possibilites to decrease mastitis sick rate in cows by improvement of udder features and optimization of milking.

Materials and methods

For many years in large herds of the Republic of Karelia (Russia) subclinical mastitis sick rate of Ayrshire and Kholmogor cows has been investigated depending on udder features and factors of milking.

The productivity of cows equaled 3800-5000 kg of milk per year. Each cow was mastitis tested 4-6 times during the lactation period. For subclinical diagnostics we used 5 % imastine solution, sedimentation test and electrophoresis (Karmanova et. al.,l979). Such factors as udder measurements, distance from udder bottom to the surface of land, dependence of sick rate on duration of milking on 2nd - 4th month of lactation, inten-sivity of milking, topographic location of mastitis were investigated for healthy and sick cows.

Data and results

Out of 13 udder measurements only one is connected with mastitis - that is the distance from udder bottom to the surface of land (table 1). Kholmogor cows with relatively raised udder are more mastitis resistant. With the distance less than 55 cm sick rate mares 25,6 %, with 55-66 cm - 13,3 %, with 67 cm and more - 8,3 %. Healthy cows have the average distance 57,2 cm, sick cows of the same age have 50,8 cm ($p<0,0l$).

Table 1.

Mastitis sick rate in Kholmogor ows of different distance from udder bottom to the surface of land

Cows tested	Distance from udder bottom to the surface of land, cm		
	45 - 55	56 - 66	67 and more
Total, n	39	105	12
Share of infected: n	10	14	1
%	25,6	13,3	8,3

We received following results for mastitis topographic location. Average measurement of cows in 5 farms (3118 sick udder quotas) have mastitis in the rear udder more often than in fore udder - 54,4 % to 45,6 % (table 2). It is particularly typical for Ayrshire cows - 54,9 % to 45,1 %. Probably rear udder having more volume are being milked for longer time, therefore stress factors can hinder milking, cause uncomplete milking and cause predisposition to mastitis. Kholmogor cows are less variable - 52,4 % to 47,6 %.

Table 2.

Mastitis frequency in fore and rear quotas of udder

Breed	Sick quotas of udder, total	including			
		fore		rear	
		total	%	total	%
Ayrshire	2297	1053	45,1	1262	54,9
Kholmogor	678	323	47,6	355	52,4
Total	3118	1423	45 6	1695	54,4

Warts appearing on the teats of the udder are the predisposing factor to mastitis, sick rate reaching 30,8 % against 13,7 % for cows of the same age without this anomaly.

Fast milkers (time of milking is less than 10 min a day) have mastitis more rarely - 7,7 % (table 3). Such milking duration is most physiologically suitable because it coincides with milking reflex time.

Table 3.

Mastitis sick rate in Ayrshire cows depended on time of milking (2-4 month of lactation)

Cows tested	Time of milking		
	less than 10,0	10.0 - 16,0	more than 16,0
Total, n	65	298	151
Share of infected: n	5	53	35
%	7,7	17,8	23,2

The cows with time of milking more than 16 min a day (23,2% sick cows) have the lowest resistance between mentioned cow groups has essenti deviation from nought hypothesis (x = 6,1; P < 0,05). For decrease of mastitis sick rate cows with time of milking more than 16 min a day and 8 min of one time milking are to be rejected from herd.

The decrease of mastitis sick rate was found depend on the increase of the average intensity of milking from 1 to 2 kg/min (table 4). Kholmogor cows with average intensity of milking 1 kg/min less had mastitis 2.3 time as mush as the cows of the same age. Ayrshire hard milkers had mastitis 3,9 time accordingly.

Table 4.

Intensity of milking influence to mastitis sick rate in cows

Grading by intensity of milking in first lactation, kg/min	Breed			
	Ayrshire		Kholmodor	
	cows tested	share of infected, %	cows tested	share of infected, %
1,00 and less	72	26,4	34	50,0
1,01-1,50	335	18,0	232	25,9
1,51-2,00	79	24,1	59	35,6
2,01 and more	15	6,7	14	21,4

Evidently high probability of mastitis is distinguishing feature of the hard milkers and low intensity milking cows. Their glandular tissues of udder are get irritated and exposed to injury more often in consequence of prolonged influence of the vacuum. Conclusion can be done that for Kholmogor and Ayrshire cows with achieved production rate average intensity of milking about 2 kg/min is optimal in order to keep healthy udder in machine milking.

We noted earlier (Bolgov, Karmanova, 1989) that with the increase of blood of crosses coming out from crossing Kholmogor cows with Ayrshire bulls average intensity of milking gets higher. Just such sort of changes of this factor corresponds to decrease mastitis sick rate in cows. Therefore crossing with Ayrshire bulls causes increase of quality of udder, machine milking efficincy and decreases mastitis sick rate.

Conclusions

Selection of cows with normal udder and teats development is needed for mastitis prevention when using machine milking. Cows with too big or small teats that are not correspond to the size of teat cups as well as cows with pendulous or irregular udder or with brought together or removed teats and hard milkers shouldn't be used. Udder features causing mastitis predisposition are highly inheritable (Bolgov, Karmanova,1989),therefore they should be taken into account when breeding nucleus are to be formed. Selection with attention to improvement morphological and functional features of udder and correct choosing based on these signs can give certain effect in selection on increasing mastitis resistance. Selection end choosing in this direction will promote increase in milk production.

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State of the knowledge on mastitis prevention among Brazilian extension agents - a survey

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Summary

A questionnaire was applied to 219 Brazilian extension agents to assess how they are prepared to advise dairy farmers to improve their management on animal health and production, with emphasis on mastitis. Questions included subjects such as hygienic milk production, etiology, diagnosis, treatment and prevention of mastitis and basic and general knowledge on dairy cattle production. Considering the overall score of correct answers, it was observed that Veterinary students ranked first (77.7 % of correct answers), followed by veterinarians that graduated in 1991-94, 1981-1990 and before 1980 (69.7%, 68.2% and 58.4%, respectively). Extensionists non-veterinarians and 37 persons that did not inform their graduation course achieved 58.3% and 68.4% of correct answers. Extensionists from the South-Southeast region had a slightly higher rate of correct answers (64.7%) compared to those from the North-Northeast regions (63.0%). The extensionists seemed to have better knowledge on the practical side of well known preventive and hygienic measures, but were not familiar with the basic concepts that could support such recommendations. These results question the extension programs (or the absence of them) and demand for a better planning of this important activity.

Key words: continuing education, dairy cows, extension service, mastitis, hygiene, milk quality.

Introduction

The basic concepts for the control of the contagious pathogens *Staphylococcus aureus* and *Streptococcus agalactiae* have been known for over 30 years (Harmon 1996). Significant success has been achieved in most developed dairy production areas in terms of reduction of the mammary gland infections leading to subclinical mastitis (Boots 1995). Programs to reduce mastitis are not expensive and, for the most part, are simply changes in attitude and management strategy (Fuhrmann 1996). In spite of the lack of comprehensive data, it is evident that little progress has been achieved in the implementation of programs to reduce mastitis in Brazilian dairy herds (Brito & Brito 1996). Usually it is considered that farmers are either reluctant or resistant to change their attitudes and management strategies. Little attention is given to the rôle played by the extension agents in advising farmers and, especially, the quality of the services they are providing. The aim of the present study was to assess how prepared are the Brazilian extension agents in advising farmers towards the adoption of improved management practices and mastitis control.

Material and Methods

The field work was conducted in 1995-1996 by applying a questionnaire to 219 extension agents working on dairy production. They were interviewed while attending extension meetings related to dairy cattle production. The meetings took place in ten Brazilian States, representing the South-Southeast and the North-Northeast regions. Specific questions were formulated in which it was attempted to establish details of their specific knowledge on mastitis control and hygiene. The questionnaire was designed to evaluate the perception or awareness of the extensionists on technical subjects (etiology, diagnosis and prevention of mastitis, hygienic milk production, dairy production and management). Information on personal characteristics (year and type of graduation, place of work) was also requested. The data were analyzed considering (a) the correctness of the answers given by all persons; (b) the region; (c) year of graduation and (d) profession (veterinarians versus other related professionals).

Results

Sixteen persons interviewed were Veterinary students due to graduate in one or two years; 112 were veterinarians, of which 15 graduated in the period 1991-1994; 39 in the period 1981-1990 and 58 before 1980. Fifty-four extensionists were non veterinarians. The veterinarians were evenly distributed between the South-Southeast (55) and the North-Northeast (57) regions of Brazil. For the two regions there were, respectively, 11 and 5 Veterinary students and 37 and 17 extensionists non-veterinarians. Thirty-seven persons did not inform their graduation course. In table 1 it is presented the proportion of correct answers given by all respondents.

Considering the overall score of correct answers, it was observed that Veterinary students ranked first (77.7 % of correct answers), followed by veterinarians that had graduated in 1991-94, 1981-1990 and before 1980 (69.7%, 68.2% and 58.4%, respectively). Extensionists non veterinarians and the 37 persons that did not inform their graduation course gave 58.3% and 68.4% of correct answers. Extensionists from the South-Southeast region had a slightly higher rate of correct answers (64.7%) compared to those from the North-Northeast regions (63.0%).

Table 1. Number and proportion of correct answers from extension agents for questions about dairy cow mastitis and related subjects

Subjects	Number and % of correct answers
Examination of foremilk with strip cup or other means	108 (49.3)
Definition of somatic cells	45 (20.5)
Definition of subclinical mastitis	101 (46.1)
Cause/effect of somatic cells' increase in milk	174 (79.5)
Use of California mastitis test as a diagnostic tool	184 (84.0)
Therapy of subclinical mastitis	98 (44.7)
Therapy of clinical mastitis	127 (58.0)
Ocytocin and milking	173 (79.0)
Dry period-length	194 (88.6)
Post-milking teat dipping	201 (91.8)
Etiology of contagious mastitis	104 (47.5)
Mastitis etiology: most frequent agent	44 (20.1)
Ecology of *Klebsiella* spp and mastitis	50 (22.8)
Streptococcus. agalactiae and mastitis	175 (79.9)
Milk production in Brazil	120 (54.8)
Brazilian legislation on the use of preservatives in milk	178 (81.3)

Conclusions

The results point out the need of funding programs for continuing education of the extension agents. This is more evident when the differences between the Veterinary students and those veterinarians that left University before 1980 are considered. As a whole, the extensionists seemed to have better knowledge about the practical side of well known preventive and hygienic measures, but were not familiar with the basic concepts that could support such recommendations. This could restrain their ability to advise and convince farmers to adopt new attitudes and management strategies. Finally, this lack of updated information rises questions about the efficiency of the extension programs (or the absence of them) and demands for a better planning of this important activity.

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Occurrence of metabolic disorders in large-scale dairy farms (experiences of a 5 year study)

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Summary

In many cases the feed intake and/or feeding strategy fails to meet the requirements of high yielding dairy cows, which may cause subclinical or clinical metabolic disorders some days/weeks prior to and especially after parturition. In order to reveal the subclinical cases metabolic profile test has been performed for five years in 100 large-scale dairy herds with the population of approximately 70.000 Holstein-Friesian cows, aged 3-6 years on average.

In the present study the following groups were tested in the herds, examined:

Group I.: dry cows, 1-10 days prior to expected parturition (n=750);
Group II.: cows 1-7 days after calving (n=1008);
Group III.: cows 2-3 weeks after parturition (n=995);
Group IV.: cows 6-8 weeks after calving at the peak of lactation (n=604);
Group V.: cows at middle of lactation (n=60);
Group VI.: replacement heifers (n=52).

The incidence of the most important subclinical metabolic disorders diagnosed in the period of the study were as follows (%):

Metabolic disorders/group	I.	II.	III.	IV.	V.	VI.
Energy imbalance	11.6	34.2	23.6	18.2	6.7	0
Aciduria	44.6	64.2	55.6	35.1	53.3	30.8
Protein surplus (non bypass)	21.3	45.5	59.9	64.4	85.0	11.5
Carotene shortage	46.2	64.7	62.2	43.5	46.2	88.5
Hypophosphataemia	21.3	37.3	24.1	24.8	15.0	0

Key words: cow, metabolic disorder, malnutrition

Abbreviation key: MPT = Metabolic Profile Test, **NEFA =** Net Acid Base Excretion, **AST** = Aspartate Amino Transferase, **GSH-Px** = Glutation-peroxidase, **NABE** = Net Acid-Base Excretion

Introduction

In most cases the annual milk yield of cows exceeds 6000 kg/animal at large-scale dairy farms, where the population size varies between 300 and 1200 head of cows. Due to high milk production of dairy herds the special requirements of animals on feed quality and feeding strategy have been changed to higher. In many cases the feed intake fails to meet the nutritional requirements of high yielding dairy cows, which may induce subclinical or clinical metabolic disorders some days/weeks prior to and especially after parturition.

Majority of the losses is caused by subclinical cases, therefore metabolic profile tests have been developed and applied all over the world since the late sixties for revealing the metabolic disorders in early stage.

The aim of the study was:

1. To reveal the occurrence of metabolic disorders in large-scale dairy herds;
2. To contribute to the better estimation of losses caused by the most frequent metabolic disorders in high yielding dairy cows.

Materials and methods

In order to reveal the occurrence of subclinical metabolic disorders caused by malnutrition a metabolic profile test has been developed and used for 5 years in 100 large-scale dairy herds that housed approximately 70.000 Holstein-Friesian cows, aged 3-6 years on average. The MPT is based not only on laboratory examinations of blood and urine samples, but also on analysis of data recorded in the herds tested. Data recording included parameters of feed composition and feed quality, feeding strategy, milk production, reproduction, health status of the herd and the body condition scores.

The biological samples were taken from clinically healthy cows, selected randomly from various groups of cows, 3-5 hours after the morning feeding. The groups differed in respect of daily milk yield, stage of lactation and gestation. In the present study the following groups were tested in the herds, examined:

Group I.: dry cows, 1-10 days prior to expected parturition (n=750);
Group II.: cows 1-7 days after calving (n=1008);
Group III.: cows 2-3 weeks after parturition (n=995);
Group IV.: cows 6-8 weeks after calving at the peak of lactation (n=604);
Group V.: cows at middle of lactation (n=60);
Group VI.: replacement heifers (n=52).

The energy metabolism was monitored by the determination of glucose, aceto-acetic-acid, NEFA concentration, subclinical fat mobilisation syndrome was diagnosed by the values of glucose, NEFA and AST activity, subclinical ketosis was revealed by the values of glucose and aceto-acetic-acid in the blood samples. Non bypass protein supply was monitored by the determination of urea concentration in the blood and urine samples. Concentration of total carotene, calcium, inorganic phosphorus, copper, zinc was measured in blood samples. GSH-Px activity of red blood cells was determined in order to monitor the selenium supply.

Acid-base metabolism was measured by the urine pH and by the determination of NABE value in the urine samples.

Results

The distribution of subclinical metabolic disorders in percentage diagnosed in the period of study can be seen in **Table 1.**

Table 1. Occurrence of subclinical metabolic disorders

Subclinical metabolic disorders	Sampled groups of animals					
	I	II.	III.	IV.	V.	VI.
	Occurrence of metabolic disorders, %					
Increased fat mobilisation	3.2	2.4	0.5	0.4	0	0
Subclinical fat mobilisation syndrome	8.3	2.9	2.5	0.6	0	30
Subclinical ketosis	4.9	20.4	14.5	14.6	6.7	0
Subcl. f. m. syndrome+subcl. ketosis	1.8	8.8	5.4	2.2	0	0
Subclinical metabolic disorders	Sampled groups of animals					
	I.	II.	III.	IV.	V.	VI.
	Occurrence of metabolic disorders, %					
Energy imbalance	11.6	34.2	23.6	18.2	6.7	0
Aciduria	44.6	64.2	55.6	35.1	53.3	30.8
Acid load	28.8	41.7	42.4	31	43.3	30.8
Danger of metabolic acidosis	15.7	22.5	13.2	8.7	10	0
Protein shortage	22.9	14.7	7.1	10.8	0	9.6
Protein surplus	21.3	45.5	59.9	64.4	85	11.5
n	750	1008	995	604	60	52
Carotene shortage	46.2	64.7	62.2	43.5	46.2	88.5
Hypocalcaemia	0	0	0	0	0	0
Hypophosphataemia	21.3	37.3	24.1	24.8	15	0
Hypomagnesaemia	0.4	0.1	0.8	0	0	0
Sodium shortage	41.2	39.8	25.6	17.3	16.7	32.7
Copper shortage	61.6	80	9.6	17.9	0	0
Zinc shortage	17.4	10	6.9	13.4	0	0
Manganese shortage	22.2	0	0	0	0	0
Selenium shortage	8.3	18.8	10.6	23.2	0	14.9
n	712	953	990	519	60	52

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The influence of different animal hygiene conditions on mastitis occurrence in goat breeds in Slovakia

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Summary

From 1993 to 1996, results of clinical and bacteriological screenings have been compared, i.e. between a breed established on the basis of 200 Alpine goats imported and 60 Sane goats with no breeding experience under improvised conditions and that of 115 domestic white horniess short-haired goats under specific conditions with many year tradition. Prroper animal hygiene, welfare, and nutrition of animals have markedly influenced the indices observed.

Key words: goat breed, mastitis in goat, level of mastitis

Introduction

Very fast decrease in the number of cow herds on the territory of Slovakia helped to the revival of goat breeding. It is true that the intention to enrich the food market with milk and milk products of natural origin follows with the late tradition of small ruminant breeding in our country, at the same time, however, as a rule it requires to use machine milking at a larger extent, taking into account the physiological requirements and those of animal hygiene as well as more strict hygienic-technological standards for goat milk.

When basic requirements at milk obtaining are not respected and there are serious breeding shortcomings, the production of milk is endangered by mammary gland inflammations of infectious origin. It must be mentioned that mastitis of goats are frequently caused by ubiquitous germ of *S. aureus* while enterotoxigenic strains of this pathogen endanger the consumer s health.

The objective of the present study is to evaluate, from a large number of long-term obtained data from three observed breedings of goats the occurrence of clinical forms of mastitis in the period from the delivery to weaning and levels of infection recorded immediately after the weaning and/or at the beginning of milking throughout the years 1993 to 1996.

Material and methods

The study of the occurrence of clinical forms of mastitis and levels of infection was undertaken in selected sheep and goat breedings with a view to the tradition, standard of breeding and, in particular, the technology of milk obtaining.

Farm S (Sklabina) came into existence in the cours of the study on the basis of an enterprise intention o an agricultural cooperative farm with an import of well-tried breeding herd consisting of 280 Alpine goats from France without proper preparation of the objects, milking room, and mainly feed. In winter, the housing of highly pregnant goats was ensured in the object after the feeding of cattle and in summer, under the shelter of the former tobacco drying kiln. Milking was ensured using the mobile milking room for sheep. In spite of the effort to realize the original intention, the general standard of breeding was accompanied by following negative phenomena: inadequate supply of full-value nutrition and continuous sale of milk leading to prolonged time of weaning of kids. Of hygienic shortcomings, milking of the first milk sprinklings on the floor of fixation cages can be mentioned.

Goat farm N (Nálepkovo) is equipped with original technology for breeding, goat milking, and primary milk treatment. In the course of the study, at mean 115 Slovak white short-haired goats have been milked daily in the object of milking room with a lowered manipulation corridor and with the equipment of the firm Alpha-Laval (2x24). Hygienic and breeding standard may be regarded as stabilized.

The study of the occurrence of clinical and/or subclinical forms of mastitis was methodically scheduled to dates of collection of individual samples of goat milk: April-May 1993 to 1996.

The clinical examination of mammary gland and/or classification of mastitis were carried out by the method of SLANINA (1975) closely before the collection of milk samples for bacteriological examination. The level of infection is expressed by the percentage of positive animals of all examined in an individual herd. The collection of individual milk samples as well as the evaluation have been carried out according to (Laboratory methods for use in mastitis Work, IDF, 1981). The bacteriological finding was aimed mainly at the most frequent germ of *S. aureus*.

Results

From the data presented in **Table 1** it follows that in breeding N, in 1993 the highest numbers of clinical forms of mastitis as well as the highest level of infection have been recorded - i.e. 5.4 % ; in the following years the tendency was decreasing. It must be mentioned that in 1995, no case of clinical form of mastitis was recorded despite the level of 2.6 %.

In 1993, in the goat breeding S after the first deliveries of the whole herd of imported goats, 23 bacteriologically positive animals were recorded - i.e. the level of infection was 9.7 %. In 1994, despite the decrease in the level of infection to 7.9 %, the number of clinical cases increased from 14 to 16. Due to improved breeding care in 1995, the level of infection decreased to 4.2 % ; there were only 6 cases of clinical forms of mastitis. In the last year of the study, however, the values increased again to 13 bacteriologically positive animals - i.e. 5.3 % and 9 clinical cases of mastitis.

Table 1 Numbers of examined animals, bacteriologically positive animals and clinical forms of mastitis, the expression of the level of mastitis infection in the observed goat breedings in Slovakia from 1993 to 1996

Year	Goat breeding N				Goat breeding S			
	A	B	C	D	A	B	C	D
1993	92	5	4	5,4	237	23	14	9,7
1994	103	5	2	4,8	240	19	16	7,9
1995	115	3	0	2,6	261	11	6	4,2
1996	124	2	1	1,6	242	13	9	5,3

A - number of examined animals, B - number of bacteriologically positive animals
C - number of clinical forms of mastitis D - level of infection (%)

Discussion

When comparing the values of the parameters observed in goats it may be stated that differences often result from incomparable conditions of the organization of breeding, housing technology, feeding, hygiene, and technical standard of the milking installation. The experience from farm S, when at the beginning of the study, theoretically minimal level of infection was expected as it was the imported breeding of young pregnant goats, is very important. The actual conditions of feeding, organization, hygiene of deliveries as well as late weaning of kids and/or lack of experience with machine milking of goats have adversely affected the observed parameters. Due to the difficulties with organization and mainly with realization of goat milk on the market, the original herd ceased to exist at the end of 1996 in the form of an assignment of healthy animals for breeding purposes.

From 1978 onwards, the goat breeding N represents the conditions of a specialized farm. Yearly actualized enterprise intention as well as breeding experience are the precondition of further perspective of the breeding.

Conclusion

Many year experience with long-term observation of the small ruminant breedings showed that the expressed numbers of clinical forms of mastitis for the period from the beginning of deliveries to the weaning of the young's as well as the expression of the level of infection based on single bacteriological screening at the beginning of machine milking indicate with confidence the standard of breeding and/or the efficacy of complying with the measures of organization and animal hygiene. The occurrence of mastitis in the period of permanent lactation is usually only sporadical and, as a rule, it does not influence markedly the general evaluation of the herd.

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The importance of diagnostics in preventing mastitis in cows.

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Summary

The objective of this study was to determine the possibilities of using the changes in composition and physicochemical properties of milk for diagnosing the morbit state of the milk gland in cows. The number of 162 BW cows were observed. The best traits helpful for diagnosing the morbid states of udders are as follows: lactose as a milk component and pH of milk.

Key words: mastitis, diagnostic, dairy cattle, lactose, pH of milk

Introduction

Medical and economic problems connected with udder diseases oblige to search for determine diagnostic criteria allowing the early detection and treatment of mastitis.
The objective of this study was to determine the possibilities of using the changes in composition and physicochemical properties of milk for diagnosing the morbid states of the milk gland in cows.

Material and methods

The investigation was conducted in 1989-1991 in two dairies in the Elbl¹g province on 162 Black and White cows. Milking in these two dairies was performed twice a day by the means of conduct milkers and the keeping was in boxes and pastures. Once a month a detailed analysis of milk yield and composition was made on the basis of milk recording. Milk quality was estimated by the density and acidity measures, Californian Mastitis Test and Somatic Cells Count.

Results

Table 1 shows the effect of the formidable milk gland on the quantity and quality of milk. From the comparision of milk yields it appears, that between the healthy and sick cows the differences were highly significant and losses ranged over 1600 kg of milk (4982,13 kg vs. 3343,04 kg). With the intensity of morbid symptoms the content of milk fat increased from 3,86% in healthy cows to 4,08% in sick cows (with high mastitis symptoms) and of protein from 3,21% to 3,40%, respectively. These changes in fat and protein content one can explain both by the intensified morbid state and also by negative correlation between the level of milk components and its yield. At the sudden drop in milk yield it may be observed as apparent increase in the content of milk components. Similar results were obtained by Artecki et al. (1). Czaplicka et al. (2,3) report differences approaching 0,38%. However, Feleñczak et al. (4) found, that with the intensified morbid symptoms there was a decrease in the content of milk fat, which indicates that there is lack of synonymous tendencies in this question. An increase in protein in milk was, on the other hand, reported by Puchajda et al. (6). Contrary to fat and protein, the morbit state of the milk glands resulted in a decrease in the lactose level in milk. The content of that constituent decrease by 0,24% (4,81% in healthy cows vs. 4,57% in sick cows). G³¹bówna et al. (5) also observed a marked decrease in lactose concentration in milk coming from the morbit milk gland of udder and they determined a minimal threshold value of that components as 45,6 g/l for the milk coming from the healthy milk gland. The differences in the percentage content of fat, protein and lactose in milk between the healthy and morbid cows were highly significant. The observed increase in the dry matter content in milk may apparent and result from a considerable decrease in milk yield, similarly like in case of fat and protein. No relationship was found between the healthy condition of the udder and milk density; however, the intensified morbid symptoms the pH of milk increased. The drop in acidity occured gradually as mastitis was intensified. Changes in milk reaction may significantly effect technological properties of milk. Moving milk reaction in the neutral or basic direction is the undesirable phenomenon because the growth of milk fermentation bacteria is hindered and favoured are the development of staphylococci and production of enterotoxin (7). As it was expected together with worsening the health condition of udder there was an increase in the number of somatic cells, which is confirmed by high correlations between the number of somatic cells and the morbit state expressed by the Californian Mastitis Test.

Summing up the results

The following generalization and conclusions an be drawn:

1. The worsening of the healthy state of the milk gland resulted in a marked decrease in milk yield, increase in the content of fat, protein and dry matter, drop in the content of lactose and the change of pH in the direction of neutral reaction.
2. The traits helpful for diagnosing morbit states of udders are lactose as a milk component and pH of milk.

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Table 1. Milk yield, content of fat, protein, lactose and dry matter , physicochemical properties and Somatic Cells Count according to state of udder health (CMT)

Table 1

Milk yield, content of fat, protein, lactose and dry matter, physicochemical properties and Somatic Cells Count according to state of udder health (CMT)

Specification	Measure	Health state (CMT) - average				
		0	0,1-1	1,1-2	2,1-3	3,1-4
Milk yield (kg)		*AE*	*BF*	*CG*	*DEFG*	*ABCD*
	$\bar{x}$	4982,13	4865,96	4638,10	4020,35	3343,04
	v	37,94	36,06	42,23	48,33	51,96
Fat content (%)		*ABCD*	*AE*	*BF*	*Ca*	*DEFa*
	$\bar{x}$	3,86	3,92	3,93	3,96	4,08
	v	15,66	15,24	17,96	15,62	16,53
Protein content (%)		*AD*	*BE*	*CF*	*DEF*	*ABC*
	$\bar{x}$	3,21	3,22	3,28	3,31	3,40
	v	12,12	11,52	13,19	10,69	10,70
Lactose content (%)		*AEHb*	*BFab*	*CGHa*	*DEFG*	*ABCD*
	$\bar{x}$	4,81	4,74	4,70	4,64	4,57
	v	6,72	6,91	6,39	6,95	7,09
Dry matter content (%)		*A*	*B*			*AB*
	$\bar{x}$	12,68	12,68	12,70	12,72	12,82
	v	7,56	6,82	7,21	6,87	7,48
Density (g/cm^3)	$\bar{x}$	1,031	1,030	1,030	1,029	1,029
	v	0,24	0,49	0,32	0,42	0,26
pH		*ABCD*	*AEF*	*BGH*	*CEG*	*DFH*
	$\bar{x}$	6,68	6,71	6,71	6,72	6,74
	v	1,21	1,32	1,38	1,67	1,81
Somatic Cells Count (thou./ cm^3)			*A*	*B*	*C*	*ABC*
	$\bar{x}$	-	921,36	974,63	1310,63	1872,41
	v	-	81,12	80,77	80,77	83,27

Values marked the same letter in line differ statistically:
capital letters - differences significant on level $\alpha = 0{,}01$
small letters - differences significant on level $\alpha = 0{,}05$

Effect of Selenium supplements on the selenium status of pregnant dairy cows at parturition

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Summary

It was made an investigation about the effect of selenium supplements on selenium concentration in the blood of pregnant dairy cows at their calvings. There were formed four groups of pregnant dairy cows. The animals from I and II group received Se-supplement as salt-mineral bricks, containing respectively 20 and 40 ppm Se, and the III group - as single injection with 50 mg Se. The fourth group served as control one. The applied diet contained 0,06 ppm Se. The blood samples were investigated at the beginning of the experiment, at parturition and in a month later. It was determined that at parturition the animals from the II and the III group have serum selenium concentration adequate for prevention of Se-dependet diseases, but in a month afterward it is adequate only in the animals, which had received salt-mineral bricks containing 40 ppm Se.

Key words: selenium supplements, salt-mineral bricks, blood samples, dairy cows, selenium status

Introduction

Selenium is an essential trace element with a dietary requirement of at least 0,1 ppm (Koller et al. 1983). Biochemical function of Selenium in organism of animals is closely related with the fact that Selenium is an integral part of enzyme glutationeperoxidase, who protects the cells from oxidative damage (Combs 1984).

In many regions of the world the soils and produced forages are with low selenium content and the animals are fed with inadequate selenium diets. The periparturient period is especially critical for the health and subsequent performance of dairy cows (Dimanov 1988, Shanks 1981). This requires in Se-deficient regions to be administered Se supplements to diets of animals for prevention of Se-responsive postpartum diseases.

The purpose of present investigation was to compare the effect of the different selenium supplements administered during the dry period on the selenium supply of dairy cows parturition and the possibility for prevention of some selen-responsive diseases in postpartum period.

Material and methods

The experiment improve 214 pregnant Holstein cows. The herd was divided randomly into four groups at the end of lactation (approximately 60 days prior to anticipated calving). The animals from the I and II group received Se supplement as 5 kg salt-mineral bricks. The bricks contained 100 mg Se (20 ppm) for the I group and 200 mg Se (40 ppm) for the II group as sodium selenite. During the whole dry period the cows had free access to the salt-selenium bricks.

The animals from III group were treated with single i.m. injection with 50 mg Se as sodium selenite 20 days prior to anticipated parturition and the IV group served as a control one. The applied diet contained 0.06 ppm Se. Blood samples were collected from all groups 60 days before parturition, at parturition and 30 days after parturition. Selenium in blood of cows and in feeds was measured by the method of Whetter and Ullrey (1978). Dates were analyzed by using the method of t-test to compare the group means implemented in Statistica package (Stat Soft Inc. 1994).

Results and discussion

The whole blood selenium concentration of cows from the four groups at the beginning of the experiment was in range from 0.065±0.003 to 0.069±0.004 ppm (table1).

Table 1. Effect of Se supplements on whole blood Se concentration

Groups	Se concentration, ppm		
	60 days prior to parturition	at parturition	30 days after parturition
I 100 mg Se p.o.	0.068 ± 0.004^{a}	0.091 ± 0.007^{b}	0.089 ± 0.006^{b}
II 200 mg Se p.o.	0.066 ± 0.005^{a}	0.115 ± 0.008^{b}	0.104 ± 0.007^{b}
III 50 mg Se i.m.	0.069 ± 0.004^{a}	0.088 ± 0.006^{b}	0.071 ± 0.006^{a}
IV (control)	0.065 ± 0.003^{a}	0.062 ± 0.004^{a}	0.067 ± 0.004^{a}

a,b - Means in same row with unlike superscripts differ significantly (p<0.05)

The administered selenium supplement in a form of salt-selenium bricks containing 100 mg Se (20ppm) or 200 mg Se (40ppm) during the whole dry period increased significantly the whole blood selenium concentration at calving from 0.068±0.004 ppm to 0.091±0.007ppm

($P<0.01$) and from 0.066±0.005 ppm to 0.115±0.008 ppm ($P<0.001$) for the I and II group respectively. Administered 20 day before calving i.m. injection with 50 mg Se increased the whole blood selenium concentration at calving from 0.069±0.004 ppm to 0.088±0.06 ppm but the determinated value was not still adequate.

According to Van Saun (1990) concentrations above 0.1ppm Se in the whole blood and above 0.07 ppm in serum are adequate. In the present experiment 30 days after calving the whole blood selenium concentration was adequate only in the cows from II group.

The influence of selenium supplements on the serum selenium concentration is shown in table 2.

Table 2. Effect of Se-supplements on serum Se-concentration

Groups	Se concentration, ppm		
	60 days prior to parturition	at parturition	30 days after parturition
I 100 mg Se p.o.	0.052 ± 0.003^{a}	0.068 ± 0.004^{b}	0.062 ± 0.002^{b}
II 200 mg Se p.o.	0.048 ± 0.002^{a}	0.076 ± 0.004^{b}	0.074 ± 0.003^{b}
III 50 mg Se i.m.	0.049 ± 0.003^{a}	0.078 ± 0.005^{b}	0.055 ± 0.003^{a}
IV (control)	0.051 ± 0.002^{a}	0.049 ± 0.003^{a}	0.052 ± 0.003^{a}

a,b - Means in same row with unlike superscripts differ significantly (p<0.05)

The supplements increased rapidly selenium concentration in serum to adequate value in the II and III group at calving. 30 days after parturition the serum Se concentration decreased significantly in cows from the III group, received Se supplement as a single injection, administered 20 days prior to parturition ($P<0.001$) while in cows from II group received salt-selenium bricks during the dry period serum selenium concentration decreased non significantly ($P<0.5$).

Conclusions

The carried out experiment shows that the administration of Se supplements as salt-mineral bricks containing 40 ppm Se in selenium deficient dairy cows is comparatively convenient and constant source of Se. This variety of Se supplements is more suitable for treatment of selenium deficiency and for prevention of selenium responsive postpartum diseases than injectable selenium, who retained in the body for a relatively short time.

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Cattle comfort under high air temperatures in mild zone

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Summary

The air temperatures above 25^{o}C negatively influence the oragnism of cattle and cause heat stress. The result of this is a decline in milk production, feed consumption, problems with reproduction etc. But water evaporative cooling improves cattle comfort and lessens heat stress. Therefore our aim was to construct of water sprinkle cooling equipment for our conditions and an experimental investigation of thermoregulatory functions of heifers before and after cooling (the changes of surface body temperature by means of thermovision).

Our construction of water cooling equipment is acceptable for barns, shades, fowlruns and pastures. It is possible to poll number of spray nozzles. Automatic steerage ensures low water consumption. The recommended air temperature for activation is 25^{o}C.

Positive influence on respiratory functions and futher thermoregulatory functions (lower surface skin temperature, respiratoty rate, rectal temperature) was proved in an experimental part. Evaporative cooling improved cattle comfort and reduced heat stress. Time of sprinkling l min (during environmental temperature 27 - 31^{o}C) is sufficient for cooling down for 45 - 60 min.

Key words: cattle, heat stress, thermoregulatory function, water evaporative cooling, thermovision

Introduction

The high temperatures (above 25^{o}C) negatively influence the organism of cattle and evoke heat stress. Some responses noted with heat stress in cattle are: increased respiratory rate, sweating, rectal temperature, surface skin temperature, reduced feed consumption, decreased activity, shade or wind seeking, decline milk production, problems with reproduction etc. (Chikamune, Shimizu 1983, Her 1988, Wolfenson 1988, Terada 1988, Shearer 1991). But water evaporative cooling - sprinkling system (this method uses large droplet size to wet the hair coat and skin of cattle, and then water evaporates from hair and skin) - improves cattle comfort and lessens the effects of the high environmental temperatures on animals (Bucklin 1991, Bray 1992, Means 1992).

Therefore our aim was: 1/ construction of water cooling equipment for our conditions, 2/ an experimental investigation of thermoregulatory function of cattle (heifers) under heat stress before and after cooling, 3/ an investigation of evaporative cooling effect on the changes in surface body temperatures by means of thermovision.

Material and methods

The effect of evaporative cooling was investigated in 10-month-old heifers (crossbred Czech Pied cattle with Holstein). Heifers were kept in a special climatic barns under environmental temperature 27 - 31^{o}C. The application of water was practiced from the special sprinkling nozzles (1m above body of animal). Time of sprinkling was 1 min. The changes of respiratory rate and volume, oxygen consumption, production and flow of heat, pulmonary ventilation before, during and after cooling were measured by means of mask method and ergospirometr Oxycon-4. Thermograms of bodies were obtained with a special thermovision set AGA 880. The thermal profiles were recorded immediately before and after cooling, then 15, 30 and 45 min after sprinkling and after drying up of animal.

Results

Our construction of water cooling equipment is acceptable for barns, shades, fowlruns and pastures. It is possible to poll number of sprinkling nozzles. Automatic steerage ensures low water consumption. the recommended air temperature for activation is 25 ^{o}C.

Heifers exposed to water evaporative cooling responded positively during and after cooling in all observed respiratory functions and heat peoduction. The ratio of the heat flow by respiration to the total heat flow decreased, the heat loss was mostly by passive flow through mist particles.

After evaluation of all screen pictures the hottest regions were found out: neck region, shoulder and rib region. Second the hottest regions were: unrib region, hunger pit and body hindparts, third the hottest regions included: throat region, withers and sacral region. heat loss is the most intensive in these regions. After water evaporative cooling decreased surface body temperature approximately about 1,2^{o}C in all three regions. Time of sprinkling (1 min during temperatures 27 - 31^{o}C) is sufficient for cooling down animals for 40 - 60 min.

It can be claimed that water evaporative cooling - sprinkling system - is profitable to perform regulatory during the whole summer period in a mild zone also at young cattle of milk or combined breeds, because water evaporative cooling positively stimulates physiological functions of organism which are in relation with the welfare of animals, health condition and production of animals.

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Temperature responses of cow udder to machine milking (thermography study)

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Summary

Milking can cause the traumatized zones in the udder and in the teats, although technical parameters characterizing the machine milking are in accordance with the norm. Our aim was to investigate the temperature responses during milking. This was done in milking parlours on the farms by means of thermovision. We used the thermovision sets AGEMA 470 and AGA 880. The thermal profiles were recorded immediately before and after milking. After evaluation all screen pictures we found out: milking causes the considerable temperature changes in the teats. The difference of temperature was 5°C before and after milking. The temperature changes in the udder were not so intensive, the difference of values does not exceed 1°C.

Key words: cow udder, machine milking, traumatization, thermovision

Introduction

During machine milking the milking equipment is brought into the contact with a very sensitive organ of the cow - the lacteal gland. This technology should meet two fundamental requirements, namely providing hygienical milk and preservation of good health condition ofthe mammary gland (Malik et al 1989). But milking can cause the traumatized zones in the udder and in the teats, although technical parametres characterizing the machine milking (magnitude of the vacuum applied, number of pulsations per minute and pulsation ratio) are in accordance with the norm. Udder traumatization during milking can lead to the increase of mastitis (Kejiík et al. 1989, Caruolo et al. 1990).

Material and methods

Our aim was to investigate the temperature responses during milking. this was done in milking parlours (autotandem 2x5, measured 12 dairy cows, autotandem 2x2x5, measured 17 dairy cows) on the farms by means of thermovision. We used the thermovision sets AGEMA470 and THV 880. This method permits to visualize the responses of the organism to the conditions of milking. The thermal profiles were recorded immediately before and after milking.

Results

After evaluating all screen pictures we found out: milking causes the considerable temperature changes in the teats. These teats are in direct contact with milking machine and they are very strained during milking. The difference of udder surface temperatures was 5°C before and after milking. The temperature changes in the udder were not so intensive, the differrence of values does not exceed 1°C.

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Immunocompetent cells in blood after natural infection of calves by Papillomavirus

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Summary

Subpopulations of blood lymphocytes (CD2, CD4, CD8, gamma/delta+ T lympho-cytes and IgM bearing lymphocytes) were evaluated in clinically manifested bovine papilloma. Significantly a lower number of CD2 (44.7%), CD4 (22.8%) and also lower ratio of CD4/CD8 (1.5) was recorded in experimental group of animals comparing to control group of animals (62.3%, 34.0% and 2.3, respectively). On the contrary higher number of gamma/delta+ T lymphocytes (9.6%) and IgM bearing cells (35.2%) was found in experimental group of animals comparing to control group of animals (4.8% and 22.1%, respectively). Biochemical results demonstrated partial anaemia, sideropenia, hypozincemia, hypocupremia, disturbance of hepar metabolism and increased concentration of arsenium, cadmium and lead in blood serum in both groups of animals. The development of papillomatosis in the region investigated suggests important external factors affecting the immune system.

Key words: cattle, subpopulations of lymphocytes, papillomatosis, immunosuppression, FACS

Introduction

The skin papillomatosis of animals is a benign tumour disease of the epithelial origin. Most papillomas are caused by infection of the papillomavirus in the Papovaviridae´s family. The tumour, after its initial progressive growth in an affected animals, proceeds to spontaneus regression in the course of one year. It suggests that the tumour´s regression is cell-mediated immunity, because humoral immunity is not effective in this process which may be induced by many types of papillomaviruses (Jubb et al., 1993). There are no papers which define lymphocyte subpopulations in cows infected by papillomaviruses.

In this work subpopulations of lymphocytes were determined with monoclonal antibodies against bovine lymphocytes in animals naturally infected with papillomavirus.

Material and Methods

Animals. The animals (heifers and bulls pinzgaw breed) 1 - 4 years old were divided into control and experimental groups. The control animals (8) - clinical healthy without papillomaviral infection and experimental animals (5) with fibropapillomatosis. The animals came from the Spiš area near copper and zinc plant.

Monoclonal antibodies. Monoclonal antibodies (MoAbs) were obtained from the International Laboratory for Research on Animal Diseases (Ilrad, Kenya). The monoclonal antibodies used are summarized in Tab. 1.

Isolation of lymphocytes. Venous blood samples were collected from all animals and put into ethylene-diaminetetra-aceticacid (EDTA). Lymphocytes were separated by Ficoll-Hypaque gradient sedimentation (Boyum, 1974).

Procedure of flow cytometry (FACS). After the separation the lymphocytes were twice washed with phosphate buffer (PBS) supplemented with 0.2 per cent sodium azide and once in immunofluorescent medium (RPMI 1640 supplemeted with 5 per cent foetal calf serum and 0.2 per cent sodium azide). 50 μl of cellular suspension (1.10^6 lymphocytes in immunofluorescent medium) and 50 μl of specific or control MoAbs were mixed and incubated at 4^oC for 30 minutes. After incubation the cells were washed twice in the immunofluorescent medium (IFM) and pellets were mixed with 25 μl of FITC-conjugated anti-mouse immunoglobulins and incubated as described above, in the dark. The working dilution of monoclonal and FITC-conjugated anti-mouse immunoglobulins (Institute of Sera and Vaccines, Prague, Czech Republic) was determined by titration and calculation of a resolution index. After being stained the cells were washed twice in the IFM once in PBS supplemented with 0.2 per cent sodium azide. The cells were resuspended in 0.5 ml of the same buffer.

Analysis of stained cells. The FACS system (Becton Dickinson) was provided with 15mW argon ion laser. The analysis examined a dot plot of the leucocyte obtained by the forward and side scattering physical character of the lymphocyte population. The results are therefore expressed as the percentage of the lymphocyte population which was positive far a specific MoAb. An unrelated MoAbs of similar isotype was used as a control.

Statistical evaluation. For statistical analysis we used unpaired T-tailed test.

Biochemical parameters. In the blood serum, photometrical determination was carried out of aspartate aminotransferase (ALT; EC 2.6.1.1.), alanine aminotransferase (ALT; EC 2.6.1.2.), gammaglutamyl transferase (GGT; EC 1.4.1.3.), alcalic phosphatase (ALP; EC 3.1.3.1.), glucose, cholesterol, total lipids, triglycerides, nonesterificated fatty acids, total bilirubin, total proteins, albumin, total immunoglobulins, vitamin A using Biola-test (Lachema, Brno, Czech Republic). Serum iron, copper, zinc, selenium, molybdenum, arsenium, cadmium and lead were analyzed by atomic absorption spectrophotometry on a Perkin-Elmer 4100 ZL device.

Results

The MoAbs which were used in our experiment are sumarized in Tab. 1. In the experimental group of animals a total decrease of T lymphocytes (44,7%) was recorded compared with the control animals (62,3%). The significance was on the level P<0,001 (Tab. 2). Likewise the decrease of CD4 lymphocytes was registered in the experimental group compared with the control group with a significance of P<0,05. The change in CD8 cell numbers was not found out between these groups. The ratio CD4/CD8 in the experimental group was 1.47 and in the control group 2.32. On the other hand, in the experimental animals an increase of null cells (non B / non T lymphocytes) was recorded with a significance of P<0,001. An increase of cells with production IgM was also found in the experimental group compared to the control group with significance of P<0.05. Disturbed hepatal metabolism was found in animals of experimental and control group (high activity AST. ALP; increased concentration of total bilirubin, decreased content of triglycerides and albumin in blood serum). Sideropenia, hypozincemia, low levels of vitamin A, increased concentration of arsenium, cadmium and lead were found in blood serum in clinically healthy animals and animals with fibropapillomatosis without statistical dependence.

Conclusions

Significantly lower numbers of T lymphosytes and a low ratio CD4/CD8 in the experimental animals relates to cell immunosuppression in infected animals. The results support the suggest that the regresion of tumors is caused by cell-mediated immunity. The development of papillomas in the region investigated also suggested important external factors affecting the immunity of the organism. In our case, animals came from Spiš area, which is characterized increase accumulation of some trace elements in organism of studied cattle.

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Table 1: Monoclonal antibodies used

Table 2: Evaluation of lymphocyte subpopulations by FACS

Table 1: Monoclonal antibodies used

Specificity	moAbs	Isotype	diluted
CD2	IL-A42	IgG2a	1 : 1000
CD4	IL-A12	IgG2a	1 : 2000
CD8	IL-A51	IgG1	1 : 5000
gamma/delta+ T lymphocytes	IL-A29	IgG1	1 : 1000
IgM (μ chain)	IL-A30	IgG1	1 : 2500

Table 2: Evaluation of lymphocyte subpopulations by FACS

Lymphocyte subpopulations	Experimental Group (n=5) (%)	Control group (n=8) (%)
CD2	44.662 ± 2.105^{c}	62.331 ± 2.422
CD4	$22.768 \pm 1{,}246^{b}$	33.999 ± 1.875
CD8	15.880 ± 1.412	16.010 ± 1.893
gamma/delta+ T lymphocytes	9.558 ± 0.954^{c}	4.832 ± 0.563
IgM (μ chain)	35.158 ± 3.560^{a}	22.145 ± 2.848
CD4/CD8	1.472 ± 0.322^{a}	2.321 ± 0.701

Statistical significance on the level: ^{a} - $P<0.05$, ^{b} - $P<0.005$, ^{c} - $P<0.001$

Investigation on heifers reproductive functions at alternative technologies of breeding

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Summary

Investigations were carried out to establish the suitability of three technologies for heifers breeding. The first technology consists of stable breeding in collectives boxes with slotted floor and free access to walking yard from 6 months age to 15 days before calving. The second technology includes except the same stable breeding and five months pasture breeding of yearling heifers. The third technology consists of the same stable breeding with every day active movement along a trace route. It was found out that heifers breeding under the first technology lead to low fertility, difficult litter and complication in the post-litter period. Pasture breeding and stable breeding with active movement along a traced route favourably affected reproductive function of heifers.

Key words: technology, heifers, reproductive function, pasture breeding

Introduction

With the introduction of industrial technologies in Bulgaria, the traditional methods of pasture breeding of heifers have been abandoned and the specialized and other farms passe to all year stable breeding. In order to compensate the lack of active movement, in some technologies a trace route is foreseen and in others a free access to an outdoor site. To what extent such a compensation is possible is a problem that requires a thorough investigation.

According to Semenuta [4] the all year round animal breeding in premises affects negatively their organism: their resistance against diseases is reduced, the reproductive functions and the posterity vitality change for the worse. Nikanorov [3] established that the regular trace route of heifers had a positive effect on their productivity, physiological state, the reproductive functions and the level of their natural resistance to different diseases. According to Gorlov [1] the s timer pasture and stable breeding of calves providing them a possibility for movement correspond to a higher extent to the organism and physiological necessities and contribute to the development of highly productive animals with good reproductive qualities.

On the grounds of many years findings Esminger [2] recommends the ranch pasture breeding of heifers as the most suitable and profitable.

Material and Methods

Some investigations were carried out in a specialized reproductive farm in order to establish the suitability of three technologies for heifers breeding. The first technology consisted of cattle-shed breeding in group boxes with slotted floors and free access to walking yard, from 6 months age up to 15 days before calving. The second technology included in addition to the same cattle-shed breeding 5 five months pasture breeding of yearling heifers. The third technology consisted of cattle-shed breeding with every day active movement along a traced route. During the experimental period the walking distance and the heifers inseminations were registered every day and the course of the parturitions were studied as well the post-calving period. At the same time microclimatic investigations in the buildings were carried out including the determination of temperature-moisture conditions, the velocity of air movement and the gas composition according to well-known animal hygiene methods.

Results and Discussion

During a period of 150 days of pasture breeding the heifers from the second technology walked every day the distance of 7 km on the average and ate various meadow grass. For the heifers from the third technology daily movement along a trace route of 4 km was assured during the spring, summer and autumn. The heifers from the first technology bred the whole year in the premises covered a distance of 176 m at an average during a twenty-four hour period. Moreover the movement was accomplished mostly in the cow-sheds where the animals were fed through cribs. The same distance was covered also by the heifers from the second and third technology during their breeding in the cow-sheds. From these data it is clear that despite the free breeding of the heifers and their free access to the yards, the movement of the animals was limited and they stayed only in the stables where they were exposed to the effect of unfavourable microclimatic factors. The results of the air environment study showed that in the buildings for heifers breeding an optimum temperature-moisture conditions were not maintained. The average ten days temperatures in summer varied between 21,8 and 26,6°C and considerably exceeded the optimum temperature for this kind of animals. The summer ten-days higher temperatures reached 31,2° C and removing their adverse effect on the animals was not done. During the winter the tendays higher moisture reached 84-92% and considerably exceeded the hygienic standard. The air movement speed in the premises was between 0,094 m/s in winter and 0,423 m/s in summer season. The registered air movement velocity in summer was not sufficient to provide for the animals the optimum quantity of cooling. The results from the gas analysis showed that during all the seasons in the premises it was found subtoxic doses of ammonia 0,014 -0,022 mg/dm^3. In isolated cases of long keeping of the manure in the channels under the grid, the ammonia content reached 0,03 mg/dm^3 and exceeded the allowed hygienic norm.

Table 1. Fertilizability of heifers depending on the breeding technology

Indices	1st technology	2nd techn.	3rd techn
Heifers (general number)	484	437	415
Age at first insemination (months)	15	15	15
Average age of fertilization (days)	538	492	513
Fertillized at first insemination (number)	252	341	251
Fertilized at first insemination (%)	52	78	60
Index of insemination	2,1	1,4	1,8
Heifers with sexual cycle under 18 days	13	7	7
Heifers with sexual cycle above 23 days	23	15	18
Miscarriages -uninfected (number)	4	2	-

The established physical and chemical factors of microclimate had the longest influence on the animals from the 1st technology which affected their reproductive functions. From the 2nd technology animals 78% were fertilized after the first insemination compared to 60% for the third technology and 52% for the first technology (table 1). The considerably lower fertilizability of the 1st technology animals was the reason for comparatively higher index of insemination (2,1 compared to 1,8 for the 3rd technology and 1,4 for the second one). As a result of the difference found in the index of insemination the heifers from the 2nd technology were fertilized at an average age of 492 days, those from the 3rd technology at an average of 513 days and those from the 1st technology at the age of 538 days.

Table 2. Course of parturition and post-calving period depending on the breeding technology.

Indices	1st techn.	2nd techn.	3rd techn.
Heifers with difficult parturition (%)	33,3	11,6	16,7
Retaining the placenta (number)	28	8	12
Rejected from breeding purposes as a result of lasting changes of the genitals (number)	12	1	1

An essential difference between the animals of the three technologies was also observed in the course of parturition and post-litter period (**table 2**). From the first technology heifers that calved 33,3% had to a certain extent difficulties during calving. From the second technology animals, the heifers with difficult calving were 11,6%, and from those from the third technology it was 16,7%. As a result of difficult parturition from the 1st technology 12 heifers with strong changes of the genitals were rejected and that was 2,5% from the calved heifers.

After analysing the data of the fertiliazability, the course of parturition and the post parturition period it was found that the best results were obtained with the heifers of the 2nd technology of pasture breeding during the summer season. Very close to them were the results from the third technology heifers with assured movement along a trace route. Comparatively the lowest results were those from the 1st technology because of the strong restriction of movements of the animals and the long effect of unsuitable microclimate.

Conclusions

1. The pasture breeding and the active movement have a favourable effect on the reproductive functions of heifers and should be obligatory included in the relative technologies.

2. The breeding of heifers in closed premises on slotted floor with access only to a yards lead to low fertilizability, difficult calving and complications during the post -litter- period.

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Fast temperature sensor in milk flow - the diverse source of information for the health control and the process of milking

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Summary

The temperature dynamics of fast sensors in milk flow can serve as an multipurpose index and could be used as a parameter for automated health control systems. Its maximum temperature value will strongly correlate with the body core temperature. The temperature fluctuation frequency characterizes the pulsation rate of the vacuum, and the current temperature peaks of the fluctuation cycles in combination with the temperature integral could serve as a measure for milk flow intensity.

Key words: cow, milk temperature, rectal temperature, milk flow, vacuum pulsation, milking process

Introduction

The high production potential of dairy cows will be realized mainly by good feeding, proper milking and effective health control which is most effective with the use of special monitoring systems based on automation. Temperature sensors in milk flow have a long lasting use for the automatic estimation of body core temperature of the cows (Schlünsen ea. 1981). In these cases relatively slow sensors are preferred as temperature alterations caused by milk flow have considered to be disturbing factors. But the signal fluctuations caused by the pulsing milk flow contain beneficial information.

Methods

Fast NTC-resistor sensors have been integrated into the different places along the milk flow path of a bucket milking machine: in teat cup, claw and long milk tube. Temperatures of these sensors, milk flow rate in milk tube and the pulsation have been registered during the milking process by a computer based data acquisition system. Temperature signal have been digitized with an on-line controller and the data were stored onto the disk of the computer.

To preprocess the data, special software for the investigation of time sequence curves were used which enabled estimate the length, peak height and integral of subsequent "temperature waves" (Praks, Miil 1993). Given numbers were later processed statistically by the EXCEL spreadsheet program.

Results and analysis

An example of the course of the milk flow and temperature data from milk tube are shown on **Fig. 1**. This non-typical chart was chosen to show the reflection of the cows behaviour on data. Soon after the start of milking, the milk flow (Q/T) has been ceased by the urination (duration of which is indicated with points P1 and P2). It caused the stop of milk flow and the temperature fluctuation peak values lessened gradually for several degrees (curve t1).

With the new start of milk flow at point P2 milk temperature fluctuation peak value went up again and reached soon its maximum level. With decreasing milk flow at the end of milking the temperature values decreased again. A slight increase at point P3 was caused by the post-stimulation of the udder.

The changes in milk flow rate changed also the temperature integral of the fluctuation period (S1). At higher flow rates temperature fluctuations in milk tube were more apparent and vice versa.

The correlation between milk flow rate and temperature peak value in milk tube was 0.68.

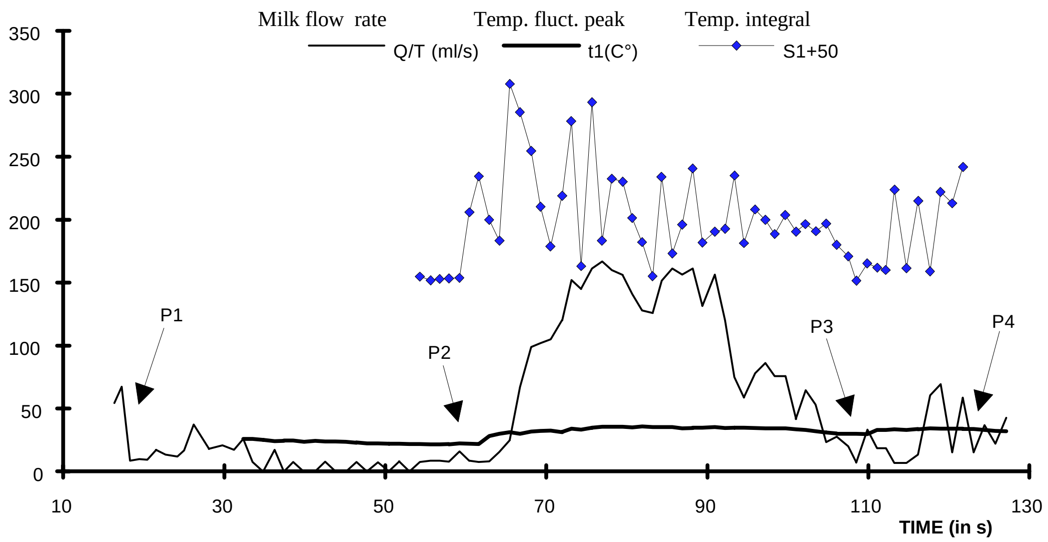

Fig. 1. Milk flow rate Q/T, milk temperature fluctuation peak value t1 and the temperature integral S1 (relative units) of the temperature wave

The milk temperature dynamics of the same experiment measured at the inlet of the claw (right back and right front teat) is given on **Fig.2**.

A regular undulating form of the temperature curve at the new beginning of milk flow (chart A) was in clear relation with the vacuum pulsation P. The temperature values grew rapidly approaching the rectal one.

At maximum milk flow (chart B) these temperature waves were still present but hardly distinguishable and the temperature curves nearly reached the rectal temperature value.

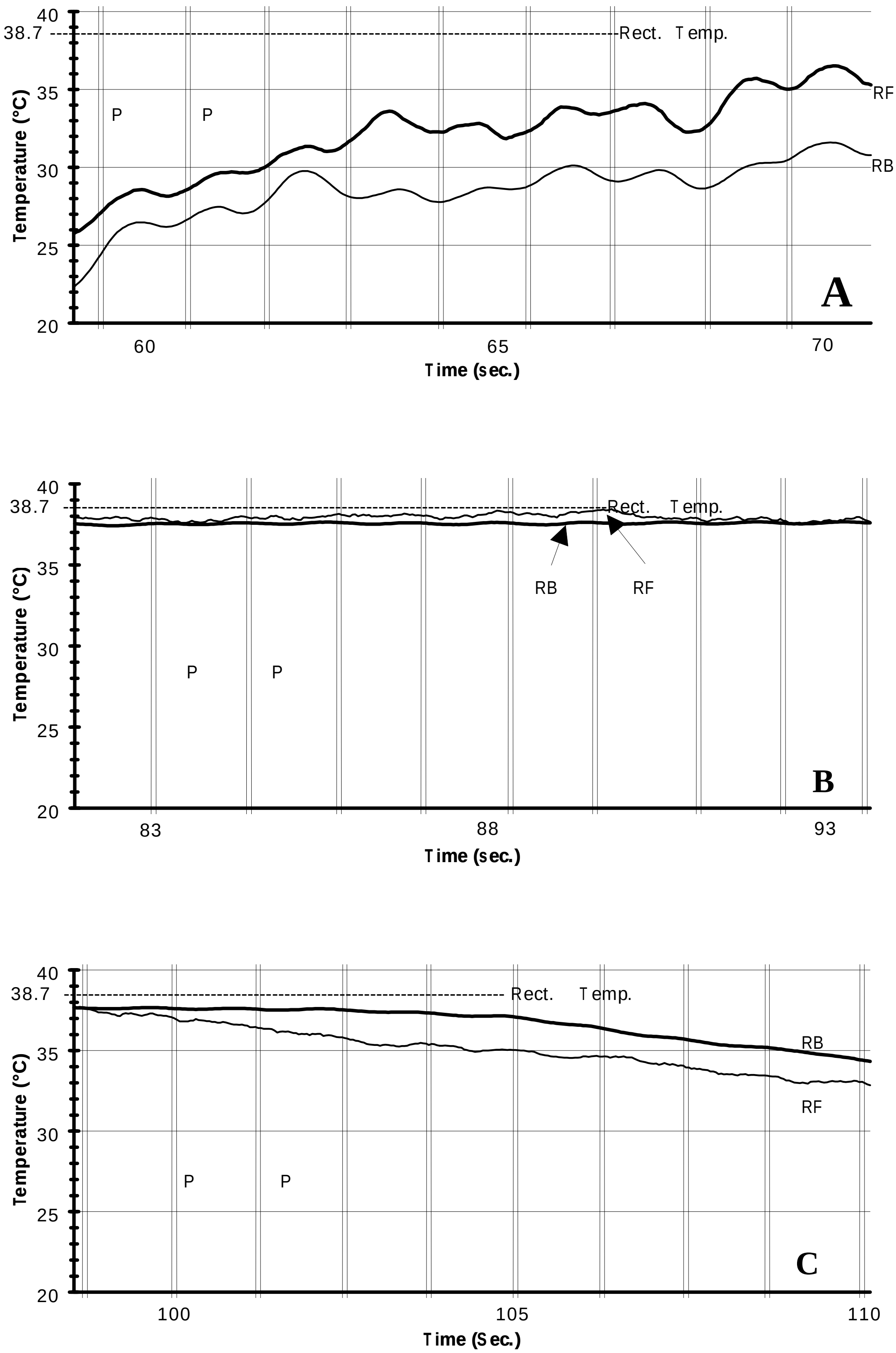

Fig.2. Milk flow temperature pattern at right side inlets of the claw. At the start of milk flow: chart A; during maximum flow: chart B and at the end phase: chart C.

At the end phase of milking (chart C), the temperatures started to decrease quite rapidly and more distinctive wavy form of the curve appeared again.

The mean statistical data of the experiment were the following:

	Temp. peak value	Temp.integral (S)	Temp. fluct. range
Start of milk flow	31.2 °C	53	0.68 °C
Max. milk flow	37.9 °C	8.2	0.18 °C
End of milk flow	37.2 °C	10.3	0.18 °C

Conclusions

The registration of temperature dynamics with fast temperature sensors in milk flow enables us to get information about the status of cow and milking process. The maximum value of temperature could be used for the traditional estimation of the body temperature of cows.

Fast temperature dynamics registration gives specific information about the milking process and the vacuum pulsation in milking unit. These aspects could be beneficial in the automation of cows' health monitoring and milking.

The temperature fluctuation data of the sensors in milk tube and at the inlets of the claw depend differently from the stage of milking and milk flow rate.

Further studies will be needed to reveal the possibilities and expediency for design of special equipment to be used in everyday practice.

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Comparative study of microwave and thermodynamic temperatures on cows

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Summary

The present study has been carried out to evaluate the distribution and differences between microwave and thermodynamic temperatures along the surface of cow's body. The microwave thermometer used measures 1.5 GHz microwave energy radiated by the body. The charts of microwave and thermodynamic temperature distribution along the cows body surface have been constructed. When using microwave thermometry for cows body core temperature estimation, the relatively strong influence of skin surface thermodynamic temperature should be taken into consideration.

Key words: cow, microwave temperature, body core temperature, skin temperature

Introduction

The microwave thermometry is a perspective method for the determination of temperature of biological objects. It has a good sensibility and is sufficiently rapid for automated measurements. For the estimation of the temperature of biological objects the microwave thermometry has several advantages. It is the only known method to get non-invasively temperature information from the inside of the body, has good sensitivity and is fast. At a stable environmental temperature the microwave temperature in several areas of the cow's body has showed up high correlation indexes with rectal temperature. It has also been established that the correlation between microwave and rectal temperatures decreased drastically at changing environmental temperatures when the microwave temperature correlated more closely with the skin surface thermodynamic temperatures (Poikalainen 1995). The current study was carried out to get microwave and thermodynamic skin temperature distribution along the cow's body surface.

Method

The microwave thermometer RT-20 with the ceramic antenna selective to 5 GHz frequency, has been used. This equipment has been worked out at the Institute of Radiotechnics and Electronics of the USSR Academy of Sciences and firstly approved on cows in cooperation with the Estonian University of Agriculture (Boravskij ea. 1985).

The accuracy of the microwave thermometer and the thermodynamic thermometer used was 0.2°C and 0.1°C respectively.

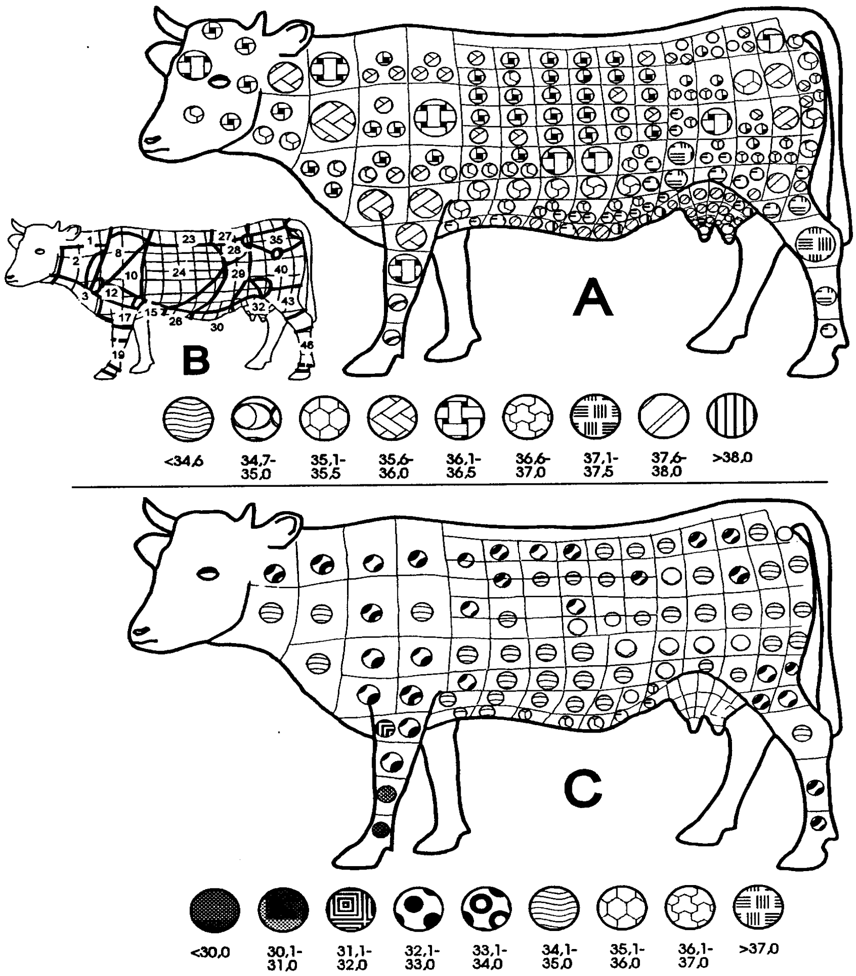

Figure 1. Distribution of microwave (A) and thermodynamic skin surface (C) temperatures on the left side body regions (B): 1. Regio colli dorsalis; 2.R. colli lateralis; 3. R. colli ventralis; 8. R. scapularis; 10. R. tricipitalis; 12. R. brachii; 15. R. sternalis; 17. R. antebrachii; 19. R. metacarpi; 23. R. vertebralis thoracis; 24. R. costalis; 26. R. xiphoidea; 27. R. lumbalis; 28. Fossa paralumbalis; 29. R. abdominalis lateralis; 30. R. umbilicalis; 32. R. uberis; 35. R. glutea; 40. R. femoris; 43. R. cruris; 46. R. metatarsi.

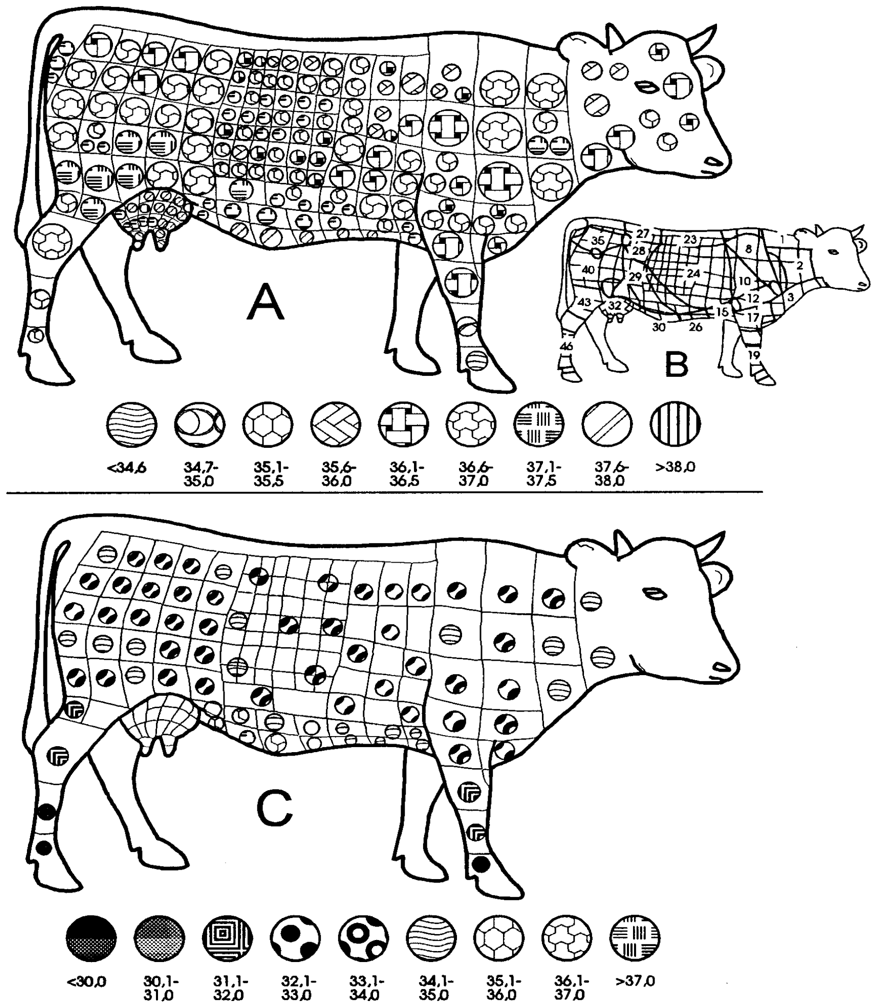

Figure 2. Distribution of microwave (A) and thermodynamic skin surface (C) temperatures on the right side body regions (B): 1. Regio colli dorsalis; 2.R. colli lateralis; 3. R. colli ventralis; 8. R. scapularis; 10. R. tricipitalis; 12. R. brachii; 15. R. sternalis; 17. R. antebrachii; 19. R. metacarpi; 23. R. vertebralis thoracis; 24. R. costalis; 26. R. xiphoidea; 27. R. lumbalis; 28. Fossa paralumbalis; 29. R. abdominalis lateralis; 30. R. umbilicalis; 32. R. uberis; 35. R. glutea; 40. R. femoris; 43. R. cruris; 46. R. metatarsi.

The cows' whole body surface was divided (using anatomic region as a basis) into 550 spots from which the measurements have been carried out during 3-week period. Ambient air temperatures were kept stable on the level of 9°C with the accuracy of 1.5°C.

Results and analysis

The temperature charts of cow's body surface (both microwave and thermodynamic temperature) are depicted in Figures 1 and 2. Spots with higher microwave temperatures are situated at regions of udder, lower part of the abdomen and perineum. The lowest microwave temperatures had the regions of legs, head and ribs. The rectal temperature altered between 38.4°C and 38.8°C during the experiment.

The differences in microwave temperature between the neighboring areas principally follow the pattern of the skin surface thermodynamic temperature differences of the same areas. As a mean, the absolute values of these two types of temperatures differed 2-3°C in favor of microwave temperatures. Greater discrepancies were on limbs (3-5°C). Some corresponding regions of the right and left side differed also to some extent. The microwave and thermodynamic temperature measurements of 4 control spots carried out on experimental days showed up alterations of 0.5-1.0°C and 1-2°C respectively.

Conclusions

The microwave thermometry is a perspective research method and suitable for the automated determination of cows body core temperature in the future. The data about microwave and thermodynamic temperature distributions along the cows' body surface facilitate to find out suitable spots for the measurement.

When using microwave thermometry on animals it is necessary to take into consideration the influence of skin surface thermodynamic temperature of the same place.

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The importance of operations associated with milking in prevention of mastitis in cows.

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Summary

The objective od this study was to establish the effect of the correct milking operations on yield, composition and quality of milk. Observation were performed in 1992-94 on 133 cows. It was found that neglecting the pre-milking decreased milk quality and worsened the health condition of udder. This was confirmed by a significant increase in intensity of the Californian Mastitis Test by 0,12 points and number of somatic cells by almost 100 thou/cm^3 . Giving up of milking dry significantly decreased the level of milk fat.

Key words: mastitis, milking prevention, dairy cattle

Introduction

In prophylaxis of udder diseases the most important role is played by well trained milkmen. Milking which apparently look like a simple operation is in assence a compound process. It refers especially to mechanical milking which done incorrectly may be a reason of mass udder diseases (4).

The objective od this study was to establish the effect of the correct milking operations on yield, composition and quality of milk.

Material i methods

The investigation was carried out since January, 1992 throughout December 194 in two dairies in the province of Elbl¹g. The experimental material were 133 BW cows. In both dairies milking was performed twice a day using conduct milkers. The management were boxes and pasture. Once a month detailed analyses were performed of yield and composition of milk on the basis of milk recording as well as the milk quality on the basis of physicochemical analyses: density, pH, and Californian Mastitis Test and Somatic Cells Count.

Results

The results of yield of milk, fat, protein, lactose and dry matter for 305 days of lactation divided into groups of cows managed by 6 milkmen are presented in Table 1. The mean milk yield in the herd was 4901 kg and the differences between groups reached over 470 kg (milkman No. 6 - 5158 kg; milkman No. 3 - 4681 kg). So great differences resulted from, first of all, differences in realizing the operations asociated with milking. The milkman No. 6 performed all operations correctly while the milkman No. 3 washed the udders in series, which resulted in extension of the period from washing and massage to the moment of putting up teat cups, and shortening the time of the effective let-down milk reflex. Winnicki and Miara (5) report after Mayer and Bruckmeier (1987) that the practice of serial washing of udders with putting up of teat cups late results in a drop in milk yield which for the time longer than 3 minutes amounts to 0,5 kg/milkinh and over 10 minutes as much as 0,9 kg. The milkmen responsible for groups 3, 5 and 6 obtained a higher percentage fat content than the average of the whole herd (3,85 %). Provided, that in groups 5 and 6 a high fat content (3,88 % and 3,96 %) is associated with a high milk yield, which is an evidence of correct milking dry the high level of fat in group 3 results from a low milk yield and a negative correlation between the yield and the content of constituents of milk. The same is true of protein. The milkmen No. 6 and 2 secured from "their" cows the highest quantities of milk: 5158 kg and 4981, respectively, of a low protein content (3,02%) while the highest protein level was found in group 3 (3,06%) at the lowest milk yield amounting 4681 kg. According to Dobicki et al. (2), milk composition changes with time of milking. The closer to its end the milk is "richer" in fat (1,3). Shortening of milking and also neglecting the milking dry results in a decrease in milk fat content from 0,15% at milk yield of 12 kg to 0,33% at yield od 6 kg of milk. No relationship was found between the operations connected with milking and percentage content of lactose as well as physicochemical properties of milk (density and pH). The content of dry matter was found to be connected with milk fat. Higher fat levls in the milk were accompanied by higher contents of dry matter. Significant differences were found between groups of cows in relation to the udder health condition as determined by Californian Mastitis Test and the number of somatic cells. The highest number of somatic cells was found in the milk from the cows of groups 1 and 3 (275 thou/cm^3 and 241 thou/cm^3, respectiveley) in which the milkmen milked dry sporadically. This effected a significant increase in the number of somatic cells as compared with the remainding groups in which premilking was performed sporadically. This was confirmed statistically for group 3. The negative effect of the lack of premilking is evidenced by the worst indexes of health condition observed in the same groups of cows.

Summing up and conclusion

The analysis of the correctness of performing the milking operations by the milkmen showed that:

1. Giving up the pre-milking resulted in decrease in milk quality and worsening the health condition of the udder. This was confirmed by a significant increase in intensity of the Californian Mastitis Test by 0,12 points and number of somatic cells by almost 100 thou/cm^3.
2. Dropping of milking dry significantly decreased the level of milk fat.

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Table 1. Milk and composition of milk for 305 days of lactation in cow groups serviced throught particular milkmen

Milk and composition of milk for 305 days of lactation in cow groups serviced throught particular milkmen **Table 1**

Specification	Milkmen												Average	
	1		2		3		4		5		6			
	$\bar{x}$	v	$\bar{x}$	v	$\bar{x}$	v	$\bar{x}$	v	$\bar{x}$	v	$\bar{x}$	v	$\bar{x}$	v
Milk yield (kg)	C 4837.26	34.00	A 4981.10	36.63	AB 4681.33	35.56	4869.42	34.98	4869.98	36.43	BC 5158.31	36.89	4901.48	36.45
Fat content (%)	3.84	11.45	A 3.81	11.34	3.86	10.06	a 3.82	10.81	Aa 3.88	10.26	3.86	10.22	3.85	11.48
Protein content (%)	Ab 3.01	8.33	ac 3.02	8.51	Aa 3.06	9.13	b 3.04	8.15	3.04	8.28	c 3.02	8.27	3.03	9.31
Lactose content (%)	4.83	8.51	4.83	7.89	4.83	8.86	4.82	6.27	4.82	8.89	4.82	7.82	4.82	8.93
Dry matter content (%)	ef 12.48	9.43	ab 12.46	8.61	ace 12.55	8.41	cd 12.48	7.32	bdf 12.55	8.19	12.50	8.28	12.50	9.14
Density of milk (g/cm^3)	1.0297	0.15	1.0298	0.16	1.0300	0.15	1.0300	0.15	1.0298	0.15	1.0299	0.14	1.0299	0.16
pH	6.66	0.27	6.66	0.28	6.66	0.27	6.66	0.27	6.66	0.22	6.66	0.30	6.66	0.28
CMT(points)	A 1.24	48.83	1.14	41.05	B 1.23	47.66	AB 1.12	40.39	1.19	45.90	1.14	45.09	1.19	48.09
Somatic Cells Count (thou./cm^3)	241.63	209.66	A 177.23	248.53	ABC 275.31	156.06	C 189.91	255.08	223.67	215.96	B 181.09	249.57	213.87	221.63

Values marked in line the same letters differ statistically:
capital letters - differences significant on level $\alpha = 0.01$ small letters differences significant on level $\alpha = 0.05$

Preliminary results of unilateral collapse load of the teat cup liner on teat tissue.

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Summary

This project was carried out to see whether the effect of continuous unilateral collapse load (UCL) could be measured experimentally. The effect of longer uninterrupted experimental application of UCL comparing with control group was examined with total and differential somatic cell count (SCC), and cutimeter measurements. There were significant differences of least square means between treatment and control for teat thickness after cluster removal, teat thickness decreasing in treatment group. Unfortunately the total and differential cell count did not react to our treatment.

Key words: milking machine, mastitis, teat tissue.

Introduction

An earlier study (Sender and Mayntz, 1996) showed that the milking units were not used random in 8 of 17 tied up stalls. Because all liners collapse always in the same plane during their lifetime, many cows run the risk of being milked often with the same liner and thus are submitted to the same unilateral collapse load (UCL) during milking at every pulsation, i.e. every second.

There were two unpublished observations dealing with the influence of milking machine on the teat tissue. The first one was the initiative research on trauma incidence in the teats of milking cows. The main diagnostic tool was an endoscop used for the inspection of the teat sinus *in vivo*. It has been seen in some cases areas of redness on the mucosa of the teat sinus after milking. Areas of high-grade hyperaemia of the mucosa had been observed sometimes as two longitudinal stripes placed opposite to each other (Bendixen and Ekesbo, 1982). The second one was the voluntary-milking experiment. The cows entered voluntarily a concentrate feeding station and were milked there always with the same cluster as only a 3-hours gap had passed since the last milking. The cows developed periodically severe, infected hyperkeratosis on teat tips. The infected areas always had the form of one narrow, well demarcated stripe across the teat tip.

This project was carried out to see whether the effect of continuous UCL could be measured experimentally with total and differential somatic cell count (SCC), or cutimeter measurements.

Material and methods

There were two experimental design with slightly changed conditions: ”Collapse plain I” and ”Collapse plain II”.

In „Collapse plain I” there were used 16 Holstein Friesian cows with low cell count of the experimental herd of the Institute of Animal Breeding and Genetics of the Polish Academy of Sciences. Experimental design was changed over within two periods of 6 days each, separated by an adoption period of 4 days. In every period one front teat was milked with a fixed (treatment, T) and the other front teat with a daily randomly changed liner collapse plain (control, C). Between the periods the treatments were switched between the front teats. The control liner collapse plain was changed daily according to a random scheme representing a minimum difference of 20° between two consecutive positions. During the adoption period only the control treatment was applied. Probes for cisternal and stripping total somatic cell count (SCC) were taken on the first, the third and the sixth day of each period. Measurements and probes were taken during morning milking, treatments, however, were applied on all milkings. All experimental cows were milked with Duovac-units. The cluster was taken of exactly 30 seconds after the „low-flow” signal had appeared. Therefore the „after-measurements” with the cutimeter were started immediately. The „before-measurements” were principally carried out as close to the moment of cluster putting on as technically feasible.

In „Collapse plain II” 11 high yielding Swedish Red cows at the Experimental Station of the Swedish University of Agricultural Sciences in Skara with low SCC were selected. There were some changes of experimental procedure. The experimental periods were longer and last 7 days each with 3 days adoption period. Additionally, the probes for differential cell count were taken on the first, fourth and seventh day in the following way:

two hours after cluster taking off, the teat was blocked with thumb and forefinger at its base and the teat sinus was stripped with the same fingers without loosing the blockage. Thereaftere the probes were treated as described in Östensson et al. (1988). The collapse plain of the control treatment was changed after every milking with minimum difference of 40° between two consecutive positions. Clusters were taken off immediately after the low-flow signal and therefore cutimeter measurements were done about fifteen minutes after cluster taking off in order to let the almost regulary appearing contraction of the teat after cluster removal disappear spontaneously.

The data for SCC (total and differential) were logarithmically transformed. To find differences in total and differential SCC, or cutimeter measurements, between control and treatment teats, an analyse of variance was performed.

Results

Longer uninterrupted experimental application of UCL comparing with control group did not effect total and differential SCC (**Table 1**).

Table 1 Least square means of logarithm of total and differential SCC.

	Total leukocytes	*Neutrophils*	*Monocyte-macrophages*
Control	2.17	1.07	2.14
Treatment	2.17	1.11	2.14
Control-day 1	2.23	1.14	2.21
Control-day 4	2.23	1.08	2.19
Control-day 7	2.06	0.99	2.02
Treatment-day 1	2.19	1.32	2.16
Treatment-day 4	2.17	0.98	2.14
Treatment-day 7	2.15	1.04	2.12

There were significant differences of least square means between treatment and control group for teat thickness after cluster removal measure with cutimeter. Teat thickness decreased in treatment group (**Table 2**).

Table 2 Results of variance analyse for teat thickness after cluster removal

	Collapse plain I			*Collapse plain II*		
Source of variance	df	F	p	df	F	p
cow	15	28.6	0.0001	10	91.9	0.0001
treatment	1	5.2	0.0240	1	12.1	0.0006
day(treatment)	10	2.5	0.0090	12	4.5	0.0001

Discussion

The results of total and differential SCC did not confirm that UCL might influence the teat tissue. It can be explained by two reasons. Concerning the treatment: Either there were no treatment effects or treatments were not applied in a proper way. Concerning differential cell count: The probes did not represent the „milk which rested in the teat sinus long enough to ensure the accumulation of cells". There are some arguments concerning possible treatment failures: Irrespective that the treatment liner collapse plain was kept constantly parallel with the long milk tube, the actual position on the cow was always slightly changed, sometimes indeed, to an astonishing extent. These changes derived from random differences in the milkers routine and/or from the cow's momentary position during putting on. Despite of such a procedure corresponding well to farm conditions, the treatment should be to the point when an effect is to be identified in a limited experiment.

Despite of extremely careful application, cutimeter measurements failed to detect treatment effect. There were significant differences of least square means between treatment and control for teat thickness after cluster removal, teat thickness decreasing in treatment group. However these unexpected results, put the question whether, and eventually to which extend, the results from measurements with the spring-loaded cutimeter are biased by occasional contraction of the smooth muscles in the teat tip.

These are only the preliminary results. The experiment will be repeated with a better control application of the treatment and additional physiological parameters.

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Usage of iodophoric ointments for prevention of cow udder skin diseases

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Summary

Iodophoric preparations Aseptolis and Jodalis were tested for disinfection after milking of udder teats of 163 cows. Iodophoric ointments Aseptolis and Vortinas were tested for treatment of cow udder skin diseases. It was determined that disinfection after milking of udder teats with iodophoric preparations for five months decreased the number of subclinical mastitis by 1.25-1.4 times, clinical - twice. The comparison of iodophoric ointment for prevention of cow udder skin diseases revealed that Vortinas is more effective in preventing the teat warts (efficacy 70%) and suppurative udder and teat wounds (efficacy 93.3%). Aseptolis is more effective in treatment of udder skin fissures and dermatites (efficacy from 80% to 100%).

Key words: udder skin diseases, iodophoric preparations, antiseptic substances

Introduction

The effectiveness of mastitis prophylaxis in large depends on the efficacy of applied antiseptic preparations. Chlorine and iodine preparations are most commonly used as antiseptic substances for prevention of mastitis (Boddie et al. 1990, Fang W. et al. 1995; Grindal R. et al. 1989; Oliver S. et al. 1989; Poutrel B. et al. 1990). Iodophoric preparations bactericidically effect Gram-positive and Gram-negative bacteria and pathogenic fungi. The applications of 0.1% to 0.5% iodophoric solutions for cow udder teats disinfection after milking the number of mastitis cases provoked by staphylococci and streptococci decreased by 20% to 61.5% (Boddie et al.1990; Grindal R. et al. 1989; Hogan J. et al. 1990).

The warts, wounds and sores on cow udder teats is rather a problem for stock-breeding specialists. Iodophoric ointments, which are characterised by an antiseptic, antimicrobial and drying effect, can be successfully used for prevention of these diseases. They are also effective against inflammation of skin and mucous membrane and various other diseases (Boddie et al.1990; Nickerson S. et al. 1990).

The aim of the present work was to test the prevention efficacy of complex iodophoric preparations Jodalis and Aseptolis. We also tested the efficacy of iodophoric ointments

(Aseptolis and Vortinas) for prevention of cow udder skin diseases. The iodophoric preparations have the following concentration of iodine: Jodalis - 0.2%, Aseptolis - 0.33%, Vortinas - 5%.

Material and methods

The efficacy of Jodalis was tested by disinfection of udder teats of 63 cows after each milking. The udder teats of 61 cow from the control group were not disinfected. The experiment lasted for 5 months. During the experiment the cows were clinically examined. Every 15 days milk samples were tested for mastitis.

The efficacy of Aseptolis ointment for prevention of mastitis was tested by oiling the teats of 100 cows after milking. The teats of 100 cows from the control group were not oiled. The experiment lasted for 5 months. For one month the content of iodine is the milk of experimental cows (titration method) and blood (colourimetric method) was examined.

The ointment Vortinas was tested for treatment of cow udder skin diseases. For this purpose 45 cows were selected with udder skin diseases (skin fissures, suppurous wounds on udder and teat skin, dermatites, warts). The damaged skin surface was once per day oiled with Vortinas ointment. The treatment of suppurous skin wounds the application of the mentioned ointment was interrupted when the wounds became clean and the processes of granulation and epithelization set in. For elimination of warts they were oiled with Vortinas ointment daily for 5 to 10 days (the duration of application depended on the size of warts and degree of their spreading). Before the application of ointment on teats and 2, 15 and 30 days after the application the milk of 10 cows was tested for the content of iodine.

51 cow with similar udder skin diseases were treated with ointment Aseptolis.

Results

Table 1 shows that the preventive efficacy of 0.2% and 0.33 % iodophoric preparations Jodalis and Aseptolis differ but little. The disinfection of cow teats after milking with Jodalis solution for 5 months reduced the number of mastitis cases to 19.0%, Aseptolis ointment 15%. Whereas, in control group the number of mastitis cases was from 1.25 to 1.4 times (21-24 %) as large. In the experimental groups, the cases of clinical mastitis reduced twice.

The data in **figure 1** show that on the second day after application of Aseptolis on teats the content of iodine in milk increased twofold ($P<0.001$), whereas, on the 15th and 30th days of experiment - almost threefold ($P<0.001$). The content of total iodine in the blood plasma of experimental cows on the 15th day of experiment increased by 15% ($P<0.01$), whereas, on the 30th day - by 18% ($P<0.05$).

The investigation of the efficacy of iodophoric ointments for prevention of cow udder skin diseases revealed (**Table 2**) that Vortinas is more effective for prevention of teat warts (efficacy 70%) and suppurous udder and teat skin wounds (efficacy 93.3%). Aseptolis was inefficient in treating teat warts (efficacy 33.3%). However, in prevention of skin fissures and dermatites the efficacy increased from 80% to 100%. After application of iodophoric ointment the udder skin becomes softer, the teats become less painful. Figure 1 shows that already on the second day after application of Vortinas on teats the control of iodine in milk statistically reliable increased to 45.6±1.54µg/l. In the following days the content of iodine changed but little, however, if compared with the data obtained before the experiment its content was statistically reliable higher.

Discussion

The conducted investigation revealed that 0.2% and 0.33% iodophoric preparations used for cow udder teats disinfection decreased the cases of subclinical mastitis in cows by 20% to 28.5%, clinical mastitis - twice. The decrease by 20% to 61% of the cases of mastitis after application of 0.1% to 0.5% iodophoric solutions for disinfection of cow udder teats was also determined by other authors (Boddie et al. 1990; Grindal R. et al. 1989; Hogan J. et al. 1990).

We determined that 0.33% and 5.0% iodophoric ointments can be used for prevention of udder skin diseases. For treatment of skin fissures and acute dermatites the low concentration (0.33%) Aseptolis ointment is more efficient, whereas, for prevention of teat warts and suppurous skin wounds Vortinas ointment (5%) is the better one.

The data obtained show that after application of iodophoric preparations Aseptolis and Vortinas the iodine contained in their composition penetrates through the skin and into milk. However, the increase of iodine in milk and blood does not exceed the physiological norm. It was determined by the scientists of the republic that the content of iodine in cow milk in Lithuania is from 26µg/l to 40µg/l, whereas, the physiological standard should be from 70µg/l to 90µg/l. The lack of iodine was determined, on the initiative of UNICEF, in the human organism. A program of concrete measures is under development. Therefore, the negligible increase of the content of iodine in milk after the application of iodophoric preparations will play a positive role in combating the deficiency of iodine in the human and animal organisms.

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Table 1. Prevention efficacy of antiseptics

Table 2. Efficacy of iodophoric ointments for prevention of cow udder skin diseases

Figure 1. The content of iodine in cow milk and blood sera after application of iodophoric ointments.

Table 1. Prevention efficacy of antiseptics

Name of preparation	Number of cows	Group	Number of cows with cases of mastitis													
			In a month		In 2 months		In 3 months		In 4 months		In 5 months		Total			
			subcl. mast.	clin. mast.	subcl. mast.	clin. mast.	subcl. mast.	clin. mast.	subcl. mast.	clin. mast.	subcl. mast.	clin. mast.	cows	%	subcl. mast.	clin. mast.
Jodalis	63	treated	2	0	2	0	3	0	2	1	2	0	12	19.0	11	1
	61	control	2	0	3	1	3	1	2	0	2	1	15	24.6	12	2
Aseptolis	100	treated	2	0	3	0	2	1	4	0	3	0	15	15.0	14	1
	100	control	2	0	4	1	4	1	3	1	5	0	21	21.0	18	2

Table 2. Efficacy of iodophoric ointments for prevention of cow udder skin diseases

Name of preparation	Number of treated cows	Udder skin diseases	Efficacy of treatment (number of cured cows after some days)							
			4	5	6	7	8	9	Total	%
Aseptolis	6	teat warts	-	-	-	1	1	-	2	33.30
	20	teat skin fissures	5	10	5	-	-	-	20	100.00
	15	suppurous udder and teat skin wounds	2	6	2	-	-	-	10	66.6
	10	chronic dermatites	-	2	5	1	-	-	8	80.00
Vortinas	20	teat warts	-	2	4	6	2	-	14	70.00
	15	suppurous udder and teat skin wounds	4	6	4	-	-	-	14	93.30
	10	chronic dermatites	-	3	4	2	-	-	9	90.00

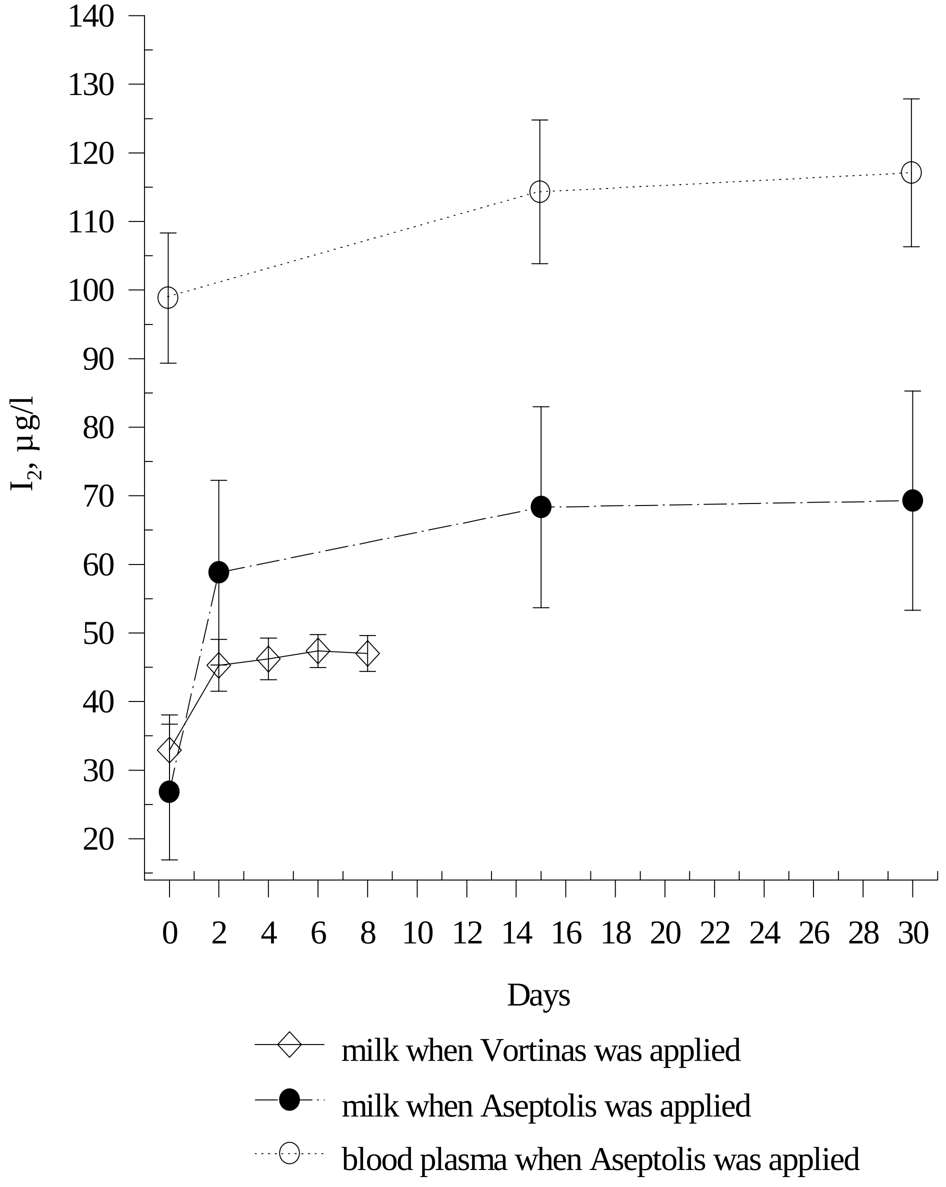

Figure 1. The content of iodine in cow milk and blood sera after application of iodophoric ointments.

Present situation of Bovines housing and management in Turkey

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Summary

The total bovine population of Turkey is 11 789 000 head. Today cosmopolitan, domestic and cross-bred ones form 14.4, 45.5 and 40.5 % of the bovine population respectively. Generally domestic and cross-bred cattle are raised in extensive and semi extensive systems respectively. And the units which apply both systems are small family units and in both systems pasturing is essential in feeding. In these systems, 1-5 animal found in each family in the village are taken to the village pasture and they graze all together all the day on the pasture. Because of this reason diseases are spread out and contamine from animal to animal very easy. That's why, epidemic diseases raise very often in various regions of Turkey. In addition the rates of the barns that have necessary conditions to raise animal are very low. For example in many village, animals are housed underneath of the houses. In these barns, ventilation is not adequate. Even, windows and doors are closed tightly. For mentioned reasons there are some problems in bovine hygiene in Turkey.

Key words: bovine, Turkey, housing, management

Introduction

The total cattle population of Turkey is 11 789 000 head. Cosmopolitan, domestic and cross-bred ones form 14.4, 40.5 and 45% of the cattle population respectively (**Table 1**). 5 885 590 of cattle population are milked animals (Anonymous, 1995a).

Table 1. The amounts of the bovines in various genotypes (x)

Genotype	Number (Million)	%
Cosmopolitan	1.4	14.4
Cross-bred	4.8	40.5
Domestic	5.3	45.5
	11.8	

(x): Anonymous, 1995a

Capacities of active bovine units in Turkey are given in **Table 2.**

Table 2. The capacities of active bovine units in Turkey (x)

Characteristics of the unit	Number	%
Family unit (1-4 head)	1 623 524	75.6
" (5-10 head)	395 044	18.4
Small unit (11-50 head)	113 830	5.3
Intermediate unit (51-100 head)	10 308	0.5
Large unit (>100 head)	3 979	0.2
Total	2 146 685	

(x) Anonymous (1995b)

As it is shown from Table 2, as a total of there are 2.146.685 bovine units including dairy, fattening and mixed (milk and meat) in various capacities. 94 % of all the units are small family units (1-10 head). 5.3 %, 0.5 % and 0.2 % of the units are in small (11-50 head), intermediate (51-100 head) and large (>100 head) capacities respectively (Anonymous, 1995b).

Breeding systems and housing

a) Dairy units

Three breeding systems can be classified on the basis of mainly components (feeding, keeping of animals, genotypes of bred, managerial technics, reproduction and other agricultural activities) as intensive, extensive and semi extensive systems. It can be said that cosmopolitan, cross-bred and domestic genotypes are raised in intensive, semi extensive and extensive systems respectively in Turkey. But in Turkey conditions semi-extensive system can not be distinguished from extensive system certainly.

In extensive and semi extensive systems the type of unit is small family unit in generally. And the aim of units are producing either only milk or milk-meat. In addition units are very spread out.

Extensive system strongly depend on natural factors. Animals graze all the year (or for a long period of the year) on natural pastures. 1-5 animal found in each family in the village are taken to the village pasture and they graze all together all the day there. Even, in some regions cattle are taken to the pasture and left from beginning of spring to end of the autumn season. Before taking to the pasture each breeder marks animals with his special sign. All coitions and calvings occur there. At the end of summer, breeders go to the pasture and collect their animals and bring to barns. Because this reason diseases are spread out and contamine from animal to animal very easy. That's why, epidemic diseases raise very often in various regions of Turkey. In generally, downstairs of the breeders' houses are used as barn in winter season. So, the barns have not necessary conditions to raise animal. In these barns, ventilation is not adequate. Even, windows and doors are closed tightly. For mentioned reasons there are some problems in bovine hygiene in extensive breeding system.

In Turkey, in dairy farming semi extensive system are applied on cosmopolitan breeds even in State Farms. Also in semi extensive system, pasturing is essential. Such as the units are set up in the place where generally at the marketing conditions are well to some degree.

Routine vaccines are implemented by Agriculture Directorates of Provinces regularly. In Turkey is any cattle breeding association yet. So, milk yield controls only are realized in State Farms, universities, research institutions and some private units that they were formed as related to some projects.

In generally the animals kept for breeding purposes are provided from State Farms, universities. But they are not adequate numbers.

Artificial insemination (AI) are implemented in the State Farms and some universities. Also AI are implemented by Agriculture Directorates of Provinces in their regions. But substructure is not adequate yet for AI in every regions of Turkey. The rate of AI implementation is approximately 20 % in Turkey.

Intensive system are only applied on cosmopolitan breeds in some private units. Such as private units' numbers are not much. In this Farms all the certain intensive breeding rules are adapted.

b) Fattening units

Intensive bovine fattening is getting increase from year to year in Turkey. Generally the fattening are implemented with in much number animals than dairying.

Young male animals from cosmopolitan breeds and their crosses are preferred for fattening. Male animals from domestic breeds (Especially East Anatolian Red and Native Black Breeds) are also taken to fattening. Also latters can be provide live weight gain to significant degree in fattening period. In addition these can be bought cheaper prices than cosmopolitan and cross-bred ones at the beginning of the fattening. In generally animals are provided for fattening from logical markets. Autumn or winter seasons are preferred for animal purchasing. 50 % of fattening barns are built as planned. In building of the barns almost all the breeders make use of various credit sources.

Fattening period is 4-6 months in generally.

Parasitic control, mineral, vitamin and vaccine applications are implemented.

In the fattening units, all the certain intensive fattening rules are adapted.

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Husbandry and Health Management System of Awassi Sheep in Bedouin Flocks in Syria

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Summary

This paper describes the performance and management of the Awassi sheep by the local Bedouin farmers in the Syrian Steppe.

Husbandry (management, body condition score and production under range conditions , age at puberty, level and quality of feeding and presence of rams, lambing age, lamb survival and lambing season) and its influence on the sheep diseases were discussed in this study.

Key words: Awassi Sheep, Syria, Management, Health

Introduction

The fat-tailed Awassi Sheep is indigenous to West-Asia. In Syria sheep are the main source of milk, meat and wool, accounting for about 69% of total meat production, 17% of milk production and 40 % of milk products. The value of sheep production is about 25 % of total agricultural production (Kassem, 1986).

Material and Methods:

Through the survey study of 73 flocks in 1991-1992 and the monitoring of 4 flocks from 1993 to 1997 the whole management system of the Awassi sheep flocks in Syria were studied, blood serum samples from all flocks were tested for some viral diseases and blood smears were examined for some parasitological diseases .The results were compared between the monitored flocks and those from the 73 flocks.

Feeding and Grazing Cycles:

The major source of sheep feed in Syria are native grazing, immature barley, mature barley, cereal stubble, and occasionally, irrigated crop residues. During winter other feeds are purchased from farmers or the market, and limited amounts are supplied by the General Organization of Feed at subsidized prices.

Flocks spent winter (December to February) at their base, which was either the village or in the steppe. Most ewes are pregnant and lactate during this period. The onset of lambing was little affected by season. In spring steppe grazing was usually the only source of nutrients for flocks since winter feeding finished in March. During summer, flocks returned to their winter base and were heavily dependent on cereal stubble, which become available in June. In the autumn most flocks were at their winter base although some were still in the villages in the higher rainfall areas. Flocks depended on the remaining stubble and native pasture.

Flock Structure and Production:

Descriptions of body condition are useful for the ensure the healthy status of the management. Hossamo et al (1986) have adapted the British system of body condition scoring for use in Awassi sheep. Six grades were used varied from 0 (extremely emaciated) to 5 (covered with fat).In our flocks grades 1,2 and 3 had the greatest practical implication. There was important association between ewe condition score at mating, lambing and the subsequent reproductive performance of single bearing ewes. Ewe lambs were mated successfully at puberty, during the first breeding season. But those who grow slowly were not sufficiently developed for normal sexual function in their first year, and the puberty was delayed.

All monitored flocks had rams with the flock all the year round and since some ewes were mated 60 - 80 days post-partum, it was possible for them to lamb 3 times per 2 years.

Neither season of birth nor type of birth affected lamb survival, ewes and their lambs were kept indoor when it was raining or snowing which affected lamb survival.

The results suggested that a high survival rate can be obtained by good management during pregnancy and after lambing especially in the cold weather conditions. Milking began in March when sufficient steppe grazing was available to support weaned lambs. Ewes which lambed in November and December were milked to provide yogurt for family consumption . At a later stage in lactation, ewes were milked once or twice a day mostly to produce cheese and this was associated with partial or complete weaning of lambs. Milking continued into April and May at a diminishing level but late lambing ewes lactated throughout the summer. The main output of the steppe flocks were lambs, milk products and wool.

Milk was converted into Yogurt (Laban), Cheese (Jibneh) and Ghee (Samneh). Sales of milk products represented up to one fifth of the total revenue of a flock . Sales of lambs and other sheep accounted for about 80 % of livestock revenue. 48 % of lambs born were sold, these being mainly males, and sales were in spring and summer when lambs were 3-8 months old. The Awassi sheep produces a coarse wool suitable for carpets and blankets. Adult sheep were hand sheared in late April and early May giving a mean fleece weight of 2.2 Kg per sheep.

The flock size varied between 100 - 500 head but the structure of the flocks was similar in all flocks.

Farmers in the different areas had mostly poor access to veterinary services, however, all flocks were visited annually by government veterinarians or vet.assistants for vaccination against sheep pox and enterotoxaemia, which are now successfully controlled in the national flock.

Mean mortality of ewes and rams was 9% and 6 %, respectively, but female yearling deaths were only 2 %. Mean mortality of lambs averaged 15 %.

In the most cases the farmers reported the symptoms of the sick animals as respiratory disorders, abortion, udder infections, walking difficulties, emaciation, worms and poor appetite.

The monitored flocks show a heavy invasion of lungworms as it is shown in **Tab. 1.**

Tab. 1. Average of lungworms in Percent in Awassi Sheep

		Protostrongylids			
flocks	D. filaria	Muell.	Cyst.	Prot.	Neos
1	55	20	36	2	9
2	40	52	60	10	25
3	39	50	50	8	25
4	49	26	70	15	25

The average of Toxoplasmosis, Theileriosis and Anaplasmosis are shown in **Tab.2.**

Tab. 2. Average of Toxoplasmosis, Theileriosis and Anaplasmosis in Awassi Sheep

flocks	Toxoplasma	Anaplasma ovis	Theileria spp.
1	15	80	80
2	20	88	90
3	19	90	85
4	20	70	80

The prevalence of Border Disease and Maedi Visna are shown in **Tab.3.**

Tab. 3. Prevalence of Border Disease and Maedi Visna in Awassi Sheep

Flocks	Border Disease	Maedi Visna
1	60	2
2	50	3
3	40	0
4	20	0

The prevalence of some other respiratory viruses are shown in **Tab.4.**

Tab.4. Prevalence of Parainfluenza-type 3, Respiratory syncytial, REO and Adenoviruses in Awassi Sheep

	PI3	RSV	REO	Adeno
Flock 1	35	80	20	2
flock 2	45	90	22	4
Flock 3	22	70	40	2
Flock 4	35	72	10	6

The prevalence of pest des petite ruminants and Bluetongue are shown in **Tab.5**

Tab.5 Prevalence of PPR and BT in Awassi Sheep

	PPR	**BT**
Flock 1	60	55
Flock 2	90	10
Flock 3	40	12
Flock 4	20	35

The following curves compare the results of the first survey from 1991-1992 in all Syrian provinces with the results of the monitored Flocks.

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Influence of the Management System on the Development of Sub-Clinical Mastitis in Dairy Farms in Syria

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Summary

This paper reports the preliminary incidence of sub-clinical mastitis in 3.696 udder quarters of dairy cattle in three farms in different locations in Syria.

The management system influences the development of the sub-clinical mastitis and shows a rate of 34.2% in one of them comparing with the other two farms (rates are 38.5% and 43.8%).Factors related to the incidence of this disease are also discussed.

Key Words: Sub-Clinical Mastitis, Dairy Farm, Management, Syria

Introduction

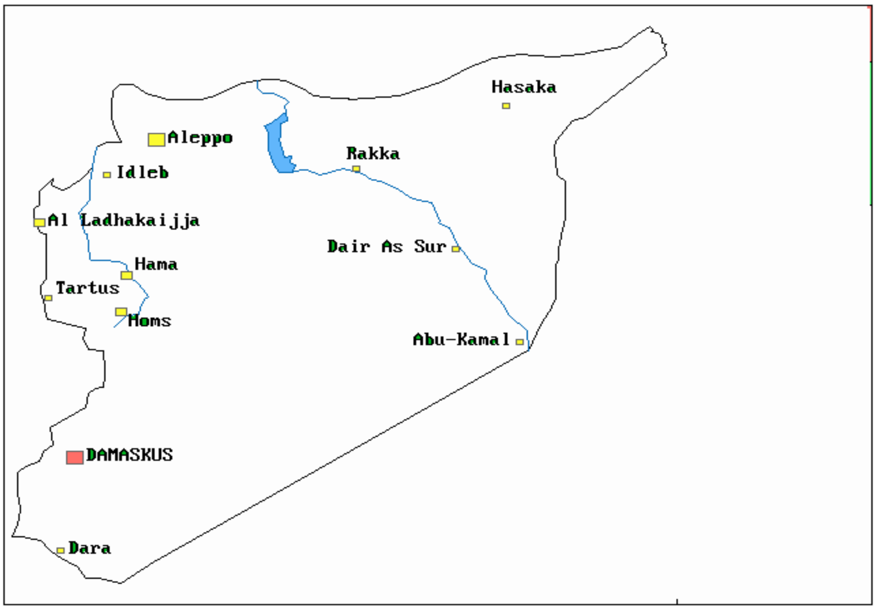
Large dairy farms are the most important supplier of milk in Syria. The Government established 10 dairy farms in different areas in the country ,which are run by the "General Organization of Cattle" with it's head offices in Hama (**Fig.1**).

The main breed in these farms are frisian and holstein-frisian. The high concentration of livestock in these farms reduces labor and operating costs, but increasing the risk of diseases.

A preventive veterinary medicine approach is the only way to insure the implementation of a complete and efficient animal health program in these farms.. Morbidity and mortality must be controlled. A small loss per animal unit multiplied by the total number of units on the farm could add up to an enormous economical loss.

Mastitis is one of the most important disease complexes affecting dairy cattle and is influenced by factors of environment and management. The relative importance of mastitis caused by environmental pathogens in dairy herds has increased (Erskine and others,1988; Booth 1993). More attention was given to the clinical form of the infection, but the sub-clinical mastitis causes a big loss in production and becomes mostly clinically apparent.

The aim of this study is to investigate the incidence rate of sub-clinical mastitis in 3 farms in the north, the middle and the south of Syria, and to study the relation between this disease and the management system.



▲ Location of the farms

Fig. 1 : The Location of the Governmental Dairy Farms in Syria

Material and Methods

Three dairy farms with a total of 2.901 heads were investigated for sub-clinical mastitis using two methods:

1- California Test

2- Universal Mastitis Detection System (Farmkey)

A questionnaire was prepared to get answers to factors influencing the occurrence of the disease. The herd structure of the three dairy farms is shown in **Table 1**.

Tab. 1. : Herd Structure in the three examined Dairy Farms at the Time of the Study

	Total Number	Dairy cows	Heifers	Bulls	Calves
Farm I	1.159	354	220	3	463
Farm II	685	276	318	9	82
Farm III	1.057	345	172	8	214

354, 230 and 340 dairy cows from the three farms were tested. The farms are ventilated naturally and two of them (Farm I & III) had a bad waste management system and open stables.

The cows were milked after the udder was cleaned with water and no drying or teat dipping was applied except in farm II.

Results:

The survey shows that approximately 5% of all examined cows were affected with clinical mastitis and only 14.4, 27.4 and 13.5% of all examined cows in farm I, II and III respectively were not affected. The occurrence of the sub-clinical mastitis is shown in **Table 2**.

Tab.2.: The Occurrence of Mastitis and Subclinical Mastitis in three tested Dairy Farms in Syria

	Farm I	**Farm II**	**Farm III**
Total number of examined cows	354	230	340
Number of cows not affected	14.4%	27.4%	13.5%
Number of quarters not affected	38.9%	56%	41.4%
Number of the dry quarters	9.1%	5.2%	9.2%
Clinical mastitis	6.1%	4.6%	5.5%
Sub-clinical mastitis + positive	7.3%	13.9%	11.5%
++,+++,++++ positive	38.6%	20.3%	32.4%

Between 40% to 55% of the teats were not affected and differences in the grade of infection were shown as in **Table 3**.

Tab.3.: The Occurrence of the Sub-Clinical Mastitis in Udder Quarters

	Farm I	**%**	**Farm II**	**%**	**Farm III**	**%**
Total Number of tested quarters	1416	100	920	100	1360	100
Quarters not affected	550	38.84	515	55.97	563	41.39
Dry quarters	129	9.11	48	5.21	125	9.19
Clinical mastitis	86	6.07	42	4.56	75	5.51
California Test +	103	7.27	128	13.91	156	11.47
++	227	16.10	82	8.91	147	10.80
+++	176	12.42	52	5.65	172	12.64
++++	145	10.30	53	5.76	122	8.97
Sub clinical mastitis	651	46.09	315	34.20	597	43.80

The high percentage of lameness resulting from claw problems were identified in farm I & III and only 7% of the cows in farm II had claw problems. The relationship between mastitis and lameness were significant in farm I & III (69.8% and 77.5%) compared with the results in farm II (28.5%).

The **Table 4** shows the comparison between the incidence of mastitis and claw problems in the examined dairy farms.

Tab.4.: Mastitis and Claw Problems in the Different Examined Dairy Farms

	Farm I	%	Farm II	%	Farm III	%
No examined cows	354		230		340	100
Claws problems	53	14.90	7	3.04	58	17
No examined quarters	1416		920			
Mastitis in quarters	86	6.07	42	4.56	75	5.51
Double infected (claw problems and mastitis)	37	69.80	2	28.5	45	77.5

Discussion and Conclusion :

From the results of our survey we found no differences between California Test and the Electrical Conductivity Test for detecting sub-clinical mastitis in contrast to the results of Nielen (1994), who found that the electrical conductivity was unsuitable for detecting sub-clinical mastitis.

The high incidence of mastitis in our dairy farms is related to the poor management system (poor hygienic conditions-bad practice of waste disposal-, insufficient maintenance, cleaning and disinfecting of the milking machines etc.), absence of herd health control, and the high number of cows being kept in these farms. Berry (1994) found that the low incidence of mastitis was related to good management practices and small flock size in the surveyed farms in England.

The two different tests we used were valuable for the detection of sub-clinical mastitis in our conditions. Zamijc and Hernja (1993) recommended Dosyl Mastitis Reagent for mastitis diagnosis.

The implementation of the following recommendations are regarded as a very important step to control sub-clinical mastitis in the Syrian large scale dairy farms:

1- To keep the cows in clean, wide and well bedded stalls or pens, free from debris, mud holes and material that could cause udder injuries

2- to introduce regular claw care

3- to properly install the milking machines, control and maintain them regularly

4- to clean each cow’s udder with a warm towel and germicidal solution before attaching the milking machine to the udder,

to remove the milking machine promptly when the cow is milked out,
then to disinfect teat cups before using them for the following cow

5- to carry through a regular health examination by the veterinary services for the early detection of sub-clinical mastitis in particular,
and to use the California Milk Test, which has proved to be sufficient sensitive to detect sub-clinical mastitis under field conditions,

6- to apply mastitis treatment based on laboratory results

7- to manage the milking procedure according to the particular situations

8- to manage herd replacement regularly

9- to take into consideration the herd size if new dairy farms are established

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Effect of management technology and feeding strategy on the health and production of high producing dairy cows

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Summary

The Sátorhely Dairy farm of the Bóly Agricultural Share-holding Company has 4564 ha land and one dairy farm with the population of 810 head of Holstein-Friesian dairy cow. The roughage is produced on 460 ha of land including 150 and 310 ha alfalfa and corn silage, respectively. The rest 4104 ha is used for seed grain and sugar-beet production. The dairy farm was founded in 1864 and the cows were kept in the old stables up to 1990. The average annual milk yield of the dairy herd was 7000 kg in 1988.

In order to increase the efficiency of the farm a new, modern dairy farm was built in 1990. The main point of the construction was to assure the welfare of animals. That is why the management technology of the new farm is loose-keeping on deep straw, the manger is roofed, and yards are connected to the stables. In order to avoid the mixing of the animals Texas gates are used. The milking parlour is polygon with 32 stands and equipped with automatic BOU-MATIC milking machine. All the milking cows are milked three times a day. In order to avoid the pollution of the mammary gland 8–10 kg of straw/cow/day is used. The teats before and after milking are disinfected. Immediately after milking the animals are fed. During feeding the teats are dried.

The cows are grouped into production groups according to their daily milk production, stage of lactation and the body condition score. The animals in the groups are fed with mixed roughage and concentrate, which is offered to the cows with computer controlled scale equipped automatic mixer wagon at least eight times a day. The organisation of work is controlled by computer.

Key words: dairy cow, management, feeding, health, production

Introduction

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The dairy farm was founded in 1864 and the cows were kept in the old stables up to 1990. The average annual milk yield of the dairy herd was 7000 kg in 1988. In order to increase the efficiency of the farm a new, modern dairy farm was built in 1990. The main point of view during the building process was to assure the welfare for the animals.

Material and method

The management technology of the newly established dairy farm is loose-keeping on deep straw, the manger is roofed, and yards are connected to the stables. In order to avoid the mixing of the animals Texas gates are used. The milking parlour is polygon with 32 stalls and equipped with automatic BOU-MATIC milking machine.

All the milking cows are milked three times a day. In order to avoid the pollution of the mammary gland 8–10 kg of straw/cow/day is used. The teats before and after milking are disinfected. Immediately after milking the animals are fed. During the feeding the teats are dried.

The cows are grouped into production groups according to their daily milk production, stage of lactation and the body condition score. The animals in the groups are fed with mixed roughage and concentrate, which is offered to the cows with computer controlled scale equipped automatic mixer wagon at least eight times a day. The organisation of work is controlled by computer.

In order to assure the energy balance the following feeding strategy is applied:

- Body condition scoring has been applied (0-5 scores) regularly. The required scores are 3.0-3.5.
- At calculation of the ration and at the grouping of cows not only the body weight, the daily milk production and stage of pregnancy are taken into consideration, but also the body condition score.
- During the dry period the feed intake is 56 MJ NE_l in 11-12 kg of dry matter. No concentrate is offered to the cows in the dry and close-up period.
- The feeding of concentrate is started with 1 kg of ration on the day of calving and it is increased by 1 kg every day until the 7th day after parturition.
- On the 8th day after calving the cows are grouped into the receiving groups, where the ration of concentrate is 8 kg/animal/day. In the receiving group the cows are kept till the 30th day of

the lactation. During this period of time ruminal microflora and ruminal epithelium is adapted to the feeding regime.

- On the 30th day after parturition the cows are grouped according to their daily milk production.
- The grouping is done every month after milk recording.
- Viable yeast culture (Live-Sacc®, produced by Dr. BATA Ltd, Hungary) as rumen additive is used during the lactation.

Results

The data of the population of the dairy farm and the average annual milk production is summarised in **Table 1**., the proportion of average Somatic Cell Count of whole milk samples is summarised in **Table 2**., the data of culling is summarised in **Table 3**.

Table 1. The data of average population of cows and annual milk production in Sátorhely dairy farm between 1994 and 1996

Year	Average number of cows	Average annual milk production	Proportion of milk sold
1994	623	7604	93.68
1995	708	7529	95.84
1996	806	8270	97.03

Table 2. The number whole germs of bulk milk samples and proportion of average Somatic Cell Count of whole udder milk samples in Sátorhely Dairy Farm between 1994 and 1996.

Year	Total germ count samples	Average of Somatic Cell Count of whole udder milk samples	Proportion of Somatic Cell Count of whole udder milk samples, %	
			>300.000/ml	<300.000/ml
1994	23000	295000	63.3	36.7
1995	25000	258000	65.4	34.6
1996	23000	220000	69.4	30.6

Table 3. Data of culling in Sátorhely Dairy Farm between 1994 and 1996

Year / Cause of culling	1994	1995	1996
	%		
Reproduction failure	3.7	2.5	2.2
Metabolic disorders	10.6	4.2	4.1
Hoof diseases	5.0	0.3	1.1
Mastitis	3.04	1.8	2.3
Phenotype problem	1.4	1.0	0.2
High Somatic Cell Count	0.0	0.4	1.1
Low milk production	8.0	7.2	10.1
Other reason	6.3	5.2	6.2
Total culling rate	38.04	22.6	27.3

Reduction of mastitis occurrence in a dairy cow herd using combined anti-mastitis methods

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Summary

This paper focuses on the reduction of mastitis in a herd of 218 dairy cows (conventional housing) by combined anti-mastitis procedures and compares the effect of intramammary treatment as a main factor of reducing the intramammary infection.

Preventive anti-mastitis methods helped to reduce the occurrence of the disease within the first 12 month from 47.3 to 36.1 %. In the 13th month, further treatment of all animals excreting the agents of mastitis led to a reduction of the disease rate from 36.1 to 2.3 %. This state has been maintained for 4 months . Later the disease rate increased in consequence of not keeping the preventive measures and reached 9,1 % in the 19th month. Subsequent treatment reduced the number of diseased animal to 1,9 %.

Key words: mastitis, treatment during lactation and in dry cow therapy of antibiotics, prevention and elimination infection mammary gland, level infection

Introduction

The reduction of the level of infection is aimed by every rational system with the remedy precaution. Not only the prevention from new intramammary infection occurrence but also the reduction of the infection duration length must become the part of these single precaution programmed aimed at the rapid reduction of the level of infection (i.e. during one year). Within the early period of the contramastitis precaution the decreased rapidity in the level of infection depends primarily on the reduction of infections process duration length (Dodd et al., 1977).

The objective of the present study was to reduce the mastitis occurrence in dairy cow rearing as much as possible using a combination of anti-mastitis methods.

Materials and Methods

The experimental herd consisted at mean of 218 milk cows (the races: black -coloreds- 70 %, cross - bred F' of Slovak colored and black colored - 30 %). The animals were stabled in two cow stables K 98 and in a calving house.

Milking in the objects is done on milking installation of Vestfalia separator (Germany). Before the start of the study, the hygiene of milking and general hygiene in the objects was insufficient.

Starting the observation, we have introduced the following preventive anti-mastitis measures: hygienic program of milking, disaffection of the surroundings according to the standards, and biotechnic control of the milking installation. Immediately after milking, the teats of each cow were dipped in 25 per cent Jodonal A or into Chloramin B solution at the concentration of 400ppm of active CL/I. The complex examination of the herds was carried out (clinically, by NK - test /modified - Schalm's test/, bacteriologically by examination milk samples) (according to IDF methods, Bulletin No. 132, 1981, and IDF, Bulletin No. 211, 1987) that were repeated monthly for control.

At the beginning of the month 13 of the study, 74 infected dairy cows were cured based on the result of the bacteriological examination done three times consecutively at a weekly interval.

Furthermore, the treatment of clinical forms of mastitis was carried out in the herd -i.e. by Ampiclox MC (Pfizer) and dry cow therapy with Ampiclox DC (Pfizer).

Results and Discussion

The implementation of preventive antimastitis methods (see Table) in the course of the first year resulted in the reduction of the level of infection by 11,2 % (i.e. from 47,3 % to the 36,1 %). After a therapeutically intervention throughout the lactation and initiation of dry cow therapy in month 13, when all the infected dairy cows from the herd were cored, the level of infection was reduced cows as much as by 33,8 % (i.e. from 36,1 % to 2,3 %). Because of neglect of hygiene of milking and surroundings in the elevated to 9,1 %. By additional therapeutically intervention at the end of month 19, the level of infection was reduced to 1,4 %. At the end of the study, the level of infection was 1,9 %. After the all bacteriological positive dairy cows were cured (at the beginning of month 13), Streptococcus agalactiae was not isolated from milk sample in the course of next 4 months of the study . In months 18 and 19 of the study, Streptococcus agalactiae was isolated from milk of 5 dairy cows which had been cured. Later on, Streptococcus agalactiae was not isolated to the end the study. From the Table it can be can seen that a beneficial effect of the treatment resulted in the reduction in clinical forms of mastitis as well as in a falling tendency of mastitis as well as in a falling tendency of positive NK - test reactions.

Table 1

Results of periodical monthly complex examination of the mammary gland in the herd of dairy cows in the course of two years

Month of examination	Number of cows examined		Percentage of the positive dairy cows		
	Clinically and NK test	Bacteriologically	Clinically	by NK-test	Bacteriologically
1.	198	222	21,2	57,6	47,3
2.	185	214	21,6	58,9	46,3
3.	197	224	20,8	55,8	46,4
4.	181	210	21	55,8	45,7
5.	191	215	19,9	54,9	41,9
6.	196	221	18,9	51,5	40,3
7.	180	209	18,9	53,9	41,6
8.	189	220	18,2	50,8	38,6
9.	192	219	17,7	49	38,4
10.	187	221	17,1	47,1	37,1
11.	183	217	16,4	46,5	36,5
12.	178	207	16,9	46,1	36,1
13.	187	221	1,4	12,8	2,3
14.	193	221	1,4	10,7	2,3
15.	196	222	2,3	9,7	2,7
16.	199	224	3,6	9,5	2,7
17.	181	220	7,7	12,2	5
18.	187	219	8,6	14,4	7,3
19.	185	219	11,2	15,1	9,1
20.	193	220	1,8	3,1	1,4
21.	191	222	1,8	3,2	1,4
22.	197	221	2,3	2,7	2,7
23.	192	218	1,4	1,4	1,8
24.	193	216	1,9	2,8	1,9

During year l of the study when only preventive anti-mastitis methods have been implemented (aimed et hygiene of milking, general hygiene of surrounding, and technical state of the milking installation), the reduction in the occurrence of both clinical forms of mastitis (from 21,1 % in month 1 to 16,9 % in month 12 of the study) and the occurrence of positive reactions by NK -test (from 57,6 % in the beginning to 46,5 % in the end of year I) was slow. The significant improvement occurred after the treatment in month 13. This positive state (except for a small elevation in months 17 to 19) was successfully maintained to the end of the study.

Depending on the infections agent the preparations used had the following therapeutic effect: Ampiclox MC 91,3 - 100 % and Arnpiclox DC 83,3 - 100 %.

The results obtained are in accordance with those presented by Federic et al.(1981), Johnston (1975), and Škarda et al. (1990).

The presented results point out to the fact that a profound analysis of the herd morbidity causes, re-transformed to an effective anti - mastitis program using both preventive and elimination methods is a basis for the reduction of mastitis prevalence in it.

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Animal housing and management – prevention of swine diseases

Animal Housing and Management - Prevention of Swine Diseases

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Summary

A lot of diseases germs who can cause pig diseases are very common in the herds in high pig density area's. Eliminate all this disease germs out of the pig population is not possible and not necessary too. Only for a few enzootic disease germs the safeguarding strategy is required. The remaining diseases can be managed by a controlling strategy in with a balance between resistance of the pig and the infection pressure of the present disease germs can be realised. There are big differences in the health status of the animals in the individual herds. Associations with pig housing and farm management show the opportunity to prevent against clinical outbreaks and economical damage by optimising the environmental conditions. Computerised systems like ZOVEX can help farm advisors to analyse the failures in the environment of the pigs. More and more multifactorial diseases are prevented by checks on minimal requirements for the farms in an Integrated Quality Control (IQC) system.

Keywords: pigs, multifactorial diseases, risk factors, integrated quality control

Introduction

In the last 20 years there was an enormous increase in pig production in several parts of the European Union. After entering of disease germs in such area's it is very easy for them to spread and to persist in the pig population. This has resulted in a situation in which a lot of pathogens continually occur in the pig population. The size of the pig farming operations and the small distance between these establishments make it almost impossible to eliminate most of the disease germs out of the populations. At the other hand there is a development in the EU-regulations that requires more and more guarantees about the absence of some disease germs in the population in a non-vaccination policy. Only countries who can met this requirements have free entrance to the European market. A second development in this field is the increasing interest in a high quality standard of the products at the end of the pig production chain; first at all in relation to the safety of the product connected to residues and zoonosis, but further to the meat quality and the emotional quality for the consumer too. This developments have lead to a health control policy in swine production based on two different traces: the safeguarding strategy and the controlling strategy.

In the *safeguarding strategy* the goal is to give guarantees about the absence of specific diseases germs in the population or the herd. This means for the disease germs who are already absent the need for a monitoring and surveillance program to control the disease free status. For that disease germs who are still present in the population this means the need for a elimination program to eradicate the disease in the farms or in the whole population. A good example for such a program is the Aujesky's Disease eradication program in the Netherlands, what is running based on a obligated intensive vaccination program (Stegeman e.a., 1994).

In the *health controlling strategy* the programs are not focused on the elimination of the pathogens. Presence of the disease germs in the herds is accepted and the program is dealing with the opportunity for the pigs to live in coexistence with the pathogens without allowing them to cause diseases and damages. Disease outbreaks depends on the infection pressure with the pathogens (quantity and quality) in the environment of the pigs at the one side and the resistance of the animals against this disease germs at the other side. Controlling strategies are focused on the measurements who can contribute to keep the balance between this two.

Differences between herds

Differences in the health status between individual farms can be used to find out the relationship between environmental risk factors and the herd health and can be used to find out the individual farms who have to be analysed for improvements. There are several ways to collect data about the herd health status:

clinical signs: The most direct way to become an impression of the health status of a pig herd is to look after the mortality and the morbidity in the individual farms on a regular base by a veterinarian. The prevalence of respiratory symptoms and enteric disorders can fluctuate between 0 and 25 % within and between farms. Elbers e.a. (1992a) found a significant relationship between this clinical signs and the pathological anatomical findings in the slaughterhouse. But only 5 to 15 % of the variation in this slaughterhouse findings could be explained. The more chronic problems in the farms are very often overlooked by this clinical observations.

Medications: In a good registration system with logbook recording of the application of drugs average drug use by individual and group treatments can be calculated and can give an impression of the health status. In the study of Elbers e.a. (1992a) individual treatments varied from 0 to over 15 % per animal and group treatments differed from 0 to more then 5 medication days per animal. Of course the use of drugs is very strongly depending on the medication strategy of the farmer. Therefore there was only a poor relationship between the application of drugs and the clinical observations, the slaughterhouse findings and the environmental conditions.

Blood parameters: In several studies sero-epidemiological information is used to become an impression of the health status of the herd. At the one hand this information is used to certificate herds for absence of disease germs, but the information can be used too, to distinguish between poor and severe infected herds. So we found for instance clear differences in the prevalence of sero-positive animals between infected finishing herds connecting Aujesky’s disease, Actinobacillus pleuro-pneumoniae and Porcine influenza (Elbers e.a. 1992b) . Beside of the serological status blood samples can be used to gather information about the health status of the pigs by analysing heamatological and clinico-chemical parameters. In a longitudinal study on 16 farrow to finishing herds we found ,that especially albumine and alfa- and gamma globuline concentrations in the slaughter animals could have a connection with the health and performance of the animals during production.(Loeffen e.a. 1996)

Slaughterhouse findings: One of the very important sources to gather information about the health status of the pigs is the slaughterhouse. Lesions and affections at carcasses and organs can be registered regularly and used to feed back the producers and the farm advisers. In the Netherlands lung-and liver affections and leg-and skin lesions are recorded at almost all the slaughterhouses. Control on residue’s of drugs and zoonosis can be carried out and blood sampling for monitoring and surveillance can easily take place. One of the viable conditions for this feed back system is a good identification and registration system. There are tremendous differences between the individual farms. We found for instance that in 1995 the prevalence of pneumonia in the lungs of slaughter pigs differed between fattening farms from 0 % in the healthy herds until over 25 % in the herds with respiratory problems. Comparable differences were found for pleuritis and affected livers.

Herd Health Index

Based on the mentioned information sources about the health of the pigs in a herd it is possible to use the data to composite a *herd health index* to become an overall view about the health status of the herd. Different parameters have to weight different in this index to become the best prospective value. It is expected, that this herd health index can be used to predict the quality of the pigs to the meat inspection in the slaughterhouses. Based on this index, farms can be divided in different groups of supply of slaughter pigs to the slaughterhouses with different protocols for meat inspection. Farms with an unsufficient herd health index can become extra attention to analyse the causes of the poor index and to advise for improvements. Improvements in environmental conditions will be a very important part of this advise. In a exercise in 16 pretty healthy farrow to finishing herds we found a variation in a first composition of the *herd health index* from 2 to 8 on a scale from 0 to 12 with the 12 for the poorest farms. There was a significant relationship with the daily gain and some blood parameters (Loeffen e.a. 1996)

Environmental Risk Factors

In the *safeguarding strategy* the most important environmental risk factors are dealing with prevention against entrance of disease germs in the population and in the individual herds. The highest hygienic standards for animal transfer and transport are required. Origin of the pigs, pig movements and -mixing and disease entrance prevention has to met minimum requirements. In each farm a hygienic lock is obligated for visitors and the farm has to executed the “black and white” principle with a clear separation between the external and internal route.

The environmental risk factors for the safeguarding strategy will of course contribute to prevent against disease outbreaks in the *controlling strategy* too. But beside of that especially the environmental conditions within the farms itself define the opportunity to keep the balance between the infection pressure with pathogens and the resistance of the pigs. This environmental conditions has to be focused on conditions and measures to decrease the infection pressure at the one hand and to increase the resistance of the pigs at the other. In several studies in the past we were able to determine the most important conditions (Tielen, 1974; Elbers, 1992, Scheepens 1991, Ekkel, 1995):

Pig housing: Preference is given to the pig operation with the farrow to finishing system in a closed herd. A compromise can be accepted by one to one relations between breeding and fattening farms. Mixing pigs from different origins increases the disease risks. In our studies differences were more then 10 % in drug use and 20 gram daily gain. The pig houses should be sectioned in small compartments for farrowing sows, weaned pigs and fattening pigs. That brings the opportunity to execute the all in- all out system and to clean and desinfect the compartments after each use. Pneumonia prevalence was 5% lower and daily gain was 18 g higher in the sectioned all in all out system.

Management: Moving and mixing pigs during production is affecting health and welfare. Ekkel (1995) showed, that the SSF- system where pigs were remaining in the same pen from birth to slaughter had clear advantage (better health and 85 g better daily gain) comparing two times moving and mixing during the fattening period: after weaning and at 25 kg. weight. Even only moving and mixing one time at 25 kg decreased health and performance.

Indoor climate: he indoor climate is one of the most important tools to increase the resistance of the pigs. Therefore stable climate has to met the requirements of the pigs in the different ages and production stages. Especially draught is disastrous for the pigs health. Scheepens (1991) showed the clear negative effects of draught upon health and welfare. He found in weaned pigs an increase in respiratory problems, a decrease in animal resistance and a decrease (about 40 g per day) in daily gain. To guarantee the optimal climate for the pigs artificial climate control is necessary for most of the animals. Automatically regulated mechanical ventilation with an adequate heating system is necessary in most of the European countries.

Hygiene: One of the most important conditions to keep hygiene optimal in occupied pig houses is to prevent against over-occupation. Too high pig density increases animal contact and infection pressure. Fattening pigs with 0.70 sq.m. surface available had lower pneumonia prevalence and 12 g higher daily gain comparing pigs in the same environment with 0.56 sq.m. available area. Daily hygiene and proper cleaning and desinfection procedures decrease infection pressure in the pig environment.

Zootechnical-Veterinary Analyses

Based on the knowledge of relationship between environmental risk factors and pig health it is possible to analyse the causes of diseases and poor health in problem farms. But this is only a curative approach. The better way is to prevent against disease outbreaks by improving the farm conditions before disease problems occur. This means a check of the environmental conditions in the farms on a regular base. For the minimal requirements connecting health and welfare it is possible to control this with a standard checklist. Preventive analysing the wide scale of possible failures in management, housing, climate and hygiene in a modern pig operation is more difficult. You need the knowledge of an expert to find the complicated causes. An other opportunity to use the experts knowledge by first line farm advisors and producers is to develop an expert system for general use. Therefore we now develop the Zootechnical Veterinary Expert system (Zovex) and we hope that that system will contribute to preventive zootechnical-veterinary analyses in a frequent way (Enting e.a. 1995).

Integrated Quality Control

Producing healthy pigs with a high quality in the pig production chain is a joint responsibility for al the links in the chain. Therefore the slaughterhouses in the Netherlands set up an integrated quality control system. In this system minimal requirements are defined for all the stages in the production chain. Housing and management requirements connecting health and welfare are incorporated in this IQC-system. Slaughterhouse information is fed back to the farmers. Farm information is used in the meat inspection at the slaughterhouse. Regular control visits are executed to the participants to check on the minimal requirements (Tielen, 1993).

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Epidemiologic studies about the incidence and the different spread of the PRRS-Virus in single age-groups and housing systems as about experences with depopulation and vaccination of pigs against the PRRS-virus

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Summary
Since the year 1990 a new pig disease with abortion and pneumonia has occured in Germany and other states of Europe.In Lower Saxonia in blood samples we found a prevalence of 98 % in regions with a high pig density and in others with a lower pig density a prevalence of 59 %.In breeding farms with only one building for all pigs,was a high prevalence of the PRRS - virus in all groups of age.Farms with different buildings for their pigs and an „all in - all out“ system for the sows,the flatdeck and the fattening pigs had a lower prevalence of the PRRS - virus in the different production groups.In our experiments with depopulation in the stable and by vaccination for piglets with the Ingelvac° PRRS MLV Vaccine we got for the pigs (N=219) in the fattening period a better daily weight gain of 42 g from a weight of 31.3 to 110 kg.After vaccination for PRRSV the clinical findings of pneumonia were lower in fattening pigs.The serologic tests after the PRRSV - vaccination showed in the experimental group a reduction of the PRRS - virus antibodies in the blood samples from the field infection and a rising of the PRRSV - vaccine antibodies.Compared with the vaccination for PRRSV the management and the depopulation in the different parts of the stables it is as important as vaccination for the success of minimaling PRRSV in the pig population.

Key words:PRRS a new pig disease,since 1990, with abortion and pneumonia,high prevalence in regions with high pig density,reduction of PRRS - virus in pigs by depopulation,“all in-all out“system,PRRSV vaccination.

Introduction
Since the end of the year 1990 a new pig disease has occured in lower saxonia.In 278 herds with PRRSV we performed epidemiological studies.In 76 farm visitings we collected dates about the new disease (Busse,et al.,1992).Now the PRRS - virus is classified as belonging to the arteriviridae (Terpstra,et al.,1991).The virus produces late abortion,the birth of death piglets and weakness .The respiratory part of the disease is a interstitial pneumonia followed by severe viral or bacterial infections.The PRRS - virus infection produces a short immunity during only one gestation.A reinfection of the sows and other pigs is possible.

Material and Methods
In different sow herds with PRRSV problems we carried out a serological profile (ELISA test) of the herds by stage of production.With our sampling method we can assess the PRRSV status in the adults (N=10 sows),in the weaning population (N=10,to 4 weeks old piglets),after changing the serostatus (N=18,to 8 weeks old piglets) and in the finisher or gilts (N=10,to 6 month age).
In Germany since 4/96 the vaccination of pigs for the respiratory part of the PRRSV disease is allowed by the Ingelvac°PRRS MCV live vaccine from 3 to 18 weeks of age.In one herd with 100 sows,PRRS problems in breeding and PRRS sero positive pigs in different parts of the pig houses,piglets (N=108),6 weeks old,were vaccinated with the Ingelvac°PRRS MCV vaccine.In the same stable were other piglets (N=111) as a unvaccinated control group.With a bodyweight

of 31 kg the pigs were transported to a separat stable of a fattening unit in another farm.During the fattening period blood samples were collected from vaccinated and control pigs.The daily weight gain,the feed conversion ratio and the pneumonia rate in the slaughterhouse of the fattening pigs was measured.

Results

The prevalence of the PRRS - virus in the farms is different.The serological profiles demonstrates stage-specific patterns of virus transmission.

Case 1:

a farm with 100 sows and breeding gilts,
farrowing house:all in - all out,
flatdeck:continous stocking,
breeding house:continous stocking,
clinical signs:wasting in the flatdeck,reduced weight gain,mortality to 20 %,

serologic profile of the breeding farm (N=100 sows)

stage	blood samples (N)	prevalence (%)	results (ELISA)
breeding	10	0 - 10	< 16
piglets 4 week old	10	0 - 10	< 0.4
piglets 8 week old	10	60 - 100	> 2.5
gilts 6 month old	10	20 - 30	< 1.0

interpretation:PRRS - virus transmission takes place only in the nursery,
options:PRRSV vaccination of weaned pigs (age 3 weeks),depopulation of the nursery.

Case 2:

a farm with 120 sows and fattening,
farrowing house:all in - all out with moving of sows and piglets,
flatdeck:all in - all out with moving of piglets,
fattening:continous stocking,
clinical signs: agalactia,piglets with wasting and meningitis,fattenings with pneumonia,

serologic profile of the farrow-to-finish farm (N=120 sows)

stage	blood samples (N)	prevalence (%)	results (ELISA)
gilts	10	50 - 100	> 2.5
breeding	10	50 - 100	>2.5
piglets 4 weeks old	10	50 - 100	>2.5
piglets 8 weeks old	10	50 - 100	>2.5
fattening pigs	10	50 - 100	>2.5

interpretation:active PRRS - virus infection in all stables of the pigs, options:close the herd,better management,control of other diseases,elimination of the PRRS - virus by all in - all out in the breeding and the flatdeck,PRRSV vaccination of the piglets 3 weeks old and the nurserys till 60 kg body weight,4 months later a new serological blood test.

Vaccination of piglets

By vaccination of young piglets coughing during the fattening period was reduced.In the vaccinated group the daily weight gain was 42 g higher and the feed conversion ratio was 0.03 point higher than in the control group (Table 1).

Table 1:

Production rate of fattening pigs with and without vaccination of 6 weeks old piglets in the flatdeck for PRRS virus with Ingelvac°PRRS MCV vaccine

parameter	vaccination group	control group
pigs (N)	108	111
average entry weight	31.6	31.0
average (kg) daily weight gain	852	810
average (kg) feed conversion rate (1:)	2.67	2.70

From 110 pigs we get the lung diagnoses from the slaughter house.47 % of the lungs from unvaccinated pigs and 62 % from vaccinated pigs were without pneumonia herds (Table 2).
Under the vaccinated pigs we found 15 % more lungs without signs of pneumonia.

Table 2:

Lung diagnoses from slaughter house of fattening pigs with and without vaccination for PRRS virus with the Ingelvac° PRRS MLV vaccine

parameter	vaccinated pigs	unvaccinated pigs
pigs (N)	55	55
lungs without pneumonia (%)	62	47

During the experiment by the breeder and by the fattening farmer there was a strict hygiene programm without continous stocking.For all pigs there was place enough in there pens during the fattening period.

Table 3:

titre results IPMA (EU/US) of PRRSV serologic profile of groups of fattening pigs with and without vaccination of piglets in the flatdeck 5 days after change of housing with Ingelvac°PRRS MLV Vacc.

	1.blood test day of vacc. IPMA		2.blood test 6 weeks p.vacc. IPMA		3.blood test 16 weeks p.vacc. IPMA		4.blood test 20 weeks p.vacc. IPMA		5.blood test 23 weeks p.vacc. IPMA	
	EU	US	EU	US	EU	US	EU	US	EU	US
vaccination-group piglets (N=31)	2.00	1.36	3.03	4.06	1.80	2.86	1.53	3.03	1.84	4.06
vaccination-group piglets (N=31)	1.47	1.13	1.97	3.67	2.07	3.18	1.41	2.70	2.11	4.00
valuation steps of titre rises:	<20=1 no infect.,		20=2 low infect.,		80=3 medium infect.,		320=4 high infect.,		>320=5 very high infect.,	

PMA°:Immuno-Peroxydase-Monolay-Assay,EU:european field virus,US:US vaccine virus
°We thank Dr.Ohlinger,CVUA,Münster for the results of the serologic test.

Serologic profile of the PRRSV vaccination

In the serologic test IPMA we can differ between the field infection (EU) and the infection with the vaccine live virus (US) in the blood samples.During 5 times the blood samples were taken in the experiment.At starting vaccination in the vaccinated group we found more PRRSV infected piglets than in the control group.23 weeks after vaccination the PRRS vaccine virus in the vaccinated and in the control group had nearly the same antibody titres.In the vaccinated group there were not so many PRRSV infected pigs as in the control group 23 weeks after starting the vaccination in the flatdeck (Table 3).

Discussion

PRRSV is a virus,that can be transmitted by infected pigs.The virus has been detected in saliva,urine,feces and semen (Gradil,et al.,1996).In the field the transmission of the PRRS virus by aerosols in regions with a high density of pigs is possible (Busse,1993).Before depopulation or vaccination can begin,an identification of the virus and a location of the replication in the herd is nessessary.By serologic tests we find the places,where the virus is actively circulating.With blood testings of a herd we get a serological profile of the pig herd.The virus circulation is stoped by nursery depopulation with all in - all out,clean-up and desinfection in the flatdeck (Dee,et al.,1996).With a better management and without mixing slow growing pigs with a younger age group the infection rate with PRRS virus and other pathogens is reduced in the farm.Combined with management the modified live virus PRRS vaccine reduced the clinical effects of the PRRS respiratory syndrome.For reducing clinical effects of the PRRS virus the vaccine must be given to the piglets as early as possible with an age of 3 weeks,before the pigs are infected with the field virus of PRRS.Controlled experimental studies have revealed,that the PRRS vaccine from American isolates of the virus provides cross protection for pigs challenged with the Lelystad virus (Sanford,1996).

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Effect of space allowance on production and health in growing-finishing pigs

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Summary

Production and health were studied in growing-finishing pigs kept at three space allowances by modifying group size. Pigs were housed in pens with fully slatted floors in all-in all-out compartments. Compartments were cleaned, disinfected, dried and heated prior to introduction of a new batch of pigs. The study included two trials. The first trial involved one farm. All treatments were applied within the same compartment. Daily gain was higher (P<.05) and lean meat content was lower (P<.05) at .75 m2/pig 799 g/d; 61,2 % meat) as compared to .55 m2/pig (770 g/d; 61,8 % meat). No significant difference was detected with respect to medical treatment associated with leg lesion or respiratory disease. The second trial comprised four herds. Only one of the three treatments were applied within each compartment. Daily gain, feed conversion and lean meat content did not differ significantly between treatments. Moreover, no significant difference was detected with respect to medical treatment associated with leg lesion or respiratory disease. Calculations of economical performance indicated that net profit was 15 and 28 percent lower at .65 m2/pig and .75 m2/pig as compared to .55 m2/pig due to decreased pen throughput. The results of the study suggest that an increase in space allowance does not significantly improve production and health of growing-finishing pigs in herds incorporating all-in all-out procedures and hygienic measures such as thorough cleaning, disinfection, drying and heating of compartments prior to introduction of a new batch of pigs.

Key words: growing-finishing pigs, all-in all-out procedures, space allowance, production, health, economy

Introduction

Minimum standards of space allowances in commercial pig production are established by the EU Commission (COUNCIL DIRECTIVE. (1991). Minimum standards for the protection of pigs. (91/630/EEC) L340/33-L340/38. (Commission of the European Communities:Brussels). In Denmark pigs in pens with fully slatted floors are normally produced with a space allowance no higher than the minimum standards. Only limited research has been carried out with respect to effects of space allowance on health, production and the economic in pigs housed in fully slatted pens with all-in all-out management.

Material and methods

The study included two trials. Pigs were housed in pens with fully slatted floors in all-in all-out compartments. Pen design (5.0 m x 2.0 m) was not changed as pigs were kept at three space allowances (.55 m^2/pig; .65 m^2/pig; .75 m^2/pig) by modifying group size. Compartments were cleaned, disinfected, dried and heated prior to introduction of a new batch of pigs. Compartments were heated 5-15 days after introduction of pigs as required to achieve efficient temperature and ventilation of the compartments.The first trial involved one farm. All treatments were applied within the same compartment. Pen was considered the experimental unit. Pigs averaged 40 kg at the beginning af the trial, which was completed when pigs weighed 100 kg on average. Animals were fed a standard growing-finishing pelleted diet, which was supplied ad libitum. The second trial comprised four herds. Only one of the three treatments were applied within each compartment. Batch was considered the experimental unit. Pigs averaged 30 kg at the beginning of the trial, which was completed when pigs weighed 100 kg on average. Animals were fed a standard growing-finishing diet, which was supplied ad libitum. Recordings included: serological tests for *mycoplasma hyopneumonia, actinobacillus pleuropneumonia type 2 (AP2) and athrofic rhinitis,* average daily gain, feed convertion ratio, lean meat content and medical treatments.

Results

Trial 1. Serological tests revealed that *mycoplasma hyopneumonia*, *actinobacillus pleuropneumonia type 2 (AP2) and athrofic rhinitis* were present within the herd.

The trial included 27 batches of pigs kept at .55 m^2/pig (17 pigs/pen), 27 batches of pigs kept at .65 m^2/pig (15 pigs/pen) and 19 batches of pigs kept at .75 m^2/pig (13 pigs/pen) or a total of 1111 pigs for the entire experiment. Daily gain was higher ($P<.05$) and lean meat content was lower ($P<.05$) at .75 m2/pig 799 g/d; 61,2 % meat) as compared to .55 m2/pig (770 g/d; 61,8 % meat). No significant difference was detected with respect to medical treatment associated with leg lesion or respiratory disease (**Table 1**).

Table 1. Results. Trial 1			
Net area, m^2/pig	.55	.65	.75
Batches	27	27	19
Daily gain, g	770a)	790	799b)
Feed conversion, FUs/kg gain	2.97	2.97	2.92
Lean meat content, %	61.8 a)	61.5	61.2 b)
Treatment, resp. %	19	25	22
Treatment, leg lesion, %	3.3	5.2	4.0

a,b means significantly different (<.05).

Trial 2. Serological tests revealed that *mycoplasma hyopneumonia, actinobacillus pleuropneumonia type 2 (AP2)* were present in all herds. Moreover *athrofic rhinitis* was present in one herd. The trial included 19 batches per treatment and 10718 pigs for the entire experiment. Daily gain, feed conversion and lean meat content did not differ significantly between treatments. Moreover, no significant difference was detected with respect to medical treatment associated with leg lesion or respiratory disease (Table 2). Calculations of economical performance indicated that net profit was 15 and 28% lower at .65 m2/pig and .75 m2/pig as compared to .55 m2/pig due to decreased pen throughput.

Table 2. Results. Trial 2			
Net area, m^2/pig	0.55	0.65	0.75
Batches	19	19	19
Daily gain, g	808	823	826
Feed conversion, FUs/kg gain	2.72	2.69	2.68
Lean meat content, %	60.2	59.9	60.0
Treatment, resp. %	11	12	14
Treatment, leg lesion, %	5.7	2.3	2.9

Conclusions

The results of the study suggest that an increase in space allowance does not significantly improve production and health of growing-finishing pigs in herds incorporating all-in all-out procedures and hygienic measures such as thorough cleaning, disinfection, drying and heating of compartments prior to introduction of a new batch of pigs.

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LSO 2000 quality chain produces non-medicated pork

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Summary

The LSO 2000 quality chain produces pork from pigs which have not been sick nor medicated during their finishing period from about 25 kg to slaughter. In 1996, the production was 9.3 million kg, and in 1997, it will be about 15 million kg. Pork produced in the LSO 2000 quality chain has been marketed under the brand names ”Kassler” and ”HK”. Non-medicated pork production has been possible in practice. Health classified feeder pigs quaranteed free from major swine diseases, are raised in finishing units with optimized housing. No mass medication, antibiotic feed additives nor growth promoters are allowed. Pigs which become sick, are medicated individually, and ear marked. The treated pigs are excluded from the quality chain at slaughter. Production figures have been good, and the number of medicated pigs has been small.

Key words: antibiotics, pork production, heavy metals, drug residues, quality, health matching, pig diseases, enzootic pneumonia, atrophic rhinitis, sarcoptic mange, swine dysentery

Introduction

HK Foods (former LSO cooperative), the largest meat packing company in Finland, has developed the LSO 2000 quality chain to produce pork from pigs which have not been sick nor medicated during their finishing period from about 25 kg to slaughter. In 1996, the production was 9.3 million kg, and in 1997, it will be about 15 million kg, i.e. about 30 % of HK Foods' total pork production. Pork produced at the LSO 2000 quality chain has been marketed by the brand names ”Kassler Priimuspossu” and ”HK Primus”.

The LSO 2000 quality chain started with health classification of farrowing units in January, 1994. Finishing units have been classified since September, 1995. The very first non-medicated pigs were slaughtered in winter, 1995-1996. The first products (fore quarter) were sold in October, 1996, when the volume of the production was high enough for continuous weekly deliveries. The first consumer packed products (rib chops and cubed ham) were sold in February, 1997. The first non-medicated carcasses were exported to Italy in March, 1997.

The aim of this paper was to describe the production of non-medicated pork in the LSO 2000 quality chain, and to show the production figures at the LSO 2000 finishing units in 1996.

The LSO 2000 quality chain

The LSO 2000 quality chain starts with feeder pigs which originate from the health classified farrowing units, quaranteed to be free from major swine pathogens including mange, swine enzootic pneumonia, atrophic rhinitis, swine dysentery and all salmonella sp. Genetically, feeder pigs originate from superior Finnish Landrace, Yorkshire or their crossing sows. In Finland, breeding animals are stress free, ensured by DNA tests carried out by the Finnish Animal Breeders’ Association.

Feeder pigs are delivered to the all in - all out finishing units, and sorted to the pens by source herd. Thus, feeder pigs from different farrowing units are not mixed into the same pens. The average transport time is about two hours.

The LSO 2000 finishing units have been certified to have optimal housing and management conditions. The demands include 0.9 m^2 pen area per pig, free access to water, solid floor on lying area, bedding, minimum light of 100 lux for 10-16 hours per day, thermoneutrality, optimal ventilation etc.

No mass medication, antibiotic feed additives nor growth promoters are allowed. Pigs which become sick, are medicated individually, and ear marked. These pigs are excluded from the quality chain at slaughter. A log book of medications must follow the pigs to the slaughter plant. Veterinary inspection is required at the first week, and then at least once per two months.

Salmonella is controlled frequently both at the farm and at the slaughter plant. At least 70 % of the feed used at the finishing unit must be domestic grain. Finnish grain is known about its very low concentration of heavy metal, pestiside and herbiside residues. Feed ingredients causing bad taste (e.g., fishmeal) or technical or ethical problems are not allowed. Commercial feed must be quaranteed salmonella free.

Use of electric prod at the transport is not allowed. Resting time before slaughter is 2 - 5 hours. Pigs with any sign of disease are removed from the quality chain at meat inspection. Only carcasses classified to E and U at the EUROP carcass classification system, qualify.

Consumers get high quality, salmonella free, lean pork from pigs which have been healthy, which have not been medicated with any medicine during their finishing period, which have been fed with Finnish barley based diet, and which have been raised gently in finishing units with optimal housing conditions.

Production figures

There were 425 farrowing units at the LSO 2000 quality chain at the end of March, 1997, which produced about 65 % of all feeder pigs of LSO Foods.

The number of colostrum samples analyzed for *Mycoplasma hyopneumoniae* -antibodies has been over 10,000 every year (Table 1). The number of positive herds has been decreasing, and only ten herds were found positive in 1996. Thirty-seven herds have eradicated Mycoplasma-infection successfully since 1994.

Table 1. Colostrum samples for *Mycoplasma hyopneumoniae* antibodies in 1994-1996. Source of information: EELA / Seinäjoki / Eero Rautiainen.

	1994	1995	1996
Samples	10992	10150	10691
Positive samples	129	208	94
Positive herds	32	29	14

Only two farrowing units have been found to be infected by *Serpulina hyodysenteriae*. The first one was found in 1995, and the last one in the spring, 1996. These herds were found to be positive for Serpulina based on feed-back from LSO 2000 finishing units. Serpulina has now been eradicated from both of these farrowing units.

Most of the farrowing units were infected with mange before joining the program, and they had to eradicate it. Almost all mange eradications have succeeded. Those herds failed in mange eradication have re-eradicated it. No farms have given up the program because of mange.

If an LSO 2000 farrowing unit is found to be infected with any of the above mentioned diseases, it is immediately separated from the quality chain until the disease has successfully been eradicated from the farm.

There were 165 finishing units, with the total of 63,301 pen places (average 383 places / farm), qualified for the LSO 2000 quality chain at the end of March, 1997.

Mean daily gain in 298 finishing batches was 875 grams, and median 882 grams (Table 2). Mean, median, minimum and maximum values of production figures are presented because most of the variables were not normally distributed.

Liver condemnations because of white spots caused by ascariasis were high in finishing units with sawdust bedding, and low in the other finishing units. Otherwise, production figures at the LSO 2000 finishing units were considered to be very good.

Table 2. Production figures from the LSO 2000 certified finishing units

Variable	Batches	Mean	Median	Min.	Max.
Average number of pigs/batch	298	359	306	89	1000*
Mortality (%)	294	1,8	1,5	0,0	13,6
Daily Gain (g/d)	298	875	882	678	982
Whole Carcass Condemnations (%)	273	0,7	0,5	0,0	9,0
Partial Carcass Condemnations (%)	242	3,0	2,8	0,0	7,2
Liver Condemnations (%)	143**	5,2	1,7	0,0	75,4
Other Organ Condemnations (%)	242	0,7	0,5	0,0	3,9
Abscesses (%)	242	0,9	0,8	0,0	4,6
Arthritis (%)	242	1,6	1,5	0,0	5,8
Pneumonia (%)	144**	2,9	0,9	0,0	46,0
Pleurisy (%)	144**	1,6	0,8	0,0	15,7

* In one herd, four rooms were filled at the same time, and thus considered as one batch.

** Disease findings from 1.1-31.7.1996 were not used because of unreliable data recording at meat inspection during that time period.

Emission and Distribution of Airborne Particulates from a Piggery

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Summary

There is increasing concern that airborne dust and particulates from animal enterprises which are emitted into the environment may impair the health of people living in nearby residential areas. Investigations were carried out to trace the distribution of particulate emissions from a piggery in the vicinity by means of an aerosol lidar. Additionally, dust was sampled with a high volume impactor (HVS) at two places downwind (50 m, 115 m) and at a reference point upwind the piggery. The total dust concentraction in the animal house air varied between 0.2 and 1.0 mg/m^3 within 24 hours. 50 m downwind the building 0.08 mg/m^3 dust was measured by means of the HVS. At a distance of 115 m downwind the same concentrations (0.037 mg/m^3) as at the reference point (0.037 mg/m^3) upwind the animal house were found. The lidar signals discriminated clearly between the density of the air directly above the exhaust chimney and the 115 m downwind position. It seems that the lidar technique in combination with high volume impaction form an useful tool to describe the distribution distance of particulate pollutants from farm animal housing.

Key words: dust, emissions, pigs, lidar, endotoxin, distribution

Introduction

Airborne dust and particulates in livestock housing can affect the respiratory health of both animal and stock persons (Wathes 1994, Hartung 1994, Donham 1990) and they are assumed to pose a risk to the neighbouring residential areas around intensive livestock enterprices (Hartung 1995). Concentrations of microorganisms and endotoxin are particularly high in poultry and pig houses (Clark et al. 1983, Seedorf et al. in press). Associated with dust they form a biologically active aerosol. These bioaerosols are emitted together with gases into the ambient air by way of the exhaust ventilation system. For odour pollution from farm animal housing safe distances and acknowledged regulations are established in several European countries. However, our knowledge about the distribution and the travel distances of aerosol particles is still poor. This paper reports on orientating measurements of aerosols emitted from a piggery with one central exhaust chimney using high volume impaction for particle sampling and a lidar technique to characterise the distribution of the plume of the exhaust air.

Material and Methods

The experiments were carried out in and around a 1000 head confined pig fattening unit with 10 separate sections which were equally equipped with a liquid feeding system and fully slatted floor offering about 100 animal places in each section. The exhaust air from all 10 compartments was discharged via one central exhaust chimney on the roof by an underpressure ventilation system. Dust samples were taken from this central exhaust by means of a continuous filtration technique (Kugelfischer, Hanover, Germany) and outside the building in distances of 50 m and 115 m downwind as well as at a reference point (control) about 50 m upwind the farm by means of a high volume impactor (HVS) with a sampling capacity of 0.68 m^3/min (Ströhlein, Kaarst, Germany). Additionally a lidar system was used which measures the light reflection of specific light beams (for some details see Kempfer et al. 1994). The instrument works from one position and is not moved during the measurements. The system can discriminate differences in the density of air with an accuracy of 1.5 m in horizontal and vertical direction. The experimental set up is shown in Fig. 1. The endotoxins were analysed in the dust by the Limulus Amoebocyte Lysate Test (LAL).

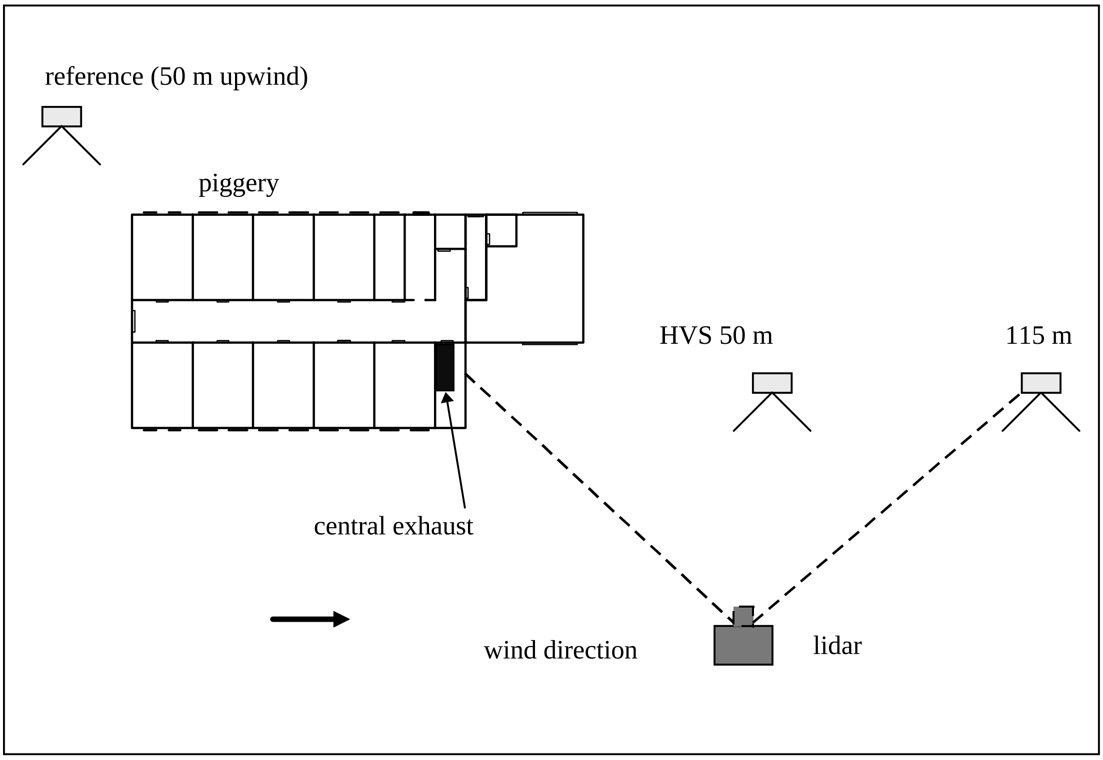

Fig. 1.: Experimental setup around the piggery with lidar and high volume impactor (HVS). Reference point 50 m upwind.

Results

Table 1 gives the concentrations of airborne dust and endotoxin at the different sampling places indoors and around the piggery. The indoor value for endotoxin was taken from other experiments (Seedorf et al. in press).

Table 1: Total dust and endotoxin concentrations indoors and at different places around the piggery

pollutant		sampling places			
		indoor	50 m	115 m	reference
dust	(µg/m³)	600	80	37	37
endotoxin	(ng/m³)	[160][1]	60	15	9

[1] Data from Seedorf et al. (in press)

The other values represent the mean concentrations of 24 hour samplings. 50 m downwind the building the total dust and the endotoxin concentration is 7.5 times and 2.6 times lower than at the source, respectively. 115 m downwind the total dust is down to about 6 % of the emission concentration. No differences to the reference point were observed. Endotoxin concentrations decrease with distance, too. At the 115 m sampling point the concentration is still above the recently recommended threshold value (Rylander and Jacobs 1997). The lidar reflection signals (arbitrary units) of the plume of exhaust air are given in Fig. 2. A sharp and high signal is observed when the light reflection is measured just above the ventilation exhaust openings. At a distance of 115 m a clear signal is received. The basis of this signal is broader because the plume is dispersed. The signals just before and after the peak can be evaluated as reflections of the „normal“ ambient air density. The roughness of curve B between 0.5 and 0.7 km indicate the influence of other weak sources in these distances.

Discussion

Particulate emissions from farm animal buildings are quickly diluted in the ambient air. This depends on factors such as wind speed, turbulences, air humidity, rain, air pressure, height of the emission point above the roof, concentration of the pollutant at the source and also on the aerodynamic diameter of the particles.

Small particles usually can travel longer distances in the air than larger particles. The endotoxin concentration at sampling point 115 m is distinctly higher than at the reference point although the amount of total dust is the same at both sampling places. It is known that the relative concentration of endotoxin in the small particle fraction of pig house dust is higher than in the larger particle fraction (Wiegand 1994). The lidar results clearly show that there is still a prominent signal at 115 m and that aerosols are obviously transported beyond this point. This is in acceptable agreement with results of Platz et al. (1995) who found viable microorganisms from pig house air about 150 m downwind the building. Own results show that there are elevated levels of airborne bacteria around livestock buildings in areas with high animal densities up to a distance of 200 m in comparison to „normal“ average values in ambient air.

The first step to assess the potential risk for nearby residents of livestock enterprises particulate is to estimate the effective travel distance of the airborne dust particles. High volume impaction sampling preferably with particle sizing, supported by the lidar technique, seems to be a promising tool for qualitative and quantitative investigations in this field.

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Fig. 1.

Table 1

Fig. 2

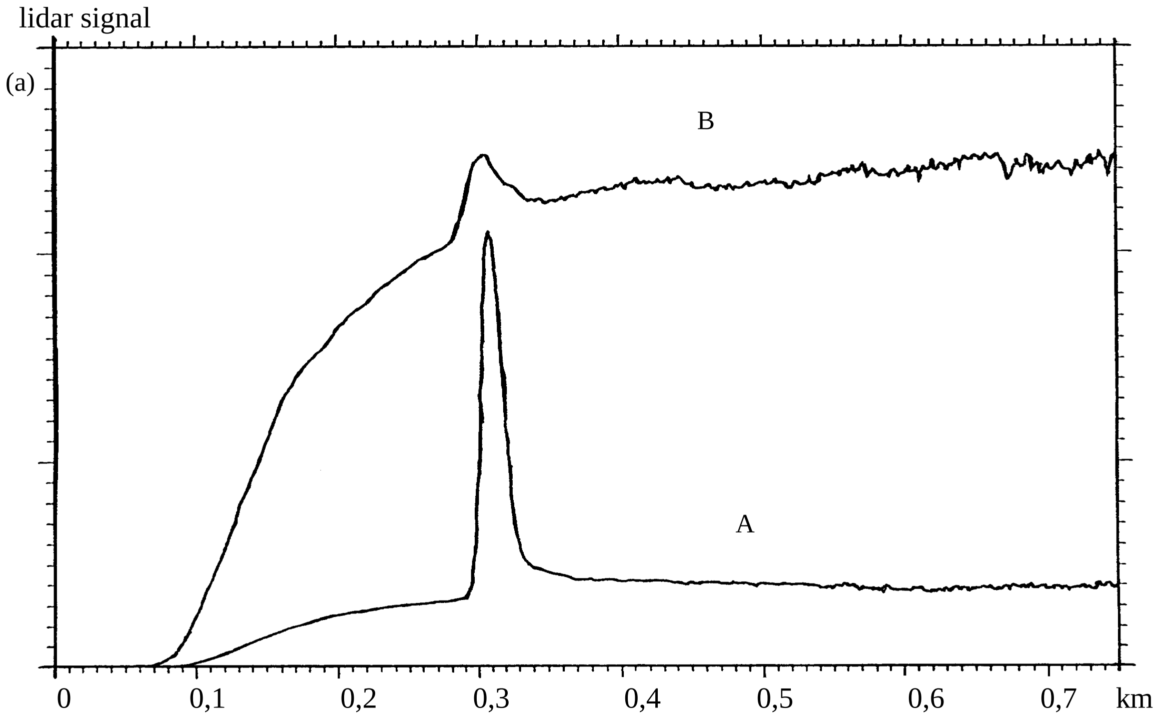

Fig. 2: Lidar reflexion signals of the plume at the exhaust (A) and 115 m downwind (B) the piggery. (a) = arbitrary units

Subacute effects of feed flour dust inhalation on the respiratory tract in pigs

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Summary

To assess the effects of dust inhalation on the respiratory tract, piglets have been exposed for 6 days in an environmental chamber to feed flour dust at levels liable to be encountered in pig buildings. Biological effects of dust exposures have been evaluated by analysing the biochemical and cellular composition of nasal lavage (NAL) and broncho-alveolar lavage (BAL) liquids. Four groups were constitued. Animals were exposed to the following inhalable dust concentrations: 1 (control), 4, 14 and 50 mg/m^3. The corresponding respirable dust concentrations were 0.14 , 0.54 , 0.84 and 1.36 mg/m^3. Dust exposure had no effect on the NAL liquid composition. In contrast, increases in the total cell counts in BAL liquid were recorded in all dust exposed groups. Alveolar macrophage counts were increased in piglets exposed to inhalable dust concentrations as low as 4 mg/m^3. In the other groups, increases in both alveolar macrophage and lymphocyte counts were recorded. In all dust exposed groups, increases in albumin concentration in the BAL fluid were recorded. It was concluded that feed flour dust inhalation (1) had no effect on the nasal mucosa, (2) can induce chronic pulmonary inflammation.

Key words: indoor pollution, swine, dust inhalation

Introduction

Respiratory disorders are the main diseases encountered in pigs during intensive breeding. These diseases display a wide range of etiologies among bacteria and viruses, but it is also hypothesized that airborne pollutants act as triggering or aggravating factors. The main airborne contaminants in pig buildings are ammonia, microorganisms, dust and endotoxins. Epidemiological studies indicate closed correlations between dust concentrations and respiratory disorders in human and pigs (Donham 1989; Robertson 1990). Dust present in pig building is a mixture of animal and vegetal material. Feed particles constitute the bulk of the dust.

The response of pigs to dust exposure has been scarcely investigated so far. The aim of this study was to detect the subacute effects of dust inhalation on the respiratory tract in pigs. Animals were exposed to dust for 6 days in a specially designed air-pollutant exposure chamber, at levels liable to be encountered in piggeries. The biological effects were assessed by analysing the cellular and biochemical compounds in nasal and broncho-alveolar lavages.

Materials and methods

Twenty-four healthy Belgian Landrace piglets (17 ± 3 (SD) kg) were selected for this study. Before exposure, they were housed for 3 weeks in a daily cleaned isolation room and fed with pellets to reduce dust air contamination. Afterwards, piglets were introduced in specially designed environmental chambers used to expose pigs to dust (Urbain 1996a). Briefly, a commercial pig feed flour was used as the dust source. The flour was filtered and dried and one kilogram was introduced into a plexiglass cylindrical tank connected to a source of compressed air to produce turbulences and to create a dust cloud. Different levels of dust concentrations can be reproduced by modulating the air flow. Gravimetric inhalable and respirable dust concentrations were measured during the exposure.

Four groups of animals (control, n=7; group I, n=6; group II, n=6; group III, n=5) were constitued on basis of different dust concentrations during the exposure (Table 1). Just before being placed in the environmental chamber, each pig was anesthetized and a nasal lavage (NAL) was performed (Urbain 1996b). Thereafter the pigs were introduced into the chamber and exposed to dust 8 h/day for 6 days. The NAL was repeated at the end of the exposure period. Then the animals were killed with pentobarbital 20% and the lung were excised. A broncho-alveolar lavage (BAL) was directly performed (Urbain 1996b). In the NAL liquid, the number of leukocytes was counted at the microscope. The cellular composition of BAL fluid was analysed by flow cytometry (FACS) after staining cells with monoclonal antibodies anti-pig CD_{14}, anti-pig CD_4 and anti-pig CD_8. Results were expressed as total numbers of cells, macrophages, granulocytes and lymphocytes per ml in the BAL fluid. T-lymphocytes CD_4^+ and CD_8^+ were expressed as percentages of total lymphocytes. In NAL and BAL liquids, albumin concentrations (ng/ml) were determined by RIA as described (Urbain 1996b). Results were subjected to one-way or two-way ANOVA and Student's *t* test.

Results

No specific clinical sign associated with exposure to dust was observed. In the NAL liquid, no changes in cellular and biochemical composition were recorded.

Table 1: Experimental dust exposures and effects on the cellular and biochemical composition in BAL fluid

Parameters	Control	Group I	Group II	Group III
Inhalable dust (mg/m^3)	1.0 ± 0.2	4.4 ± 2.4	14.1 ± 9.7	51.6 ± 28.6
Respirable dust (mg/m^3)	0.14 ± 0.09	0.54 ± 0.22	0.87 ± 0.52	1.36 ± 0.74
Total cells (x 10^6/ml)	5.25 ± 1.32	7.41 ± 2.08 *	18.02 ± 4.65	14.34 ± 2.82
Macrophages (x 10^6/ml)	3.43 ± 1.02	4.85 ± 1.40 *	***	****
Granulocytes (x 10^6/ml)	0.14 ± 0.09	0.34 ± 0.21	9.46 ± 1.78	7.98 ± 2.21
Lymphocytes (x 10^6/ml)	1.69 ± 0.60	2.26 ± 0.79	****	***
CD_4^+ (%)	29.8 ± 7.7	30.7 ± 8.1	0.41 ± 0.33	0.25 ± 0.12
CD_8^+ (%)	45.0 ± 4.4	45.5 ± 10.3	8.13 ± 3.35	6.09 ± 3.20 **
Albumin (ng/ml)	75 ± 18	170 ± 31	***	21.6 ± 7.6
		****	23.3 ± 11.0	58.5 ± 12.3
			54.3 ± 10.3	143 ± 60 *
			299 ± 109 **	

Values are mean s ± S.D. * : values significantly différent than in control goup : * : p<0.05; ** : p<0.01; *** : p<0.001; **** : p<0.0001.

In all dust exposed groups, the total number of cells in BAL fluid was increased (Table 1). Taking into account groups control, I and II, a linear relationship between dust exposure and total cell increase was recorded. The equation of the linear regression between the inhalable dust concentrations (x) and individual total cell counts (y) was $y = 3.58 + 1.03\ x$ ($R = 0.912$; $p < 0.0001$). The corresponding equation for the respirable dust was $y = 2.75 + 14.61\ x$ ($R = 0.703$; $p = 0.0016$). In group I, the increase in the total number of cells is explained by a significant increase in the number of alveolar macrophages. In groups II and III, both alveolar macrophages and lymphocytes are significantly increased. The number of granulocytes increased, but not significantly. The relative T-cells subpopulations of lymphocytes were not significantly affected by the treatments. In all dust exposed groups, the albumin concentrations in BAL fluid were increased compared to the concentrations recorded in control (Table 1).

Conclusions

Under our experimental conditions, dust concentrations were in the range of the values recorded in pig buildings. Indeed, inhalable dust concentrations range from 2 up to 20 mg/m^3 in pig buildings, and the respirable fraction ranges from 0.2 up to 1.0 mg/m^3. In the present study, a 6 days exposure to dust had no effect on the extra-thoracic airways. However intra-thoracic inflammation was present, as shown by increase in the number of inflammatory cells and in the albumin concentration in dust-exposed pigs. Pigs exposed to low dust concentrations showed an increase in the number of alveolar macrophages. This effect reflects the stimulation of non-specific lung mechanism defenses. The increases in the number of lymphocytes and in the albumin concentrations in groups exposed to higher dust concentrations are the manifestation of pulmonary inflammation despite the non significantly increase in the number of neutrophils. It was concluded that feed dust represent an hazardous air contaminant in pig buidings.

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Peak concentrations of pollutants in the air of piggeries and broiler houses in Germany

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Summary

Gases, dust, endotoxin and microorganisms were determined in the air of German pig and broiler houses. Air quality was characterised by peak values, mean data and data-related frequency distributions considering recommended threshold limit values. The peak values of all air quality parameters were clearly above the thresholds in nearly all housing types. Mean values are not suitable to describe the air quality in all investigated animal houses sufficiently. It makes more sense to use the frequency distribution of the data in comparison to recommended threshold values. This method revealed that in fattening pig houses 25% of the ammonia data, 36% of the respirable dust data and 25% of the respirable endotoxin data were above the recommended threshold values. For sows on litter, sows without litter, weaner and broilers these figures were 3%, 21%, 14%, 52 % (ammonia), 15%, 21%, 48%, 34% (respirable dust) and 44%, 19%, 25%, 63% (respirable endotoxin).

Key words: livestock, air quality, peak concentrations, threshold limit values

Introduction

To prevent health effects usually averaged data over a certain period of time (i.e. TWA_8) are used although it is assumed that peak concentrations of pollutants can complicate the risk assessment (Zeitler-Feicht et al. 1991). In contrast to humans, animals in livestock buildings are exposed to aerial pollutants for 24 hours per day. As possible consequences continuously appearing peak values or a batch of high concentrations of airborne noxious compounds could produce cumulative effects influencing more severely the health status of mammalians than regularly occurring burdens just below threshold limits.

This paper reports on a field study in 40 German livestock buildings of pigs and broilers monitoring aerial pollutants such as carbon dioxide, ammonia, inhalable and respirable dust, inhalable and respirable endotoxin (ET), bacteria and fungi. The range of measured maximum concentrations of various parameters are discussed in relation to recommended threshold limit values.

Material and Methods

The sampling techniques and analysis procedures were mentioned elsewhere (Seedorf 1994) and are described briefly. The sampling system consisted of seven sampling sites in the animal house. Carbon dioxide (CO_2) and ammonia (NH_3) were measured by automatic gas analysers. Dust measurements were carried out with two different sampling heads, which are able to sample selectively inhalable and respirable dust. The dust deposition on filter disks were performed by vacuum pumps sucking air through the dust sampling heads. After the gravimetric determination of the dust, the filter disks were investigated for endotoxins (Wiegand 1994). Airborne microorganisms were sampled by a new automated bacteria sampler (Hartung 1994) at only one sampling position. Indoor pollutants were measured over a sampling period of 24 hours. The sampling intervals differed between 7.5 min (gases) and 12 hours (dust, endotoxin, microorganisms).

Measurements were made in 8 sow houses (with and without litter), 4 weaner units (without litter), 4 fattening pig barns (without litter) and 4 broiler houses (with litter). All livestock buildings were visited twice a year (summer and winter). Mean values and peak concentrations were calculated from the data. Parameter-related frequency distributions were used to characterise the magnitude by which the threshold limits were exceeded (Table 1).

Table 1
Selected and recommended threshold limit values for air quality parameters

Parameter	Threshold limit values	Reference
Carbon dioxide	3000 ppm	CIGR (1984)
Ammonia	20 ppm	CIGR (1984)
Inhalable dust	1 mg/m³	Done (1991)
Respirable dust	0.23 mg/m³	Donham (1991)
Endotoxin	10 ng/m³	Rylander and Jacobs (1997)
Total bacteria	10^4 CFU/m³	Done (1991)
Fungi	1.3 x 10^4 CFU/m³	Donham (1991)

CFU: colony forming units

Results and Discussion

In all livestock types and for all indoor air quality parameters there was at least one peak value which exceeded known threshold limit values (Table 2). Only in sow houses with litter the maximum concentration of CO_2 was below 3000 ppm. Peak values are single events within certain measurement periods. Therefore mean values are commonly calculated to give an comprehensive overview about the *real* magnitude of aerial pollutants.

Several average data are also clearly above the defined limits such as ammonia in broiler houses, inhalable dust in all housing types, respirable dust in weaner and broiler houses, inhalable endotoxin in sow units with litter and in weaner, fattening pig and broiler barns as well as the respirable endotoxin yields in sow buildings with litter and in broiler flocks. Some other mean data are below the threshold limits suggesting falsely an acceptable indoor environment. Therefore, a more realistic approach is to count all data exceeding the threshold limits. This is expressed as relative frequency (**Table 2**). Based on this relative frequency distribution 21% and 25% of all observed ammonia data in sow houses without litter and in fattening pig units, respectively, are above a threshold of 20 ppm, although the mean values are distinctly < 20 ppm. In the same livestock buildings the frequency of respirable dust concentration values are 21% and 36% within a range of 0.23 and 0.5 mg/m³, respectively. For respirable endotoxin 25% of all samples in weaner and fattener units are between 10 and 200 ng/m³, but mean values are 7 ng/m³, only. Airborne bacteria and fungi were above recommended limits, except for fungi in sow houses without litter.

Table 2
Peak values, frequency distributions of data (x) within defined limits (framed area) and mean values of air qualities in piggeries and broiler flocks.

Parameter	Criterion	Sows with litter	Sows without litter	Weaner without litter	Fattening pigs without litter	Broiler with litter
CO_2 [ppm]	Peak value	2300	4775	3460	3090	4068
	x<=1000	53.3%	30.7%	10.0%	22.3%	13.0%
	1000<x<=1500	41.4%	21.3%	19.1%	30.1%	31.8%
	1500<x<=3000	5.2%	43.8%	66.9%	47.0%	36.8%
	x>3000	**0.0%**	**4.3%**	**3.9%**	**0.5%**	**18.3%**
	Mean	1042	1574	1801	1577	2002
NH_3 [ppm]	Peak value	27.3	43.7	35.5	35.2	41.29
	x<=5	0.0%	10.3%	50.5%	1.0%	0.0%
	5<x<=10	32.4%	21.6%	8.6%	16.1%	16.4%
	10<x<=20	64.4%	47.5%	26.6%	57.8%	31.7%
	x>20	**3.3%**	**20.7%**	**14.4%**	**25.1%**	**51.9%**
	Mean	12.4	14.4	9.1	15.9	21.2
Inhal. dust [mg/m^3]	Peak value	3.83	2.30	8.11	6.44	8.89
	x<=1	8.9%	33.9%	8.0%	6.3%	10.7%
	1<x<=3	**83.9%**	**66.1%**	**47.3%**	**64.3%**	**8.0%**
	3<x<=10	7.1%	0.0%	44.6%	29.5%	81.3%
	x>10	0.0%	0.0%	0.0%	0.0%	0.0%
	Mean	1.75	1.24	3.20	2.60	5.17
Resp. dust [mg/m^3]	Peak value	0.30	0.36	0.71	0.50	1.36
	x<=0.23	84.4%	78.6%	36.6%	64.3%	0.9%
	0.23<x<=0.5	**15.2%**	**21.4%**	**48.2%**	**35.7%**	**33.9%**
	0.5<x<=1	0.0%	0.0%	15.2%	0.0%	57.1%
	x>1	0.0%	0.0%	0.0%	0.0%	8.0%
	Mean	0.14	0.15	0.32	0.21	0.67
Inhal. ET [ng/m^3]	Peak value	2563.8	64.1	179.9	501.9	7518.1
	x<=10	0.0%	81.3%	50.0%	62.5%	0.0%
	10<x<=200	**75.0%**	**18.8%**	**50.0%**	**25.0%**	**50.0%**
	x<200	25.0%	0.0%	0.0%	12.5%	50.0%
	Mean	311.0	7.5	35.0	55.8	1601.5
Resp. ET [ng/m^3]	Peak value	131.2	30.8	21.1	22.4	337.8
	x<=10	56.3%	81.3%	75.0%	75.0%	18.8%
	10<x<=200	**43.8%**	**18.8%**	**25.0%**	**25.0%**	**62.5%**
	x<200	0.0%	0.0%	0.0%	0.0%	18.8%
	Mean	30.7	5.8	6.8	7.1	79.1
Bacteria [CFUx10^4/m^3]	Peak value	33.4	8.0	n.d.	21.4	381.6
Fungi [CFUx10^4/m^3]	Peak value	2.5	0.1	n.d.	1.5	5.7

The air in livestock buildings with litter showed higher microbiological pollutions than houses without litter.

Conclusions

- Current threshold recommendations for air pollutants in livestock housing require scientific justification especially in terms of cumulative and combined effects of airborne components.
- The use of frequency distributions is more advantageous than mean values, because the former one may allow a distinction between hazardous and non-hazardous periods in the animal houses. Mean values can disguise alarming situations. Thus, the concept of the frequency distribution of airborne pollutants seems to be more suitable to evaluate human and animal health and well-being.

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A knowledge-based system to prevent health disorders in weaned and finishing pigs

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Summary

A knowledge-based system (Zovex) to analyse factors associated to health, welfare and performance problems of weaned and finishing pigs has been developed. In order to test Zovex in the field, farms with and without pleurisy were analysed with Zovex in a case-control study. Preliminary results indicate that high air velocities, small air inlets and the absence of a heating system are related to pleurisy, and are easily and uniform detected by Zovex.

Key words: knowledge-based system, fattening pigs, pleurisy, risk factors, case-control

Introduction

A knowledge-based system has been developed to assists (veterinary) advisors in the evaluation of pig farms on the presence of factors associated to health, welfare or performance problems. The system is called Zovex, Zootechnical-Veterinary EXpert system, and has two functions: a vertical 'problem solver' and a horizontal 'preventive screener'. In the vertical function a structured analysis based on a specific health, welfare and performance problems is carried out at the individual farm level, followed by an advice to solve the problem. In the horizontal function a screening of the pig fattening farm on a specific zootechnical domain (e.g. hygiene, housing or climate) for the presence of risk factors that sooner or later could cause problems is performed.

To validate Zovex as a 'problem solver' a field test was designed. The test focuses on the capability of Zovex to detect on-farm weaknesses (risk factors) associated with a specific health disorder. Under Dutch circumstances, the majority of individual (Elbers *et al.*, 1990; Blocks *et al.*, 1994) and group medical treatments (Elbers *et al.*, 1990) are related to respiratory problems. These disorders are of highly interest in the Netherlands and for finishing pigs they can be detected at slaughter: affected lungs, abscess(es) in the lungs and pleurisy (Tielen, 1974). While the two first lesions can be the result of various pathogenic organisms, the latter is more related to a few specific infectious agents. Therefore pleurisy was choosen as the specific health disorder for validation of Zovex.

First a description of Zovex as a ‘problem solver’ will be given in this paper. Then the design of the field test and preliminary results will be presented and discussed.

Description of Zovex

In the vertical function (‘problem solver’) Zovex traces the zootechnical causes of health, welfare and performance problems on a pig fattening farm. These problems are the basis of the knowledge-based system (input). Through a reasoning process, Zovex tries to find abnormalities which could be the cause of the problem (output). The input of Zovex can be divided into three different kinds: (1) direct clinical health and performance parameters such as 'coughing' or 'diarrhoea' and ‘decreased growth rate’ noticed by the farmer, extension worker or veterinarian, (2) laboratory findings such as serological or autopsy results, and (3) information from the slaughterhouse, e.g. high percentage of pleurisy. Zovex runs with one or more inputs. In the latter case, when more input data are available, the problem-solving process can be facilitated. When the input is entered in the context of the system, it determines a list of risk factors associated to the problem at hand (see Figure 1). Afterwards these factors are analysed. Important zootechnical factors incorporated into Zovex are climate, hygiene and housing factors and besides this health management factors (see Figure 1). These four domains contain very detailed knowledge to asses whether risk factors are present or absent at the farm, and to what extent they contribute to the problem. The session ends with an advice to reduce the health, welfare or performance problem.

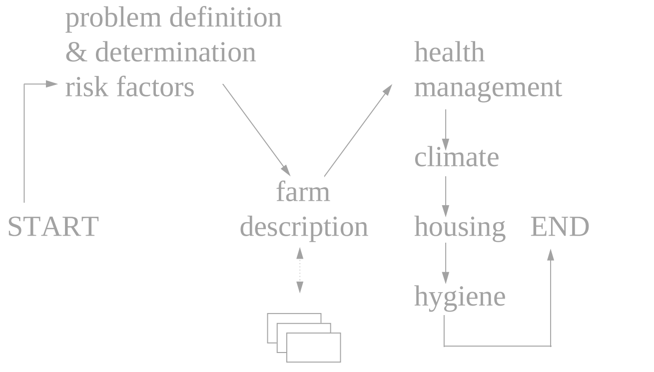

Figure A: Structure Zovex as ‘problem solver’.

Design of the field test

A case-control study was designed to test whether Zovex is able to help detecting on-farm risk factors associated with pleurisy. Per farm (≥ 300 fattening pigs), figures of the percentage of pigs detected at slaughter with pleurisy lesions were collected in the period October 1995 until June 1996 and transformed to quarterly averages. Due to differences in the prevalence of pathological lesions among slaughterhouses (Elbers *et al*., 1992), absolute values of pleurisy lesions are hard to interpret. Therefore the individual herd values are indexed by comparing them to the average pleurisy percentage of the slaughterhouse: pleurisy index = (quarterly average $pleurisy_{herd}$ / quarterly average $pleurisy_{slaughterhouse}$) * 100. Twenty-five case farms were randomly selected out of a sub-population of farms having all three quarters a pleurisy index above 120, and 25 control farms out of a sub-population of farms always having a index below 80.

Case and control farms were visited in the first quarter of 1997. Risk factors of interest during the farm visits were the all in all out principle, disinfection of the pig unit, number of source farms, climatic measurements (such as CO_2 content, NH_3 content, air velocity) and their related climatic defects (e.g. absence heating system), pen area per pig, mixing and moving of pigs and possible chance of PRRS infection. Within a farm two pig units were analysed with Zovex: a ‘good’ pig unit having almost no pleurisy problems during the last two fattening periods, and a ‘bad’ one having many pleurisy problems during the last two fattening periods (pleurisy lesions compared to the slaughterhouse average).

Results and Discussion

Due to 1997 outbreak of Classical Swine Fever in the southern part of The Netherlands, only 6 control and 5 case farms (= 22 pig units) have been analysed with Zovex until now. Herd size varied from 404 to 2350 finishing pigs.

In Table 1 the presence of risk factors in pig units of case and control farms, and in ‘good’ and ‘bad’ pig units is presented. In 19 pig units (out of 22) the all in all out principle was applicated in the right way: cleaning the empty pig unit between fattening periods, and no mixing of pigs between pig units. However, 10 farms (out of 11) did not disinfect the pig unit after cleaning. Although all in all out and cleaning followed by disinfection are known risk reducing factors related to respiratory disease, there were no differences between farms and pig units for these factors in this research.

Common risk factors that were present in a pig unit and more often detected by Zovex on case than control farms were a too small air inlet into the central corridor, the absence of a heating system in the central corridor to condition the incoming air in the pig unit, and high air velocities in the pens of the pigs (**Table 1**).The latter two factors are known to cause draught, which has a large harmful impact on the health status of the pigs (Tielen, 1974; Scheepens, 1991). Opposite to this, a high NH^3 content and leaks were more often detected in pig units of control than case farms. Within a control farm, however, high NH_3 percentages were mostly found in the bad pig units.

The preliminary results presented indicate that Zovex can assist to check for possible risk factors on a farm. Advantages to use Zovex are: (1) expert knowledge can be used by farm advisors, (2) a computer system never overlooks an important risk factor, and therefore it is a reliable knowledge support, and (3) possible risk factors are assessed in a uniform way, which enhances comparison between farms. If Zovex is used before clinical signs of pleurisy are observed in the pig unit, Zovex is likely to prevent health problems.

Table 1: Number of pig units where risk factors associated of pleurisy were present.

Risk factor	Control farms	Case farms	Good unit	Bad unit
no all in all out	2	1	1	2
no disinfection	10	10	10	10
origin of the pigs > 3 farms	-	2	1	1
high or low CO_2 content	1	2	1	2
high NH_3 content	7	5	4	8
high air velocity	-	5	3	2
small air inlet central corridor	5	9	6	8
small air inlet pig unit	7	6	7	6
no heating central corridor	4	6	3	7
leaks	6	2	4	4
too much ventilation capacity	6	5	6	5
incorrect ventilation temperature	3	-	1	2

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The assessment of residual contamination in the postweaning facilities for pigs after usual hygiene procedures

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Summary

129 farms were involved on voluntary basis in a survey. The measurements took place within the 2 hours prior to restocking the postweaning rooms. Bacterial contamination load was assessed through the impression of VRBG medium (Rodac plates) on the floor and the partitions between the pens. Twenty four plates were applied per room on the surfaces. In addition four air samples were taken using VRBG and PCA medium. A visual estimation was also performed. 12.8 % of the plates applied on the surfaces were heavily contaminated (> 300 CFU). There was a correlation between air and surfaces contamination. Based on the countings a score was calculated. An overall relationship was found between the visual exam and the microbiological score. The degree of cleanliness of the surfaces, the level of slurry in the pit below the slatted floors and disinfection were particulary related to the microbiological score.

Key words : hygiene, pig postweaning rooms, bacterial contamination, VRBG agar plates.

Introduction

Despite its broader etymological sense, the word hygiene is related in many countries to cleanliness and to prevention of contamination. An agreement is generally found on the importance of hygiene in livestock production (Thomas 1982, Radostits et al 1994). Moreover, literature reports on the health advantage of animal flow disruption and of thorough cleaning and disinfection of the facilities after the removal of the animals belonging to subsequent batches (Scheidt et al 1995). However cleaning-disinfecting operations are above all still considered as laborious and time-consuming. A recent study in confined farrow-to-finish farms in France showed that they reach 7.5 % of the whole time spent to raise a slaughter pig. An unresolved question is the practical appraisal of cleaning-disinfection efficiency. The present study is aimed at measuring on the farms the residual bacterial contamination of postweaning rooms prepared to accomodate a new batch of piglets after "in use" hygiene procedures.

Material and methods

1 - Results of a pilot study

A pilot study was designed to assess the different ways to measure the residual contamination. The trials were focused on the sampling procedure (devices available, number of samples and sites) and on microbiological aspects (medium composition, incubation temperature). A wide range of fluctuation was found depending on the criteria considered and especially on the medium and site of sampling in the postweaning rooms. The method which was selected at the end of the pilot study gave the "best compromise" taking into account the scientific aspects as well as practical considerations and the cost.

2 - The survey

- Sampling on the surfaces. Special Petri dishes (Rodac plates, 60mm diameter) containing VRBG agar medium (Pasteur Institute 1981) were used. The medium contained a disinfectant neutraliser. The surface of the medium had a convex shape in order to allow a good impression on the floor and the partitions. The impression duration was 5 seconds. 2 plates were applied on the floor of each pen and 4 on the side partitions. The impression took place on standard sites : middle of the two half virtual floor surfaces and at mid-distance from the corners for the sides, at 20 cm height. After sampling the plates were incubated 24 hours (37°C).
- Air sampling. An Anderson air sampler system was used. Different media had been tested but finally the PCA medium (Pasteur Institude 1981) which allows the aerobic mesophilic flora to grow was selected in addition to VRBG. Two plates were used per room per medium. PCA plates were incubated at 30°C.
- The farms. 129 postweaning rooms were involved (one per farm). They were recruited on voluntary basis. All the farms were farrow-to-finish units of confined intensive type. At the time of sampling all the rooms were "ready for the reception" of piglets since the usual measures of hygiene had been performed. They were all empty (all-in all-out). Ventilation was on but at a low rate. All the investigations, starting with sampling, took place within the two hours of repopulating the rooms. After bacteriological sampling, other measurements were undertaken especially those in order to correlate microbiological findings to the visual appraisal of hygiene.

Results

- 3 045 plates were used on the surfaces. The number of colony-forming-units could not be obtained in 6.2 % of the plates because of a too confuse image after incubation. 18.4 % of the plates remained negative and 12.8 % had more than 300 CFU. The median was 20 CFU for the whole sample of readable plates.

- The results obtained from air samples using PCA medium varied from zero to around 10^4 CFU/m^3 (median : 278). At the postweaning room level, air and surfaces countings were correlated. The number of CFU was lower with VRBG medium (median = 35).

- For each postweaning room a score was calculated by combining the figures obtained (Foucher and Madec 1997). Multivariate methods were used for the purpose and finally eight levels were obtained corresponding to the bacteriological score (**table 1**).

- The bacteriological score was related to measurements made during the farm visit in an attempt to a visual appraisal of hygiene. **Table 2** shows a significant relationship for the degree of cleanliness of the surface, for disinfection and for the nearness of the slurry beneath the slatted floor.

Table 1 : Spread of the farms on the score obtained. The score was calculated by combining 6 variables from bacteria countings on the plates sampled in each farm.

-Score 1 means the following profile : 1st quartile>5 CFU, 3rd quartile>150 CFU, median>50 CFU, <15 %plates with less than 15 CFU, no plate negative, >15 % plates with more than 300 CFU... Score 8 means : all the plates negative

score	1	2	3	4	5	6	7	8
Number of farms (%)	23 (17.8)	8 (6.2)	13 (10.1)	20 (15.5)	31 (24)	10 (7.8)	8 (6.2)	16 (14.4)

Score 8 was interpreted as "very satisfying situation" and score 1 as "high polluted situation". There is a gradual increase in the residual bacteria contamination going from score 8 to score 1.

Table 2 : Relationship between certain hygiene measures and the bacteriological score

- Distance slatted floor to slurry surface in the pit *(n)*	< 40 cm *(17)*	40-70 *(43)*	70-99 *(41)*	≥ 99 (or empty) *(28)*
- Bacteriological score (mean)	2.9	4.3	4.4	5
- Situation of the pit *(n)*	presence of slurry *(61)*	emptied *(60)*		emptied + washed *(8)*
- Bacteriological score (mean)	3.9	4.3		7.6
- Clean surfaces *(n)*	yes *(76)*			no (traces of dirt) *(53)*
- Bacteriological score (mean)	5			3.5
- Disinfection *(n)*	yes *(120)*			no *(9)*
- Bacteriological score (mean)	4.6			1

Discussion-conclusion

The methods used to measure the contamination level of buildings for livestock widely vary. Beyond the type of sampling device, the choice of the "target bacteria" or the "target micro-organism" remains the most disputed point. E. coli and coliform bacteria have been used (Beer et al 1980, Boon and Wray 1989) as well as staphylococci (Maris 1990). In our case after several attempts, the enterobacteria which attest fecal residues were finally considered since they were found to give the best compromise. The number of samples made in each postweaning room was another compromise between the cost and the marginal amount of information that could be obtained. The sampling schedule was facilitated since in our facilities, despite a wide range in the type of material used, we had a relative homogeneity in the general design and size of the rooms. Concerning the hygienic procedure in use on routine in the farms, it was interesting to notice that in nearly half of the rooms the pit was not emptied between two subsequent batches of piglets. Four conditions were found to be related to the bacterial counting. As they can be easily assessed, they can be used on daily practice for a first estimation of hygiene level.

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Eradication of sarcoptic mange from swine herds joining a health class system

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Summary

The success of an eradication program against sarcoptic mange was evaluated on swine farms. A questionnaire was sent to 379 farms and 30 farms were visited. According to the questionnaires 96.2% of the farmers believed in the success of the program. Most of the herds (87%) had been injected with two ivermectin injections and most of the farmers (88%) had dry-cleaned and sprayed the pens with insecticides on the days of medications. Half of the failed farms had employed other methods than those recommended. During each farm visit a rubbing index was calculated, and it was $\leq$0.1 in all herds. Fifteen-20 animals per farm were skin scraped and no *Sarcoptes scabiei* was found. The latter animals were also blood sampled. A modified indirect ELISA was used to detect serum antibodies to *S. Scabiei*. All except one farm had low antibody levels in most of the samples, and these results tallied well with the outcome of the successful eradication program.

Key words: Antibodies, ELISA, *Sarcoptes scabiei,* itching index, skin scrapings

Introduction

A high proportion of pig herds is affected with sarcoptic mange even though there are different ways to eliminate the disease. The reports about the results come only from 1-4 herds (for example Madsen 1988) and no information in large scale is obtainable. According to Bornstein and Zakrisson (1993) assays of serum antibody to *S. Scabiei* can discriminate infected from uninfected animals, but the method has not been used in evaluating the success of eradication programs yet. The objective of this study was to monitor the success of eradication of sarcoptic mange in health classified farrowing units and the methods used. Another aim was to determine whether serum antibodies to *S. scabiei* could monitor the efficacy of large eradication programs.

Materials and methods

A questionnaire was sent to 379 health classified farrowing units joined the LSO 2000 quality chain (Tuovinen et al. 1997). A local veterinarian must clinically check the health situation of these farms four times per year to prove the freedom of certain diseases including mange. All farmers answered the questionnaire and 346 of them had attempted to eradicate mange. The rest of the farms had never been infected by mange. The questionnaire contained the following information: number of sows, time of eradication, success or failure of the eradication, methods used (medications and cleaning procedures) and possible reasons for failure. Thirty farms were visited: 25 were randomly selected from the 333 farms which had succeeded and 5 were selected from the 13 farms which had failed or were uncertain. The rubbing index was determined: 10-15 animals were observed for 15 minutes, the number of rubbing episodes were recorded and divided by the number of pigs observed. Skin scrapings were collected from the outer ear canal of 15-20 sows, gilts or finishing pigs and examined for mange mites within 12 hours. The same animals were blood sampled, and sera from these were deep-frozen within 12 hours until assayed. A modified indirect ELISA (Bornstein and Zakrisson 1993) was used to demonstrate serum antibodies to *S. scabiei*.

Results

Questionnaire. The farms had in average 45 sows (standard error of mean, s.e.m.=1.7). Over 96% (96.2) of the farmers believed in the success of the eradication, 2.3% had failed and 1.5% were uncertain. When asked for reasons for failure 4 farmers claimed that it was the opinion of the local veterinarian, 2 reported about a new infection and 2 did not indicate any reason. The eradications had been done 20.9 months (s.e.m.= 0.8) before the questionnaire was answered.

On 301 farms (87%) two ivermectin injections(Ivomec®, 300 mcg/kg) were used with 14 days interval and on 9 farms phoxim (Sebacil Pour-on®, 30 mg/kg) was used three times with six days interval. Ten farms had used both ivermectin and phoxim at the same time and 22 farms had different ways: one ivermectin injection, ivermectin and phoxim 1-3 times, phoxime twice or stamping out. Half of the unsuccessful farms had used two ivermectin injections and the other half different methods: ivermectin once and phoxim once (1 farm), phoxim twice (2 farms) or ivermectin once (1 farm). Most of the farmers (88%) had dry-cleaned and sprayed the pens with insecticides, 4% had not done other measures than medications and 8% had used different kinds of cleaning procedures. Of the unsuccessful farmers all except one had dry-cleaned and sprayed the facilities with insecticides.

<u>Farm visits.</u> Skin scrapings were negative and rubbing indexes $\leq$0.1 in all farms visited. On four of the unsuccessful or uncertain farms, the eradication had been redone ½-6 months before the visit. Two uncertain farmers had become convinced about the success of the eradication at the time of the farm visit. Serum antibodies against mange are presented in Table 1 as optical density (OD) values.The cut-off value of the ELISA is 0.175 (Bornstein and Wallgren 1997).

Table 1: Serum antibodies presented as optical density (OD) values from 30 farrowing units after mange eradication, 15-20 samples per farm. The farms are divided according to the opinion of the owner. A= number of herds succeeded, B= number of herds failed or uncertain.

OD values	A	B*
OD $\leq$ 0.175 in all samples	10	2
0.176 $\leq$ OD $\leq$ 0.253 in 1 sample	11	3
0.176 $\leq$ OD $\leq$ 0.250 in 2-3 samples	3	0
0.232 $\leq$ OD $\leq$ 0.353 in 4 samples	0	1

* One farmer from the group A had become unsure about the success and was transferred to group B

Discussion

The eradication program against sarcoptic mange was in large successful. Very high percentage of farmers believed in the success. The recommended methods for mange eradications have been two ivermectin injections (Kelliher 1988) or application of phoxime three times (Madsen 1988). Half of the failed eradications had been done with other methods than those recommended. The need of cleaning and spraying the pens with insecticides remains questionable. In this study most of the farmers had cleaned and sprayed the pens in contrast to recommendations of Boraski and Brown (1992).

Farm visits confirmed the results of the questionnaires. The negative skin scrapings and low rubbing indexes indicate that the farms were free from sarcoptic mange. With only clinical signs it is difficult to estimate the presence of the parasite. Rubbing index has been considered to be a good indicator of mange when being higher than 0.4 (Madsen 1988). Skin scrapings are not very reliable in prooving freedom of sarcoptic mange. Bornstein et al. (1994) found mites only in 25% of samples. The results from the antibody determinations are not as easily interpreted. According to Bornstein et al. (1994) antibodies decrease in 10-12 months after eradication. When the cut-off point of 0.175 is used, the success of the few farms having 1-3 values slightly increased is questionable. It is not sure whether these herds can be classified as uninfected. The OD values of some individuals may take longer to decrease than expected. More experience is needed about individual variations of OD values in practical conditions.

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CHARACTERISTICS OF SEASONAL INFERTILITY OF THE SOW IN FINLAND

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Summary

Seasonal infertility of the sow is a problem recognised worldwide. A reduced farrowing rate in late summer and early autumn has been found to cause economically the most significant losses related to this problem. The present retrospective analysis includes breedng records of 1500 herds for the years 1994-1996 includes 230 000 mating / insemination events and 190 000 farrowing events.The preliminary results show considerable year to year variation in the incidence of seasonal infertility. On the other hand, significant differences between different geographical areas were detected. It was also noteworthy that in the far North, where the sun does not set for several weeks in the summer, seasonal infertility was not found to be a major obstacle. An interesting characteristic of seasonal infertility in Finland appears to be its long duration in the autumn.

Key words: Seasonal infertility, sow, housing

Introduction

Seasonal infertility seems to be a global phenomen. It has been been described all over the globe including Europe, America, Asia and Australia. The diversity of photoperiods represented by these continents is great. As the seasonal changes in the photoperiod are more profound towards the poles, one would expect to see more readily seasonal effects on reproduction closer to the arctic and antarctic regions. This statement stems on the fact that photoperiod has been identified as the primary factor underlying seasonal infertility in the pig (Love et al., 1993). Traditionally, pig housing methods in this country have been confine; this has included keeping the dry sows in individual stalls. Under these circumstances the sows may have been protected against the adverse effects of season on reproductive performance since individual housing seems to be the only way of housing that essentially prevents seasonal infertility in the presence of other stress factors of modern pig housing; restricted feeding, high and low ambient temperatures, restricted space, limited chances to express species characteristic behaviuor and limited light intensity. Current trend in the pig industry involves more extensive production of weaned piglets on the herd level with less attention being paid to individual animals. Concurrently, there is a tendency towards more loose housing methods as a result of public concern over housing methods and more importantly, as a result of improved health status of herds related to loose housing methods. These aspects have been taken into account in the present law in which recommendations and minimal requirements regarding housing methods (i.e. space allowance and grouping of dry sows etc.) have been defined. The present study was therefore undertaken to determine the significance of seasonal infertility in this country.

Materials and methods

Records of the Finnish Animal Breeding Association (FABA) are being utilised. They consist of more than 1500 farrowing herds (the majority of farrowing units in Finland), in which more than 230 000 artificial insemination (AI) events resulted in more than 190 000 farrowing events during the period under observation (1993-1996). Records regarding production and diseases are written down by the practitioner and forwarded to FABA for further analysis. The statistical model includes parity, type of housing (ie. group vs. individual) and geographical area as explanatory variables and reproductive performance variables (proportion of repeat breedings, farrowing rate, weaning to oestrus interval and age at first mating / insemination) with regard to the month of the event as response variables.

Results and discussion

The preliminary results show that there seems to be trend of impaired succes rate of breedings in the latter half of the year, as expressed by the seasonal variation in the percentage of repeat breedings (**Figure 1**). The fluctation in succes rate is within the range of 15 % and averaged 5-7 %, which has to be considered as a moderate seasonal fluctation in international comparison (Love et al., 1993; Xue et al., 1994 and Leman et al., 1992).

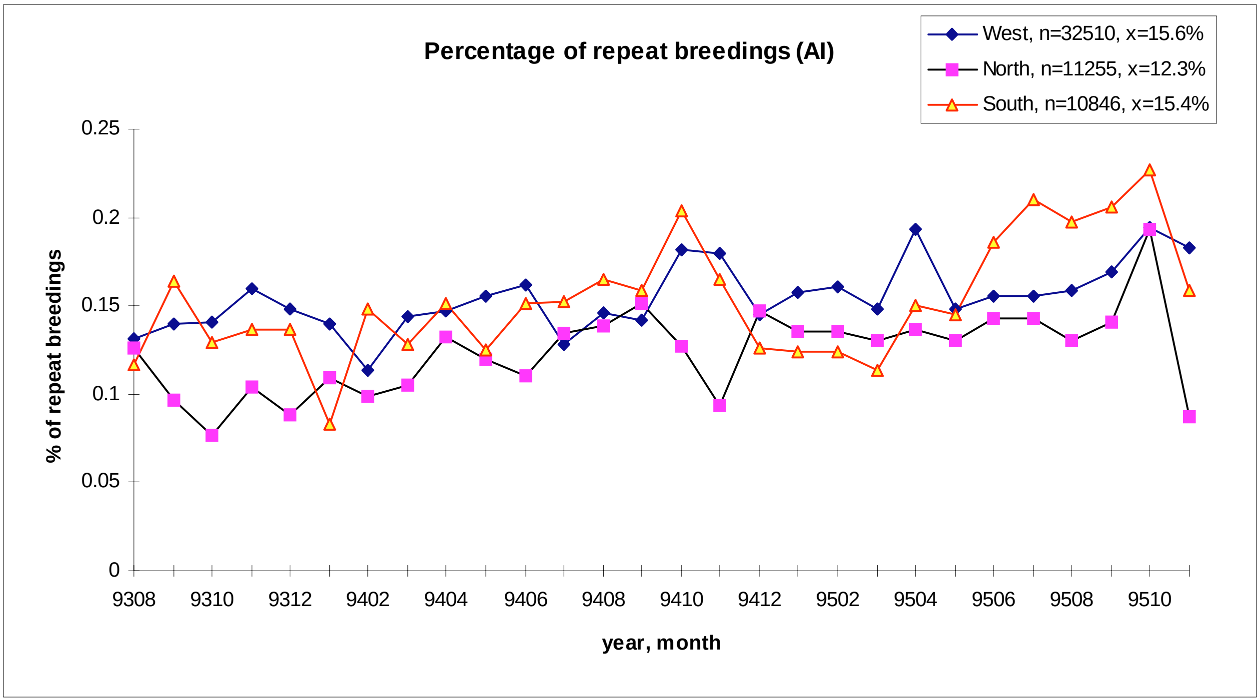

Figure1: Seasonal fluctuation in the precentage of repeat breedings expressed as a proportion of total number of breedings recorded during the period under observation.

A noteworthy observation is that of the relatively low and less remarkable fluctuation in the presentage of repeat breedings in northern Finland in comparison to the other regions (Figure 1). This contrasts with the hypothesis that northern parts of the country with constant light at nights during summer would be more readily affected by seasonal effects on breeding succes rates. There is a general tendency in this country, however, of the facilities, materials and buildings where domestic animals are kept, being in a better condition in northern Finland compared with the southern regions. This could partly explain the regional differences seen in the present study.

The moving average of the number of weaned piglets per sow indicate a tendency of less successful survival of piglets in the winter (**Figure 2**). This may be interpreted as the sows being less successful in their ability to take care of the litter in winter, since there was no corresponding trend in liveborn littersize. Interestingly enough, the seasonal pattern seen in the present study coincides with the seasonal pattern seen in prolactin concentrations in the European wild boar (Mauget, 1982).

Previous studies have shown that loose housing methods (i.e. group housing of pregnant sows) essentially predispose sows to the seasonal disruption of pregnancy (Love et al., 1993). This is currently being avoided in many Finnish loose dry sow units by closing sows into individual stalls for the first 3-4 weeks of pregnancy, and grouping of sows is being carried out thereafter. Promising production figures wihout significant problems related to seasons or other aspects of reproduction from farrowing units where sows are being housed in groups during and after farrowing in addition to keeping them in goups during pregnancy would suggest that such a system was eventually the most favourable one.

It is thought that photoperiod is the primary environmental factor signalling to the pig of a season of reduced sexual activity. Pathophysiological mechanisms involved in seasonal infertility, wheter it would be related to nutrition, temperature, photoperiod or social interactions, are not clearly understood.

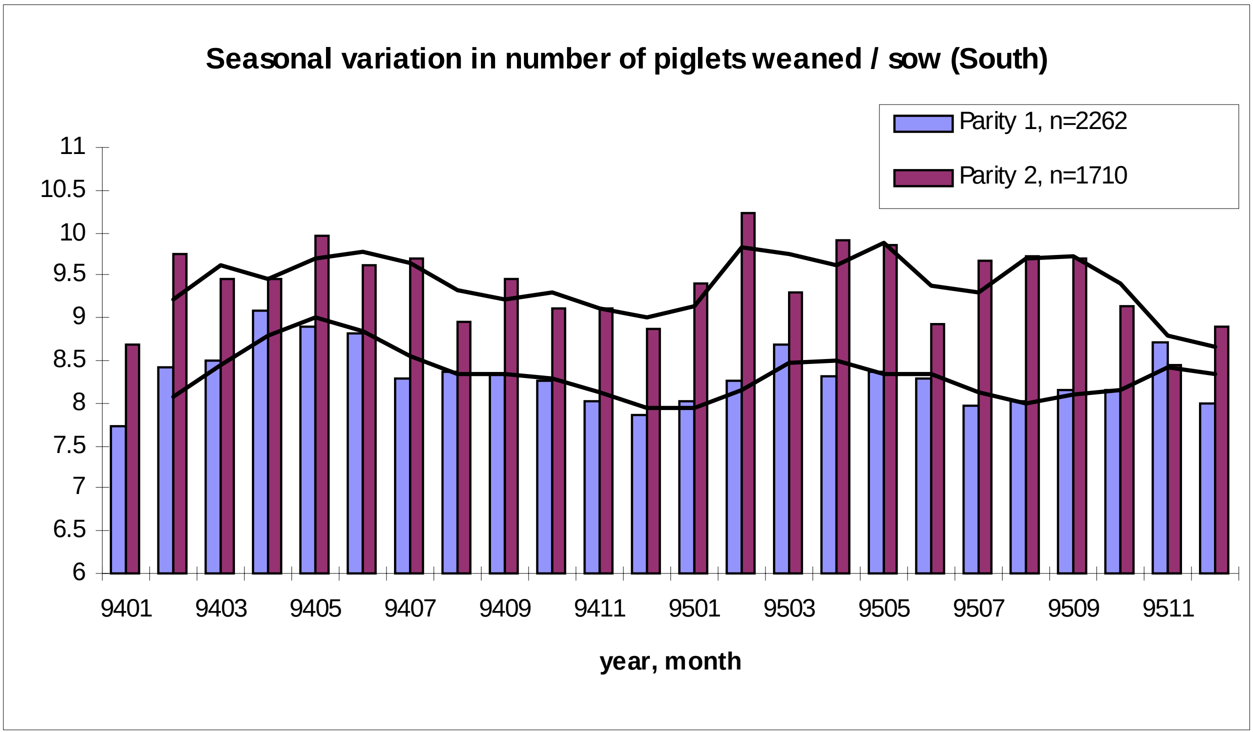

Figure 2: Seasonal variation in littersize at weaning in Southern Finland for the years 1994 and 1995 (trend expressed as a moving average).

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THE ROLE OF CHOLECYSTOKININ IN REGULATING FEED INTAKE IN PIGS

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Summary

The effect of exogenous cholecystokinin (CCK) on the behaviour of pigs under different feeding regimen was studied in 24 castrated male pigs that were either fed on a restricted basis or had ad libitum access to feed and were injected intraperitoneally (i.p.) with CCK-8S (the sulphated form of the CCK-octapeptide) or saline following a Latin Square Design with 2 replicates. The time used to consume a 500 g meal and the duration of the behavioural elements eating, exploration, walking, sitting and lying in recumbency were measured. As expected, animals that were fed on a restricted basis spent more time eating (28.0 ± 0.4 vs. 14.0 ± 1.1 min; $p<0.001$) and less time in recumbency (0.6 ± 0.3 vs. 13.7 ± 1.1 min; $p<0.001$) than animals that had limited access to feed. CCK only had a clear effect in those animals that had ad lib. access to feed. In the second replicate, CCK (vs. saline) caused a reduction in the time spent eating (11.6 ± 1.4 vs. 14.3 ± 1.2 min; $p=0.012$) and a rise in the time the animals were lying in recumbency (7.1 ± 1.4 vs. 4.4 ± 1.1 min; $p=0.002$). The CCK application (vs. saline) also resulted in a greater feed left-over at 60 min after delivery of the meal (146.5 ± 23.5 vs. 214.8 ± 30.2 g; $p=0.002$).

We conclude that the function of CCK in pigs is still not full understood. To make sound statements on the role of CCK further experiments are necessary.

Key words: CCK, pigs, feed intake, behaviour

Introduction

The role of endogenous CCK (a neuropeptide that is known as a satiety factor for the termination of a meal and that is produced in the gastrointestinal tract as well as in the central nervous system) in pigs is still not clear (Houpt 1985, Ebenezer and Parrott 1993). Pigs that are fed on a restricted basis still show behavioural elements related to feeding after they have stopped eating. Work with calves showed that the concentrations of CCK in plasma rise during non-nutritive sucking after a meal indicating that feeding behaviour itself is important to induce satiety (de Passillé et al 1993). This leads to the conclusion that during feed intake not only the nutritional requirements, but also the behavioural requirements need to be taken into account.

More information on the relationship between behavioural elements and the rise in CCK-release may bring important knowledge on how to feed animals in a way that the physiological and behavioural needs are accounted for.

Our goal was to investigate the influence of exogenous CCK on the behaviour of pigs fed under to different feeding regimen.

Material and Methods

Twenty-four castrated male pigs ((German Landrace x Large White) x Piétrain), 38.1 ± 5.3 kg) were kept in individual pens (1.5 x 1.5 m) in a environmentally-controlled room. The animals had ad lib. access to feed or were fed restricted (1 kg of the standard food/day) and were injected i.p. with saline (1 ml) or CCK-8S (1 μg/kg in 1 ml saline; Saxon Biochemicals GmbH, Hannover) according to a Latin Square Design in 2 replicates. Water was available all the time. Ten minutes after the injection, animals received 500 g food from a single feeder. Up to that point the animals that were fed on a restricted basis had been deprived of food for 18 hrs., the animals that had ad lib. access to food for 1 hr. Together with the latency time (time period from delivery of food untill the start of eating), the time needed to eat the meal or the feed left-overs at 60 min. after food delivery were measured. By means of videorecordings the duration of the behavioural elements eating, exploration, walking, sitting and lying in recumbency in the period from 10 mins. before until 40 mins. after the injection were measured. The data were analysed using the Wilcoxon Matched Pairs Test (StatSoft, Inc. 1995).

Results

Animals that were fed on a restricted basis spent more time eating (28.0 ± 0.4 vs. 14.0 ± 1.1 min; $p<0.001$) and less time in recumbency (0.6 ± 0.3 vs. 13.7 ± 1.1 min; $p<0.001$) then the animals that had ad lib. access to feed. CCK only had a clear effect on the animals that had ad lib. access to feed. In the second trial, CCK (vs. saline) caused a reduction in the time spent eating (11.6 ± 1.4 vs. 14.3 ± 1.2 min; $p=0.012$) and a rise in the time the animals were lying in recumbency (7.1 ± 1.4 vs. 4.4 ± 1.1 min; $p=0.002$). The CCK application (vs. saline) also resulted in a greater feed left-over at 60 min. after delivery of the meal (146.5 ± 23.5 vs. 214.8 ± 30.2 g; $p=0.002$). CCK application caused an increase in the time pigs spent consuming the meal when fed under a restricted regimen (33.6 ± 2.1 vs. 31.7 ± 2.0 min.; $p= 0.039$).

Discussion

CCK-application only slightly affected the behaviour of the animals and our data therefore only partly confirmed the results found in the literature. An explanation for this might be found in the methods we used. Baldwin et al (1982, 1983) showed that an intravenous injection of 0.9-3.7 µg/kg CCK significantly reduced feed intake in animals that were fasted for 23 hrs. These effects were investigated with the operant conditioning technique, a method where animals are working for food on a fixed schedule. Under practical conditions the situation might be different in that the animals have free access to feed. Motivation for feeding in pigs that were fed on a restricted regimen seemed to override the effect of CCK which was apparent in animals with had ad lib. access to feed. Anika et al (1981) showed that an intraperitoneal application of 3.7 or 5.5 µg/kg CCK in animals that didn't have access to food for 4 hrs reduced the feed intake by 30.3 and 16.9% respectively. Although a dose of only 0.47 µg/kg CCK reduced intake by 13%, our dose (1.0 µg/kg CCK) might have been too low to have an effect in the animals that fasted for 18 hrs. Furthermore, in the course of the experiment there was a tendency that animals needed less time to consume the meal, independent of the treatment. This points to an effect of the method of application on the behaviour. Perhaps the first injections caused a stress reaction that suppressed the effect of the CCK- or saline-application, whereas animals seem to habituate with successive treatments. In future experiments animals should be given more time to adapt to the method of application. Another point that should be taken into consideration in future experiments is the role of endogenous CCK. Douglas et al (1995) tested the effects of feeding regimen (access to feed once a day or once every 3 days) on feeding motivation and blood parameters in gestating sows. They found that the blood plasma concentrations of CCK were the same before a meal, but 2 hrs. after feed delivery were higher in sows that had access to feed once every 3 days compared with sows that had access to feed once a day. The animals that had access to feed once every 3 days also showed less oral stereotypies. When analysing the effects of CCK the levels of endogenous CCK must also be considered in order to optimise meal size and feeding regimen to satisfy the behavioural needs of pigs.

Conclusions

- The feeding regimen strongly affected feeding behaviour as expected.
- Decreased feeding motivation through exogenous CCK was strongest in animals that had ad lib. access to feed.
- Further research is needed to clarify the role of CCK in regulating feed intake in pigs.

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Circadian rhythm of the light-dependant hormone melatonin as an indicator for the photicrequirement of domestic pigs

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Summary

The basic characteristics of living organisms are: reproduction, excretion, motion, respiration, excitation, nutrition, growth and rhythmicity. The endogenous rhythm, the so called \`biological clock´, controls and regulates physiological processes, behaviour and hormone profiles. Within the biological rhythm, the endogenous impulses will be synchronised by natural- (i.e. daytime or season), housing- (i.e. artificial light) and management- (i.e. feeding and controlling time) dependent regulators (\`Zeitgeber´).

The aminoacid tryptophan, will be enzymatically converted to serotonin and further to melatonin in the pineal gland. During darkness the pineal gland produces more melatonin than during daylight. The duration of the higher nocturnal melatonin secretion depends on the duration of darkness. The hormone is excreted by urine and salivary glands.

Five domestic pigs (DE/DL; body weight approximately 30 kg) have been reared in single-pens with a light/dark rhythm of 8 hours light and 16 hours dark (8 lx). The period of light was divided in 6 days of artificial light with 1300 lx and 6 days artificial light with 50 lx. The 24-h profile of melatonin in saliva has been analysed by radio-immuno-assay. In comparison to the 50 lx conditions, the 24-hours hormone profiles of saliva of the pigs housed with 1300 lx conditions have a distinct melatonin rhythmicity with significantly higher concentrations at night and low day levels. The melatonin concentrations of pigs under 50 lx treatment are in the photophase significantly higher than of the pigs under 1300 lx treatment. The melatonin concentrations of pigs in 50 lx treatment did not differ between photophase and scotophase. Therefore it is necessary to increase the required minimum light intensity of currently 50 lx (German law for swine husbandry) accordingly to realize pig housing under respect of rhythmicity and therefore behavioural and individuals welfare. Obviously the rhythm of melatonin is an appropriate indicator for the assessment of the quantitative, temporal, and possibly the qualitative light requirements.

Keywords: Melatonin - pigs - saliva samples - light intensities - rhythmicity

Introduction

N-Acetyl-5-methoxytryptamine (melatonin) is a biogenic amine or indolamine, which is produced in the pineal gland and in low values also in the gastrointestinal tract (Huether et al., 1992). The Hydroxyindol-O-Methyltransferase, a organ specific enzyme of the pineal gland, converts the aminoacid tryptophan to serotonin and further to melatonin. As 6-hydroxy-melatonin or after decarboxylation and desamination, melatonin will be excreted with the urine or the saliva (Garfinkel et al. 1995). The concentration of melatonin in human saliva is in close correlation to the melatonin-concentration in human plasma (Miles et al. 1985a). Approximately 70% of the circulating melatonin is bound to plasma-albumin (Cardinali et al. 1972). The remaining unbounded fraction (approx. 30%) can diffuse by the aciniform cells of the salivary glands into saliva (Miles et al. 1985a, Nowak et al. 1987, Rice et al. 1995).

The secretion of melatonin from the pineal gland is influenced by different factors. These are social factors, physical activities, food intake, and light regulating the rhythm-regeneration by the nucleus suprachiasmaticus (Stoll and Müller 1996). Aside from an indirect effect of light through skin, the perception through eyes is the most important factor. Light suppresses the secretion of melatonin. The pineal gland produces more melatonin during darkness than during daylight . The duration of the melatonin-secretion equals the duration of darkness both in animals with a seasonal and non seasonal estrous cycle and in man (Utiger 1992). A circadian rhythm of melatonin was found in cattle (Critser et al. 1988), in sheeps (Earl et al. 1985), in rats, hamsters, gerbils, guinea pigs (Rudeen et al. 1975), and in chinchillas and rabbits (Hudson and Distel 1990).

In contrast to many other mammals, for a long time it was assumed that pigs has no melatonin rhythmicity. Neither in long nor in short photoperiods a distinct melatonin rhythmicity could be measured (McConnell and Ellendorf 1987, Brandt et al. 1986). On the other hand, in the european wild boar a distinct melatonin rhythmicity with a 4-5 fold higher serum melatonin level at night could be measured (Mauget et al., 1990). Only in series of tests with pigs housed with increasing luminous intensities (Griffith and Minton 1992) or with artificial photoperiodic conditions which are equivalent to the natural photoperiod (Paterson et al. 1992a) a distinct nocturnal rise of melatonin in serum was detectable.

Material and methods

General. Five crossbred pigs (DE/DL), two males (castrated) and three females (body weight 30 ± 2.4 kg) were moved from group housing into one environmentally controlled room (22-24°C), where they were tethered in single-pens. They were fed twice daily and water was available continuously. Pens were washed and animals were checked daily; the routine tasks varied from 1200 to 1300 on consecutive days. An 8-h photoperiod (lights on 0800 to 1600) was provided throughout the experiment. Artificial lights provided 50 ± 8 lx (mean ± standard deviation) for 6 days (control (**CON**) treatment; n=5) and 1300 ± 113 lx (intense (**INT**) treatment; n=5) for another 6 days in every single pen. Dim lights provided 8 ± 2 lx were illuminated continuously at night (dark 1600 to 0800; 16 h). *Saliva sampling and Hormone Assays.* Pigs were given at least 10 d of exposure to tethering and 4 d to each photoperiod before saliva samples were obtained. During a period of 48 h, saliva samples were taken with a cotton swab every 2 h. After centrifugation and extraction with C-18-columns, melatonin in pig saliva was analyzed with a radio-immuno-assay [^{125}I] according to the assay procedure (Bühlmann Laboratories AG, Allschwill, Suisse).

The performance characteristics are listed in **table 1**. The recovery of dilution linearity was for the saliva:buffer dilution of 75% approx. 113%, for the 50% dilution 126%, and for the 25% dilution a recovery of 130% was measured.

Table 1: Performance characteristics

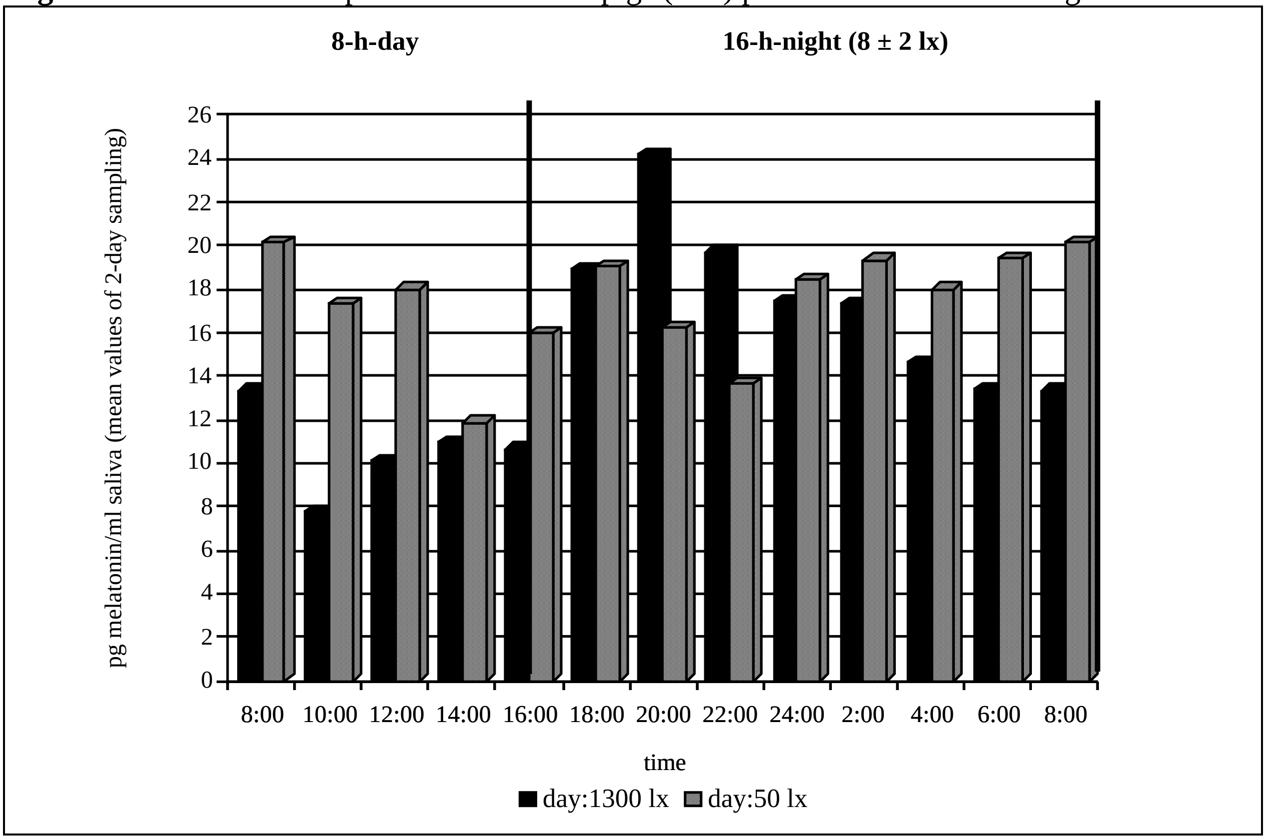
Concentration	**Intra-Assay Precision (Within-Run)**	**Inter-Assay Precision (Run-to-Run)**	**Spiking Recovery**
5pg melatonin/ml saliva; n = 12	SD 3,575 CV% 9,1	SD 0,72 CV% 2,01	Recovery 98%
10pg/ml melatonin/ml saliva; n=12	SD 4,093 CV% 9,2	SD 5,077 CV% 12,25	Recovery 99%

SD - Standard Deviation in pg/ml; CV% - Coefficient of Variation in %

Results

The 24-h melatonin profiles showed a significant treatment x time interaction at day (**Figure 1**). The melatonin concentrations in saliva differ between the two treatments at day and pigs in the CON treatment had a greater ($p<0,05$) melatonin concentration during the photophase (CON=15,788 ± 2,37 pg/ml) than pigs in the INT treatment (INT=9,875 ± 1,25 pg/ml). In contrast, concentrations of melatonin did not differ in the scotophase between pigs in the CON and in the INT treatment (CON=18,03 ± 1,99 pg/ml; INT=17,384 ± 3,43 pg/ml; $p>0,05$).

Figure 1: 24-h melatonin profiles in saliva of pigs (n=5) provided with different light intensities



Pigs in INT treatment had a greater (approx. 56,8%) melatonin concentration in the scotophase ($p<0,05$) than in the photophase. The INT melatonin profiles show a distinct circadian rhythmicity with a maximum at 2000 (24,19 ± 13,7 pg/ml), followed by gradually decreasing concentrations, a minimum at 1000 (7,79 ± 7,2 pg/ml), and than gradually increasing concentrations. Figure 1 shows the distinct decrease (approx. 58,3%) of melatonin when the lights have been turned on (0800) and the increase (approx. 65%) when the lights have been turned off.

The melatonin concentrations of pigs in CON treatment did not differ between photophase and scotophase (CON photophase = 15,788 ± 2,37 pg/ml; CON scotophase = 18,03 ± 1,99 pg/ml). There is no obvious circadian rhythmicity of melatonin in saliva as well as a distinct decrease (approx. 13,9%) and a distinct increase (approx. 19,2 %) of the melatonin concentrations in saliva when lights have been turned on and off.

There is a good reproducibility for the individual 24-h profiles of melatonin in saliva, but interindividual are distinct differences of the melatonin concentrations (e.g. pig nr. 151: mean value of 48 h = 10,066 ± 1,53 pg melatonin/ml saliva; pig nr. 161: = 21,514 ± 4,68 pg/ml).

Conclusion

The 24-h profiles of melatonin in saliva of pigs housed under 1300 lx (INT) conditions have a more distinct melatonin rhythmicity with significantly higher melatonin concentrations in the scotophase than in the photophase and a clear circadian rhythmicity with low day- and increasing night-levels. A distinct circadian rhythm of melatonin in saliva of pigs provided with 50 lx (CON) was not detectable.

The \`biological clock´ is a endogenous rhythm which regulates physiological processes, behaviour and hormone profiles. Within the biological rhythm, the endogenous impulses will be synchronised by natural- (i.e. daytime or season), housing- (i.e. artificial light) and management- (i.e. feeding and controlling time) dependent regulators (\`Zeitgeber´). The interaction of endogenous impulses and external regulators (\`Zeitgeber´) gives rise to phenotypic identifiable and defined rhythms which organize functional sequences. Rhythmicity is next to reproduction, excretion, motion, respiration, excitation, nutrition, and growth one of the basic characteristics of living organisms. The most important rhythms, the daily and seasonal rhythms, are regulated by light and its photoperiodical changes. Also the endogenous rhythm of melatonin is regulated by the \`Zeitgeber´ light. But housing of pigs with low artificial light intensities (50 lx) prevent the development of a biological endogenous rhythm. According to the results of Griffith and Minton (1992) a distinct circadian melatonin rhythm in pigs is only detectable under higher luminous intensities. In addition, housing of pigs under low luminous intensities lead to significantly higher melatonin concentrations in the photophase in contrast to the 1300 lx treatment.

The difference between 50 lx (day) and 8 lx (night) is not sufficient to inform the organism about day or night and so there is no decrease (day) or increase (night) of the melatonin concentration in saliva of pigs detectable. Therefore it is necessary to increase the required minimum light intensity of currently 50 lx (German law for swine husbandry) accordingly to realize pig housing under respect of rhythmicity and therefore behavioural and individuals welfare. Obviously the rhythm of melatonin is an appropriate indicator for the assessment of the quantitative, temporal, and possibly the qualitative light requirements.

In addition the results show that saliva of pigs is a good diagnostical medium for measuring melatonin and collection of saliva with cotton swabs as a non invasive stress-reduced technique is more easy to handle with pigs in comparison to blood samples.

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The list of literature with titles can be requested from the authors.

What is important in preweaning mortality ?

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Summary

Data of 60 litters was analysed with multivariable regression models to find out risk factors for low piglet production and mortality. Litter size alone explained 80 % of the variation of the number of weaned piglets, when intrapartal hypoxia, trauma and hypoglycaemia had been accounted for. Large litter size caused a higher risk of mortality because of the lower birth weight of piglets in large than in small litters and because of the greater variation of weights. High mortality rate did not decrease mean weight gain of survived piglets within a litter when controlled for litter size.

Key words: piglet mortality, risk factors, causes of death

Material and methods

During a 2-year period data of a total of 60 independent litters on the Pig Research Centre was collected. No gilts were included in the study population. Every stillborn or unweaned dead piglet was frozen and later autopsied in a diagnostic laboratory to find out the primary reason for death. The date of the death and the finding place in the pen were recorded (in front of the sow/ behind the sow/ under the heat lamp/ somewhere else). The sows were farrowing in crates in conventional farrowing pens with concrete floor and straw bedding. No cross fostering was practiced. In addition, the following data was recorded of every litter: sow and piglet race (Yorkshire, land race, cross breed); sow farrowing number and feeding group (4 groups); gestation length; time of farrowing (day/night) and length of farrowing; total number of piglets born; sex of piglets; individual piglet weight at farrowing and on days 1,2,3,21 and 35; need of farrowing assistance; medications; sow body temperature and appetite twice a day on days 1,2 and 3.

Statistical analysis was carried out with Statistix® 4.1 software. Both parametric and nonparametric tests were used to find out simple associations between different variables.

Multivariable technics (linear and logistic regression) were used to find out risk factors on litter level for low piglet production and for different causes of mortality.

Results

Table 1. Some descriptive statistics of 60 independent litters counted on litter level.

	Mean (Median)	Range	SD
Sow farrowing no.	3,6	2 - 7	1,7
Liner size	11,8	3 - 18	4
Mortality rate of liveborne piglets (%)	(10,6)	0 - 60,0	—
No. of weaned piglets	9,2	2 -14	3,1

Table 2. The causes of mortality and their proportion of the tot. mortality.

	Proportion of the total mortality rate (%)	**No. of litters with mortality in question (total N=60)**
Ante partum death	**8,9**	**8**
Intra partum death	**30,5**	**29**
Trauma	**21,6**	**22**
Hypoglycaemia	**11,4**	**12**
Arthritis	**6,9**	**5**
Splayleg	**6,6**	**7**
Kahexia	**5.0**	**5**
Underweight	**5 0**	**8**
Other cause	**4,9**	**7**

The best multivariable model to predict the number of weaned piglets explained 87 % of the total variation. Litter size alone explained 80 % of the variation, when the dichotomous variables intra partum hypoxia, trauma and hypoglycaemia had been accounted for. According to residual analysis, one litter was dropped out of the final analysis. This litter was hit by an unusually high splayleg mortality rate (8/15). The risk factors for the three main causes of death were studied in three different logistic regression models (table 3). High mortality rate (3 or more dead piglets/litter) did not decrease mean weight gain of survived piglets within a litter when controlled for litter size.

Discussion

The regression models together showed clearly the fact that more piglets were weaned from large than from small litters in spite of the higher risk of mortality in large litters. This means that farmers certainly should select for large litter size. However, if the risk of high mortality rate could be reduced in those litters which have the greatest risk, the production numbers could be significantly improved. According to the linear regression model the different causes of death were at least partly associated to different risk factors. Consequently, to reduce mortality, the real causes of death behind the cold numbers should be known.

Table 3. Coefficient, p-value and odds ratio (OR) of different variables of 3 different models to predict the risk of mortality.

		Coefficient	STD error	Coef/SE	P	OR	95 % C.I.
Intrapartum mortality	CONSTANT	-3,31	1,19	-2,79	0,01		
	OLD	-1,63	0,68	-2,39	0,02	0,20	0,05-0,75
	LITTER SIZE	0,34	0,10	3,34	< 0,01	1,40	1,15-1,71
Mortality due to trauma	CONSTANT	-67,26	21,29	-3,16	< 0,01		
	OLD	1,26	0,66	1,91	0,06	3,51	0,97-12,71
	TEMP5	1,69	0,54	3,12	< 0,01	5,44	1,88-15,79
Mortality due to hypoglyc.	CONSTANT	-8,85	2,86	-3,09	< 0,01		
	LITTER SIZE	0,35	0,16	2,15	0,03	1,42	1,03-1,95
	CROSS BREED	-2,69	1,26	-2,13	0,03	0,07	0,01-0,80
	MINMAX	3,20	1,60	2,00	0,05	24,61	1,06-570,63

TEMP5 = body temperature of the sow at 5th occasion, C
MINMAX = difference between the highest and the lowest birthweight, kg
OLD = farrowing no. >= 4 CROSS BREED = Yorkshire X landrace (sow)

One mechanism why large litter size caused a higher risk of mortality, was the seemingly lower birth weight of piglets in large than in small litters and the greater variation of weights. If the mean birth weights of intra partum dead piglets, traumatized and hypoglycaemic piglets were separately compared to the mean weights of survived piglets within the litters (data not shown), a difference was seen. All piglets that died were significantly lighter even at birth. The differences between mean weights ranged between 219-373 g . Of course, the lighter birth weight did not have to be the cause of mortality. However, these piglets were more exposed to those environmental conditions and sow behaviour which led to mortality. This was probably the case with intra partum dead piglets, too. In spite of having suffered from some placental insufficiency even during the gestation period, these small piglets could have survived if the farrowing process had progressed fast. In fact, the mean length of harrowing in litters with intra partum mortality was more than an hour longer (p=0,08) than that in the rest of the litters. The length of harrowing was not included in the model because it was only known of 40 litters.

Health is difficult to define. In our study the body temperature of sows was measured and the appetite estimated regularly during the 3 first days post partum. In addition, piglets were weighed to follow the milk production by the sows. Furthermore, a new dichotomous variable (MMA) was made in combining body temperature and appetite (body temperature >= 39,5° C and appetite not normal). The only variable which remained in any model was TEMP5 (see table 3.).

In contrast, high mortality rate did not decrease mean weight gain of survived piglets within a litter when controlled for litter size. So, the effect of "bad health" on mortality was difficult to express. The rise in temperature in litters with mortality due to trauma (0,6°C on average) can probably not have been accounted for disease but rather just an increase of metabolism. Could it have been that sows who violated their piglets were individuals, who were particularly sensitive to disturbances and stress during the post partal period ? The increasing age of the sow decreased the risk of mortality due to intrapartal hypoxia but increased the risk due to trauma. It is obvious that "old age" expresses several age dependent factors, which should first be identified and then analysed separately.

Conclusions

The reduction of preweaning mortality to 10-15 % presupposes the use of cross fostering. It should be practiced according to litter size and birth weights of piglets. The harrowing attendance should in all occasions be concentrated on piglets with the lowest birth weights. Farrowing pens, where sows are able to behave in a natural way, probably reduce the risk of mortality due to intrapartal hypoxia and trauma.

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Practical application of chitosan in pig' production.

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Summary

The studies were carried out in two farms on 290 sows and 2223 piglets born by these sows. The animals were divided in three groups: the first was treated with chitosan intramuscularly; the second orally and the third was a non treated control group. Chitosan was used in two formulation - as chitosan adipate and chitosan ascorbate. The drug was administered following: sows 10 days before farrow in a dose of 2 - 3 mg/kg of body weight and for piglets - in a dose of 5 mg/kg of body weight 21 days after birth; per os the dose was higher - for sows 3 - 4 mg/kg of body weight and for piglets 7 mg/kg of body weight. In piglets the following parameters were analysed: weight gain, mortality, number of weak born animals.

It has been established that chitosan stimulated the immunity and production of piglets. After oral or intramuscular application of the drug, the weight gain in the experimental groups were higher (about 0.5 - 1.0 kg) and the mortality was lower (4 - 5 per cent), comparing with the control group.

Chitosan could enhance the non-specific host resistance and gave a high protection against lung and intestinal diseases. In the experimental piglets higher weight gain and lower mortality were established.

Key words: pigs, chitosan , immune adjuvant, weigh gain, mortality

Introduction

Chitin, which is a biodegradable polymers is an natural mucopolysaccharide and chitosan is N-deacetylated product of chitin (DAC-70). Chitosan has a lot of valuable biological, chemical and physical proporties and can be used in wide spectrum applications in medicine, veterinary, cosmetics, food industry, agriculture, and biotechnology. For many years investigation has been done to apply chitin and chitosan in veterinary medicine. As it has been prove, chitosan is an attractive pre -paration in healing injuries (Allan et al. 1984, Brzeski et al. 1991, Ramisz et al. 1993) burns (Burke et al 1979) and after surgical intervention as well as old suppurating wounds Chitopan, a preparation containing chitosan, as an active component, was successfully implemented in Poland for external use in veterinary practice (Ramisz et al. 1993). This preparation is highly efficient in healing wounds of various kinds, including whitlow caused by certain Fusiformis strains (Ramisz et al 1994).

It has been reported, that chitosan showed potent immunological activities such, as activation of macrophages and stimulation of nonspecific host resistence (Nishimura et al. 1984, Nishimura et al. 1986, Ramisz et al. 1994, Sawayanagi et al. 1982).

The aim of these studies was to establish the influence of chitosan on alimentary canal infection in pigs.

Material in metods

The studies were carried out in two farms on sows 290 and 2223 piglets born by these sows. The animals were divided into three gropus: the first treated with chitosan adipate intramuscularly; the escond was treated orally with chitosan ascorbate and the third was a non treated control group. Chitosan was used in two formulastion - as chitosan adipate and chitosan ascorbate. Basic quality requirements for chitosan are given in Table1.

Table 1. Parameters of chitosan*

Item	Properties	Requirements
1.	Moisture content	Not greater than 5%
2.	Ashes	No more than 1%
3.	Degree of deacetylation	Greater than 80%
4.	Viscosity of standard solution	Not greaterv than 30mPa*g
5.	Molecular weigth**	In the range $4.0*10^5$ to $5.0*10^5$

* Chitosan is consistent woth the Polish Standard No. PN-89/A-86850 [7]

** According to the method of Robers and Domszy [8]

Intramusculary the drug was administered as follows: sows - 7-10 days before farrow in a dose of 2-3 mg/kg of body weiht, and for piglsts - in dose 5 mg/kg of body weiht, 31days after birth. The doses per os were higher - for sows 3-4 mg/kg of body weiht and for pigles 7 mg/kg of body weiht. The information regarding experimental animals, drug doses and reseach time is presented on tables 2 and 3. For piglets, the following parameters were analyzed: weight gain, mortality, number of weak born animals.

Results

After chitosan adipate or ascorbate was administered intrajmuscularly or orally, better production and lower mortality in the experimental groups, comparing with the control group, were observed. It was established that in experiment, stage II (tab. 2) after intramuscular treatment, the weight gain was about 0.82 kg higher and the mortality 4.1%lower than in the control group.The results after intramuscular administration of chitosan ascorbate were following: weight gain 1.06 kh higher and mortality 4.6% lower comparing with the control group.

Table 2. The influence of chitosan adipate and ascorbate on health and production of piglets after intramusculary administration

Group of animal	Number of animals		Average body weight		x_2-x_1	Mortality	
	Sows	Piglets 31 days old	before (kg) x_1 treatme-nt	60 days after treatme-nt x_2		number	%
3% of chitosan adipate - 5 mg/kg b.w.							
Control	55	408	7.90	25.68	17.78	54	13.74
Experimental	55	427	7.98	26.50	18.52	39	9.19
4% of chitosan ascorbate solution - 5 mg/kg b.w.							
Control	45	348	8.56	26.09	17.53	39	11,21
Experimental	45	338	8.45	27.15	18.70	23	6.60

After oral administration (tab.3) of chitosan the results were similar: the weight gain was 0.35 to 0.47 kg higher and the mortality was 3.5 to 4.9% lower than in the control group. The oral dose of chitosan was about 40% higher than the intramuscular dose.

Table 3. The influence of chitosan adipate and ascorbate on health and production of piglets after orally administration

Group of animal	Number of animals		Average body weight		x_2-x_1	Mortality	
	Sows	Piglets 31 days old	before (kg) x_1 treatment	60 days after treatment x_2		number	%
I experiment - 4% of chitosan ascorbate solution							
Control	30	231	7.8	24.65	16.85	27	11.66
Experimental	30	235	7.6	25.5	17.55	17	7.20
II experiment - 4% of chitosan ascorbate and 3% of chitosan ascorbate solution							
Control	10	80	7.8	25.1	17.30	9	11.2
Experimental (ascorbate)	10	79	7.9	25.87	17.97	5	6.3
Experimental (adipate)	10	77	7.6	25.75	18.15	6	7.7

Chitosan and Chitopan® has been introduced in veterinary practice in Poland, for wounds and trauma treatment only [ ]. Practically, up till now, the drug was used internally only for experimental studies on laboratory animals [ ]. For the first time in our studies, chitosan was used internally (intramuscularly nad orally) for prophylaxis of animals canal infections in pigs.

Conclusions

1. It has been established that chitosan adipate or ascorbate afrer intramuscular or oral administration, gave a better production and lower mortality in the experimental groups comparing with the control group.
2. The following doses of chitosan are recommended: intramuscular administration: sows 2-3 mg/kg of body weiht, and 31days old piglsts; 5 mg/kg of body weiht; oral administration - sows - 3-4 mg/kg of body weiht and 31days old piglsts; 7 mg/kg of body weiht. The doses were established in relation to the active substance.
3. Chitosan adipate and ascorbate could be recommended for prophylaxis of alimentary canal infections of piglets.

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Application of Lactobacillus Reuteri and E. coli and immune response in pigs.

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Summary

The aim of our study was to obtain more information about the influence of Lactobacillus Reuteri on the systemic immunity response in relationship to bacterial pathogen E. coli in the digestive tract of piglets. In two model experiments, 18 pigs in each group - experimental (E) and control (C) - were used. For 49 days, 10 animals in group E were given 3 ml of Lact. Reuteri oral for 5 days. Each animal was applied with 3 ml E. coli. Blood collection was from eyes, through the venous circulation on the 49, 54 and 59 days of age. To realize the aim, we determined phagocytic activity of neutrophils (FA Ne) and leukocytes (FA Lc), the phagocytic activity index of neutrophiles (IFA Ne) and leukocytes (IFA Lc), reduction of tetrazolium salt (INT Test) and concentration of total immunoglobuline- (Tlg). 24 hours after application of E. coli in group C, first clinical changes, such as increased temperature and, in one case, death, appeared. In group E no death was recorded. Obtained values were highest in group E on 59 day of age.

Key words: Pigs, Lactobacillus Reuteri, enteropathogenic E. coli, digestive tract, probiotics, phagocytic activity, total immunoglobulin (Tlg), tetrasolium salt test(INT test).

Introduction

Pathogenic E. coli present the most frequent diarrhoea causing- agents in young animals (Holoda, Mikula, 1995). Employing probiotics seems to be a very efficacious method of preventing and treating diseases caused by a pathogenic micro-organisms, mainly the diarrhoeic syndrome in the young farm animals. Some authors explain the antibacterial effects of probiotics to result of the production of organic acids (lactic, acetic and formic acids) and a decrease of pH (Babel, 1977), the production of hydrogen peroxide, free radicals and their bacteriostatic or bactericidal effect (Piard and Desmazeaud, 1991), the production of natural antibiotic substances - bacteriocins (Vanderbergh, 1993), competitive exclusion (Chauviere et al., 1992) and antienterotoxic activity (Mitchell and Kenworthy, 1976), having direct effects on the individual immune response in animals.

Materials and methods

18 piglets weaned on 42 day were included in the experiment. They all were from the same bear, genetic origin, age, approximately- the same weight. Two groups were created: control group (C) and experimental group (E), containing both sexes. Lact. Reuteri was orally applicated to 10 piglets, age 49 days, in group E for a five days in amount 3 ml per animal.

1 ml of the concentrate contained 10^8 Lact. Reuteri, E. coli 08:K88 was orally applicated to animals in both groups in amount 3 ml per animal on 54 day of age. Blood samples taken from eye venous circulation were collected on 49 day (before application of Lact. Reuteri), on 54 day (before application of E. coli) and on 59 day on purpose to gain the values of FA Ne, FA Lc, IFA Ne, IFA Lc, INT Test and Tlg concentration. The FA Ne, FA Lc, IFA Ne, IFA Lc was done by the modified method according to Vetvièky et al., 1982 Tetrazolium reductase activity (INT Test) were done by the modified method according to (Lokaj, Obúrková, 1978).

The concentration of the serum immunoglobulins (Tlg) was gained by turbidimetric method according. to (McEwon et al., 1970)

Results

FA test with HEMA elements confirmed the increase of FA Ne in group E 38.80 ±0.32 (group C 32.41 ±0.86 - graph 1), IFA Ne group E 3.91 ±0.05 (group C 3.33 ±0.20 - graph 2), FA Lc group E 34.00 ±1.0 (group C 29.50 ±0.5 - graph 3), IFA Lc in group E

3.88 ±0.06 (group C 2.91 ±0.29 - graph 4) on the 59 day of age. INT test quantity parameters were in correlation with FA test results. Metabolic activity increase of the phagocytes in group E was 1.93 ±0.04 against group C (1.31 ±0.11 - graph 5). Tlg concentration before experiment (49 day of age) was in group E

1.16 ±0.13 and in group C 1.16 ±0.01. An increased level of the Tlg concentration was inspected in group E 1.93 ±0.04 (group C 1.31 ±0.11 - see graph 6).

Discussion

The results gained by various authors are equivalently different. Analysis of our results confirmed immunostimulatory effect of Lact. Reuteri against E. coli and proved the effects of probiotics on the protection of digestive tract against E. coli colonization. The improvement of health environment in group E confirms these facts. Meanwhile, negative clinical performances in control group (C) were evident: inapetency, increased temperatures, diarrhoea and death of one animal with gastroenteritis signs. The experiment confirmed, that objected application of suitable probiotics (Nemcová, 1997) can lead to therapeutical, prophylactic and immunostimulatory effects, also when keeping the ecological, economical and ethical conditions by pig-breeding.

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Values of immunity indicators after peroral application of Lact. Reuteri and E. Coli in weaned piglets

Graph 1. Phagocytic activity of Neutrophilis

Graph 2. The Phagocytic activity index of Neutrophilis

Graph 3. Phagocytic activity of Leucocytes

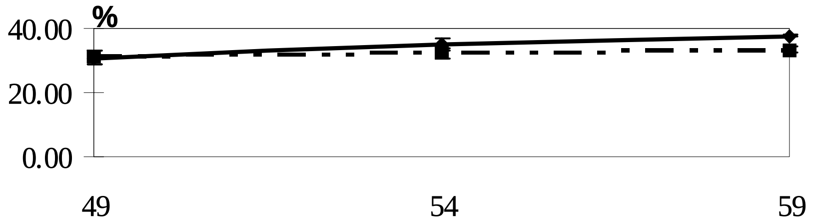
Graph 4. The Phagocytic activity index of Leucocytes

Graph 5. Values of reduced tetrasolium salt test

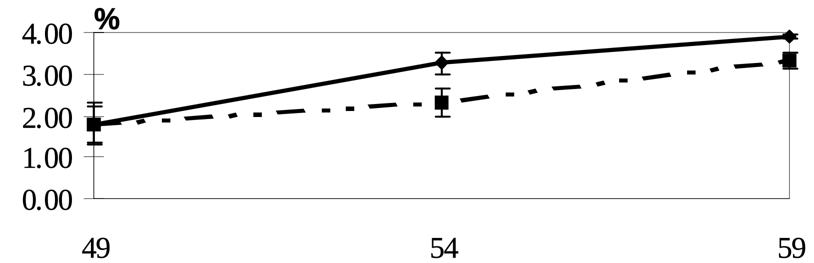
Graph 6. Concentration of total Immunoglobulin

Values of immunity indicators after peroral application of Lact. Reuteri and E. Coli in weaned piglets

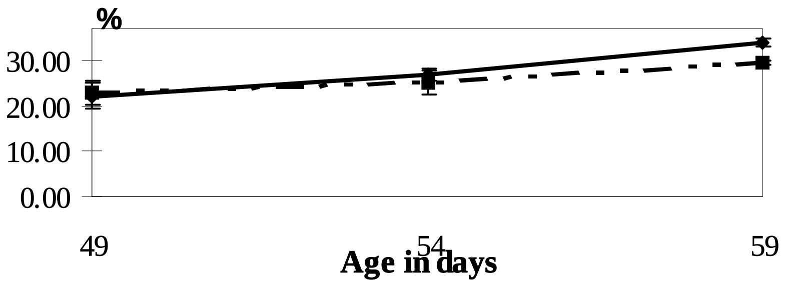
Graph 1. Phagocytic activity of Neutrophils



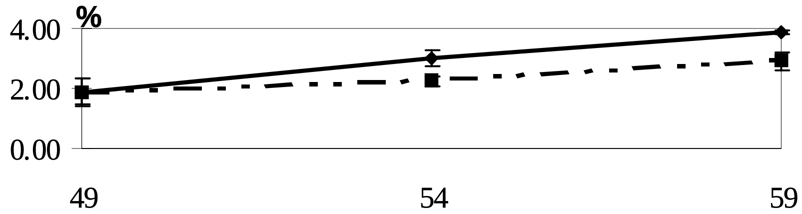
Graph 2. The Phagocytic activity index of Neutrophils



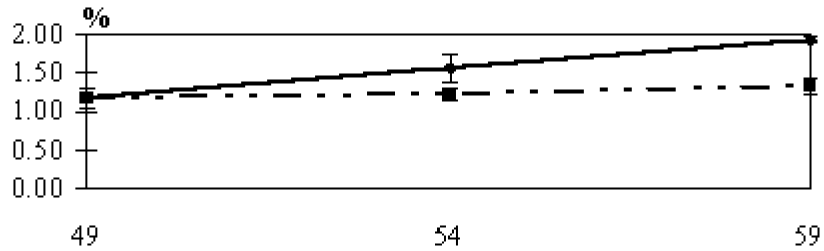
Graph 3. Phagocytic activity of Leucocytes



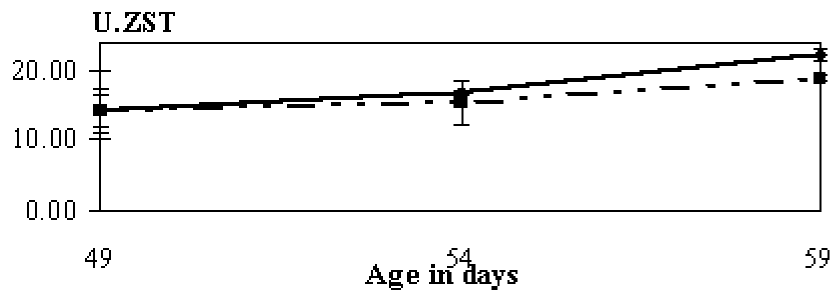
Graph 4. The Phagocytic activity index of Leucocytes



Graph 5. Values of reduced tetrasolium salt test



Graph 6. Concentration of total Immunoglobulin



Experimental group

Control group

Hygienic condition of farms and swine health

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Summary

There have been registered in swine rearing at low temperature, high level of humidity, bacterial contamination gastric disturbances - 30-52%, diseases of respiratory organs - 25-30%. There was a 21-23% increase in food expences.

Under adynamia conditions the damages of backbone and legs have been shown in 18-25% of animals, the premature rejection of sows reached 25%, the number of stillirths reached 12-15%.

Key words: sanitary, hygenic conditions, microclimate, bacterial contamination, resistance and productivity of pigs.

Actuality

Losses in pig breeding are due to abiotic factors of sanitary regimes in the establishment (Volkov et al. 1984, Turin et al. 1987, Bijleveld, Rober 1977).

The aim of our work was to study the productivity and clinico-physiological state of pigs reared under different sanitary and hygienic conditions.

Materials and Methods.

The object of our research were piglets of the large white breed, got from sows after the third farrowing. Pigs of different age groups were kept intensively. Experiments were carried out on three groups of animals. For the first group: the ventilation system ensured the expulsion from under the floor air in volumes of 30-35 m^3/hr per kg body weight, the second group 20-25 m^3/hr and the third 10-15 m^3/hr.

The assesment of the sanitary and hygienic state of the sections was determined by the temperature-humidity regime, the rate of air flow, bacterial contamination, and the quantity of ammonia in the atmosphere. The state of health of the pigs was determined by results of clinical, haematological and immunological analysis.

From the productivity indices of the sows and piglets; were considered the litter size, live weight of piglets, period of exploitation and morbility.

Results of research and analysis.

Microclimate: research indicated, that in the control section the quantity of ammonia in the air was registered between 115±0,08 - 20±0,04 mg/m^3 and its concentration was 18-25% less, in comparison to the II-III stys. The level of bacterial contamination of the atmosphere ranged between 150±10,1 - 180±12,4 in the first section; in the second section 210±7,8 - 230±11,3 and in the third 250±8,1 -280±12,4 microbes/micobial bodies/m^3 of air, and maintenance of air temperature in the sections - 24-26°C and humidity 70-76% favoured the development and viability of microorganisms.

Productivity and Health of Pigs. We established a relationship between the sanitary and hygienic state in the sections, productivity and resistance of animals (**Tabl.1**).

1. Productivity and surviability of piglets in experimental groups

Indices	Groups 1	2	3
Litter size at farrowing,heads	341	345	338
Live weight of piglets at 106 days, kg	36.4±0.2	32.1±0.7	29.1±0.7
Diseases of the gastrointestinal tract,%	10.8	30.1	52
Diseases of the respiratory tract,%	8.5	25.2	30
Survivals at 106 days,%	93.4	85.1	78.3

The following table shows that, piglets from the first group up to the age of 106 days exceeded piglets of the same age group in weight in the second section by 13,3% and the third by 25%. Among them was registered 17,7-21,5% less diseases of the gastro-intestinal and respiratory tracts.

Indices of productivity of sows shown in **table 2.**

2. Productivity and morbidity of sows

Indices	Groups 1	2	3
Number of sows,head	33	33	33
Number of piglets at farrowing, heads	10.3	10.4	10.2
Number of still births,%	5.6	12.1	15.08
Agalactia in sows,%	4.5	13.1	19.5
Diseases of the limbs,%	7	18.1	25
Duration of exploitation, years	3.5	2.5	2

Research showed,(tab.2) that from sows kept in section I the number of stillbirths was 2,5-3 times less and ailments of the limbs 11 and 18% less than in section II and III.

The state of health of piglets was determined at the morphological, humoural and cellular levels (**tab.3**).

3. Resistance of pigs under experiment

Indices	Groups		
	1	2	3
Erythrocytes,10^{l2}/li	6.9±1.05	6.1±0.2	5.3±0.18
Leucocytes,10^{9}/li	13.1±1.2	12.2±1.1	11.8±1.5
Lymphocytes,%	53.6±1.8	48.4±2.1	44.1±2.3
T-lymphocytes,%	26.4v2.1	22.8±1.7	19.1±1.5
B-lymphocytes,%	18.1±1.6	16.8±2.1	15.6±1.7
Bactericidal activity of serum,%	48.7±1.9	35.2±2.0	32.04±1.8
Lysozyme,% lysis	41.3±1.4	32.8±1.3	28.4±±1.5

The following table 3 shows that pigs from the first group showed an increase in erythrocytes by 11,6-23,2% leucocytes - 9,2-17,8%. An increase in T-lymphocytes by 13,7-27,7 and B-lymphocytes - 7,2-13,2% bactericidal activity of blood 27,8-34,3% and lysozyme - 20,6 - 31,3% - indicative of a rise in cellular and humoral nonspecific defence.

Conclusion Intensive rearing of pigs in premises without control of the microclimate encourages the accumulation of noxious gases, dust and microorganisms that hitherto reduces the resistance of the organism and productive potential of animals.

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Eradication of *Mycoplasma hyopneumoniae* from selected Finnish swine herds

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Summary

Twenty-three eradication programs for *Mycoplasma hyopneumoniae* were carried out on 20 herds using different strategies based on separating adult animals for two weeks from infected piglets which were not returned into the herd. Infected piglets were kept in the same building in 35% and on the same compound as healthy piglets in 43% of the herds. On 22% of the herds only adult animals were present during the eradication. The adult animals were treated with antibiotics in 87% of the herds. The elimination of the disease succeeded on 83% and failed on 9% of the herds. The result was unsure on two herds (9%) because of a reinfection. Possible reasons for failure of the program were the short distance between infected and uninfected animals and the long period of time when they were kept close to each other.

Key words: Enzootic pneumonia, elimination, distance, medication

Introduction

Reports from Switzerland (Zimmermann 1989), Norway (Lium et al. 1992), Sweden (Wallgren et al. 1993) and Denmark (Baekbo et al. 1994) show that it is possible to eliminate *M. hyopneumoniae* without totally depopulating the herds. All animals younger than 10 months were removed from the herds for two weeks and the remaining animals were medicated. In the study of Wallgren et al. (1993) also some younger animals remained on the compound. Cutting down the production is the major element in causing financial losses during an eradication attempt. This study aimed to find out how the different eradication programs have succeeded in Finland, also when infected piglets are kept near the healthy piglets during the program.

Materials and methods

Twenty-three programs to eliminate *M. hyopneumoniae* was followed on 20 farms. On one farm the attempt was done twice after a failure and on two farms after a reinfection. The size of the farms was 55 sows/herd (30-350, expressed as median, minimum-maximum). Most of the herds (65%) were farrowing units, and the rest had integrated production with 270 finishing pigs (100-430). The programs based on separating adult animals from infected piglets for at least two weeks during which time the adult animals were possibly treated with antibiotics and the buildings were cleaned. Infected piglets did not return into the herds. Three variants of the program were used: 1. Infected piglets were kept in the same building as healthy piglets 2. Infected piglets were kept on the same compoud, but not in the same building as healthy piglets. 3. Only adult animals were kept on the same compound as healthy piglets. The herds which succeeded in eliminating mycoplasma joined the LSO 2000 quality chain (Tuovinen et al. 1997). It means that their disease status is clinically controlled four times a year by a veterinarian. The herds are also tested serologically for *M. hyopneumoniae* (blood and colostrum). Piglets from these herds are placed in pens in finishing units by source herds, and if enzootic pneumonia is found, the infection is immediately traced back to possible farrowing units. The eradication program was classified as successful if the herds had no clinical signs of enzootic pneumonia and the serum and colostrum samples were negative for *M. hyopneumoniae.*

Results

Eighty-three percent of the eradication programs succeeded and 9% failed. On two herds (9%) the result was uncertain because of a reinfection. Table 1 presents data about the eradication programs and Table 2 about places and distances of different pig groups from the healthy piglets. The two herds (32 and 80 sows) that failed used the variants 2 and 1 in their eradication programs.

In April 1997 the herds had been followed clinically for 22 months (10-82 months). The success of the program was confirmed on 17 herds with serum and colostrum samples in average 6.3 (s.e.m. 0.3) and 16.5 (s.e.m. 1.5) months after the eradication respectively and on 2 herds with blood samples only (5 and 6 months after the eradication). The failure was confirmed on one herd with colostrum 17 months and on the other herd with serum samples 12 months after the program. On the two uncertain farms, samples were taken only after reinfection (40 and 10 months after the eradication).

Discussion

An eradication program against *M. hyopneumoniae* was carried out successfully in many herds even though piglets with different disease status were reared close to each other. It is important that an individual, detailed design for each farm is planned. Possible risk factors need to be explained to the owner: distance between infected and healthy piglets, time when infected piglets stay on the compound, the youngest animal left in the herd, spread of disease with equipment or personnel and cleaning of the facilities. In addition, very little is known about the development of immunity in individual animals. In this study the reason for failure could not be explained precisely. Wallgren et al. (1993) suspected in his study that the infection was spread by turbulent air flows. The distance between uninfected and infected animals is a dominant risk factor, but as shown in this study eradication succeeded on several farms even though only a wall separated the animals. Another risk factor is the time when infected and uninfected animals are kept close to each other as was found in this study. Also Wallgren et al. (1993) preferred the ”fast” to the ”slow ” variant of the program. More knowledge about the risk factors is needed to make the success rate even higher.

Table 1. Information from farms with success (19 herds), uncertainty (2 herds) or failure (2 herds) in eliminating enzootic pneumonia. * = median (minimum-maximum), ** = number of herds.

Information	**Success**	**Uncertainty**	**Failure**
Youngest pig remaining in the herd, months	12 (7.5-18)*	10 and 16	12 and 20
Time, when infected and uninfected on the same compound, weeks	10 (0-52)*	4 and 12	15 and 20
Same person taking care of infected and uninfected animals **	13	1	0
Antibiotics (‡) for adult animals **	17	1	2

(‡) lincomycin (Lincomix premix®) 44 grams/ton feed or tiamulin (Tiamutin®) 200 grams/ ton feed for 14 days and an injection of lincomycin 10 mg/kg (Lincocin®) on day 1 and 14

Table 2. The place and distance in meters (median, minimum-maximum) of different pigs from the healthy piglets during an eradication program for *M. hyopneumoniae*. For variants see text. bldg=building, cmpd=compound

Variant (number of herds)		**Piglets born before the eradication**	**Piglets born during the eradication**	**Sows and boars**
1 (n= 8)	Place Distance	Same bldg Behind a wall	Same bldg or cmpd 50 (10-200)	Same bldg Behind a wall
2 (n=10)	Place Distance	Same cmpd 22.5 (10-200)	Same cmpd 50 (10-200)	Same bldg or cmpd 10 (10-200)
3 (n=5)	Place	Another cmpd	Another cmpd	Same bldg or cmpd
	Distance	5000 (10-10 000)	150 (100-5000)	10 (10-150)

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Diseases and medications in finishing units buying health class feeder pigs

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Summary

The proportion of pigs needing medication, the most common diseases treated and the treatments used were studied in 196 groups of health class feeder pigs in all in-all out finishing units. Altogether 18.5% of the animals needed medication during the finishing period. The most common diseases were arthritis and tail biting, and contagious infectious diseases were rare. Local veterinarians visited the farms frequently and initiated most of the treatments. The most common antimicrobials used were tetracyclin and penicillin. It is concluded that with good health status of feeder pigs the need of medications can be lowered and that the usage of medications is well controlled in the herds studied.

Key words: antimicrobials, control, health, pork production, veterinarian

Introduction

Consumers are interested in how the foodstuffs they buy are produced. One way to describe the quality of pork production is to collect information about medications used and the proportion of pigs needing medicines for different diseases. This kind of information is seldom available. Bacteria can develop resistance against antimicrobials and the resistance may be transferred to the microbes causing diseases in humans. The pork industry needs to clarify which antimicrobials are used and how well the situation is controlled. The objectives of this study were to find out the proportion of health class feeder pigs (LSO 2000) needing medication during the finishing period, the most common diseases and the medications used. Another aim was to clarify, how many times per finishing period the local veterinarian visited the farms and who initiated the treatments on the farms.

Materials and methods

The study consisted of 196 groups of feeder pigs from all in-all out finishing units. The pigs were transported to the finishing units at the average weight of 25 kg between December 1993 and April 1995. The size of one finishing unit was in average 337 pigs (s.e.m.=11.6) and the whole study consisted 65997of pigs. The pigs originated from health classified farrowing units

(LSO 2000 herds) being free from major swine pathogens including mange, swine enzootic pneumonia, atrophic rhinitis and swine dysentery. The finishing units were not classified and no special precautions were taken during the finishing period.

The amount of medicated pigs, the date, the disease code, the code of the person initiating the treatment and the medications were recorded on the log book on the day of the treatment. The pig disease codes of Agricultural Data Processing Centre (Suomen Maatalouden Laskentakeskus) were used in recording the diseases. The log book followed the pigs to the slaughter plant.

Results

Altogether 18.5% of the pigs were medicated during their finishing period. Antimicrobials were used for 17.6 % and other medicines (antiparasitic drugs, vitamins, selenium, kortisone, anti-inflammatory drugs or iron) for 9.4% of the pigs. No medicines were used in 18 finishing units (9.2%) and less than 10% of the animals were medicated in 132 groups (67.3%). Mass-medication was given to 21 groups (11%). A veterinarian visited the herds in average 2.7 times (s.e.m.=2.1) during the finishing period. Seventy percent of the sick animals were treated by the veterinarian and 30% by the owner. Antimicrobial treatments were initiated by the veterinarian in 82% and by the owner in 18% of the cases. **Table 1** presents the percentage of the units where the most common diseases were treated and the percentage of pigs affected in those units. The antimicrobials used for different indications are presented in **Table 2**.

Discussion

The need for medications was low in the finishing units because of the good health status of the animals. Finland is free from major swine diseases (e.g. Aujeszky disease, swine influenza, PRRS). In other parts of Europe it is very common to use prophylactic medications. The need for medications depends on the number of source herds. If piglets come from one, two and three or more farrowing units, 10.5%, 7.8% and 4% of finishing units respectively don´t need any medications (Tielen 1995). Elbers et al.(1990) found that not a single pig was treated with antimicrobials in 12.5% of 100 finishing units being supplied by one farrowing unit. In the present study the finishing units had 10-15 source herds and in spite of that 9.2% of the groups did not need any medications.

The most common diseases treated were arthritis and tail biting. Contagious infectious diseases were rare contrary to the finding of Tubbs (1995), who believes that disease is a major factor in poor performance of pigs during the growing/finishing phase. When the health status of the animals is improved the diseases needing treatment are different. Even though infectious contagious diseases were rare most of the medications were antimicrobials. Sometimes animals were treated with several antimicrobials together or with an antimicrobial not appropriate.

Table 1. The percentage of 196 finishing units where the most common pig diseases were treated and the percentage of pigs affected in those units.

Disease treated	% of units affected	% of pigs treated in the units
Arthritis	68	5
Tail biting	66	5
Unknown disease	16	5
Glässer´s syndrome	14	2
Other respiratory disease	12	4
Other locomotory disease	11	1
Sel-vitamin E deficiency	11	2
Disorder in digestive organs	9	14
Leg weakness	9	2
Claw lesion	7	1
Skin infection	7	3
Erysipelas vaccination	6	63
Abscess	6	1
Erysipelas	5	8
Edema disease	5	3
Other preventive medication	5	53

Table 2: Percentages of antimicrobials used for the most common diseases in 196 finishing units. PEN=penicillin, TET=tetracyclin, S-TR=sulfa-trimetoprim, TYL=tylosine, LIN=lincocin, ENR=enrofloxacin, SEV=several antimicrobials together, TREATED=number of treated animals.

	PEN %	TET %	S-TR %	TYL %	LIN %	ENR %	SEV %	TREATED n
Arthritis	46	44	2	0	0	<1	7	1829
Tail biting	62	28	1	0	0	0	8	2133
Unknown	1	47	11	40	0	<1	<1	2207
Glässer	9	18	63	0	0	0	10	151
Respiratory	1	65	<1	0	33	<1	<1	2329
Locomotory	27	69	2	0	0	0	2	51
Sel-E def.	10	88	2	0	0	0	0	83
Digestive	<1	33	<1	54	0	<1	12	1619
Leg weakness	36	64	1	0	0	0	0	121
Claw lesion	33	55	11	0	0	0	0	9
Skin infection	70	18	0	0	0	1	11	151
Abscess	4	96	0	0	0	0	0	24
Erysipelas	89	0	0	0	0	1	10	152
Edema disease	1	3	92	0	0	3	0	89
Other prev.	0	25	75	0	0	0	0	257
TOTAL	23	43	6	16	7	<1	5	11205

The amount and selection of antimicrobials used and the development of resistant bacteria to antimicrobials has been under a lot of public discussion. This study shows that the usage of antimicrobials has been under close veterinary control. According to Tubbs (1995) ineffective antibiotics for the condition, inadequate drug dosages and a duration of treatment insufficient to properly evaluate the animal´s response are common. The list could be extended with the selection of wrong antimicrobial in the ecologic point of view. Educating farm personnel and veterinarians about the matter is very important.

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EFFICACY OF *RESPISURE* VACCINE IN PREVENTION OF ENZOOTIC PNEUMONIA IN PIGS

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Summary

Enzootic pneumonia in young pigs is the most frequent respiratory disease caused by *Mycoplasma hyopneumoniae* (Mhp). The aim of the study was to determine the efficacy of *Respisure* vaccine administered to the suckling pigs and then fattened in different types of houses. 240 pigs were vaccinated with the *Respisure* vaccine administered on the 1st and 21st d-of-life. On the 42 d-of-life pigs were divided into 2 groups and placed in one of two houses provided either with deep straw litter or concrete slatted floor. There were two control groups of 120 pigs per group. Air temperature, humidity and ammonium concentration were measured. Weight gain and feed intake were controlled. Lungs were examined post mortem for lesions. Significant differences between houses were stated due to ventilation rate and all remained parameters. System of housing influenced on the lung status in pigs, however, it was more evident in the groups treated with vaccine than in controls. Lung status corresponded with performance that vaccination improved daily gain, feed conversion and final weight.

Key words: pig, enzootic pneumonia, environment, vaccination, *Respisure* vaccine, lung lesions, performance

Introduction

In young pigs enzootic pneumonia is the most frequent disease of respiratory system markedly reducing performance. Economical losses arise not exactly due to high mortality rate but rather due to low daily gain and increased feed consumption (Dayalu 1994; Muroz et al. 1996). The infection agent is *Mycoplasma hyopneumoniae* (Mhp) which - if occurs - readily disseminates in the air over whole piggeries or, at times, transmits directly from sow to its offspring as early as during farrowing. Pigs housed in confinement systems are particularly exposed to mycoplasmic pneumonia (Goodwin and Wittlestone 1973; Martined 1996). Air temperature, if out of thermal needs, as well as high ammonium concentration, dust and microbiological contamination all make the advantageous conditions for transmission and exacerbation of disease (Piffer et al. 1984). In the prevention of young pigs against mycoplasma disease *Respisure* vaccine appeared to be effective (Dayalu 1994; Pejsak 1995; Straw et al. 1989). Less is known, however, whether system of housing may influence on efficacy of vaccination.

The purpose of the study was to determine the efficacy of *Respisure* vaccine administered to the pigs fattened in different types of houses.

Materials and methods

All over 240 pigs were vaccinated with the use *Respisure* vaccine administered twice, on the 1st and 21st day of life. On the day 42 of life pigs were randomly divided into 2 groups each of 120 pigs and moved into growing-finishing houses: one group to house A and the second group to house B. House A was provided with deep straw litter while house B was provided with concrete slatted floor. Experimental period fall on autumn and winter season and was terminated on 142 day of pigs life. There were two control groups of 120 pigs per group (not vaccinated) which were littermates of those vaccinated. The control pigs were kept in house A or B together with those pigs treated with vaccine.

Microclimatic measurements included the air temperature, air humidity and ammonium concentration. Weight gain of pigs and feed intake were controlled. Lungs were examined post mortem for lesions according to the method described by Goodwin and Whittlestone (1973). With reference to that method, cranial and cardiac lobes do gain the maximum score of 10 points, in that case, if 100% of lung is affected. Accessory and caudal lobes do gain the maximum score of 5 points, thus the total score takes the number of 55 points.

Results

Significant differences between house A and B were stated due to microclimatic conditions (**table 1**). Contrary to house A, in which ventilation rate was adequate to hygienic standards, there was insufficient air exchange in house B. It resulted in ammonium concentration higher even two times than in house A and air moisture higher by 17%. It should be pointed out that for young pigs air humidity at the level of 90% is a critical factor which acts as an agent predisposing to lung diseases. In both houses the air temperature was lower than recommended for growing pigs.

Vaccination procedure with the use of *Respisure* vaccine significantly decreased incidence of lung lesions in pigs in both types of houses (**table 2**).

Microclimatic conditions influenced on the lung status in pigs, however, it was more evident in the groups treated with vaccine than for controls. In those vaccinated pigs microclimatic stress, as measured in house B, resulted in the number of score points two times higher than that found in house A, as well as the percent of lung lesions was higher by 15%. At the same time, in house A the percentage of lungs without disease symptoms was lower by 15%. Comparing the control groups A and B one can state that the percentage of lungs without lesions was near the same (16 and 13%, respectively).

Table 1. Air temperature (AT), relative humidity (RH), ammonium concentration (NH_3) and ventilation rate (L) in two types of growing-finishing houses

House	AT (^{0}C)	RH (%)	NH_3 (ppm)	L (m^3/h.head)
A	18.4 ± 3.1	76 ± 8.0	18.1 ± 3.1	65 ± 15
B	18.5 ± 4.2	93 ± 4.6	38.4 ± 6.2	22 ± 12

Table 2. Score points for lung lesions (SPL) and percent of lung lesions (LL) in pigs affected with Mph and percentage contribution of pigs without lung lesions (WLL) in two types of growing-finishing houses

House	Group	No of pigs	SPL (points)	LL (%)	WLL (%)
A	Vaccinated	118	3.6	21	79
	Control	117	16.8	84	16
B	Vaccinated	115	7.2	38	64
	Control	112	18.3	87	13

Lung status, as it was determined in pigs post mortem, closely corresponded with performance monitored during growing-fattening period (**table 3**). Vaccination procedure advantageously influenced on daily gain and feed conversion, finally leading to a great differentiation in slaughter weight between groups kept in house A and B. On the last day of experiment vaccinated pigs weighted on average by 9 kg more than controls.

Environmental conditions in house B depressed healthiness of pigs, especially those not vaccinated, what was proved by high mortality rate.

Conclusions

1. Vaccination of pigs against enzootic pneumonia with the use of *Respisure* vaccine is an effective way to improve healthiness of young pigs and performance.

2. System of housing and microclimatic conditions influence on efficacy of vaccination which is more effective in environmental conditions close to optimal than in worsened.

Tab. 3. Average daily gain (ADG), feed conversion ratio (FCR), final body weight (FBW) and mortality rate (MR) in two types of growing-finishing houses

House	Group	ADG (g)	FCR (kg)	FBW (kg)	MR (%)
A	Vaccinated	497	2.86	104.1	1.7
	Control	456	3.72	98.2	2.5
B	Vaccinated	474	2.94	102.0	4.2
	Control	422	3.83	90.7	6.7

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REARING OF SUCKLING PIGLETS IN VARIOUS TYPES OF ELECTRICALLY HEATED NESTS

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Summary

Thermal requirements of sows and newly born piglets vary. The best temperature for sows is 14 to 18°C while piglets in the first days of their life must have the temperature from 30 to 32°C, which then is successively reduced by a few degrees every 2-3 days. In order to meet these requirements the investigations of various ways of warming up piglets were undertaken. They aimed at evaluating some electrically heated wooden nests: with infrared radiators, with heating floor boards or heating boards installed in the roof of the nest. The best seems to be the floor heating in which case the highest body weight gains and the lowest losses of piglets were observed.

Key words: suckling piglets, rearing.

Introduction

Thermal requirements of sows and newly born, suckling piglets vary. The optimal conditions for a saw include the temperature from 14 to 18°C, relative humidity from 65 to 75% and air velocity of up to 0.3 m/s. On the other hand, the piglets in the first days of their life must have the temperature from 32 to 30°C, relative humidity of 70-75% and air velocity of up to 0.1 m/s. In the following days the temperature in their nests is decreased by 2-3°C every 2-3 days. This requirement is met by using various systems of heating (upka et al. 1977, Ober, Blend 1972) which differ in their effectiveness. To solve the problems of temperature, the investigations were undertaken testing three types of electrically heated nests for piglets in a pig farm and examining the effect of those nests on the incidence of diseases and the death rate of animals.

Material and methods

The investigations included three types of electrically heated nests for suckling piglets.

Fig.1. - a three part wooden nest heated with an infrared heater of 300 W.

Fig.2. - a three part wooden nest with the floor electicaly heated (150 W).

Fig.3. - a two part nest made of a wooden floor and heating board (150 W) installed over the piglets at various hights, depending on their age.

The three part nests (Fig.1 and 2) are used for two weeks and as two part nests (Fig.4) for the further 3 weeks and later the piglets are kept on the floor (Fig.5). The effect of particular nests on the health state of piglets was determined on the basis of the breeding and veterinary documentation.

Results

For many years now the warming up of suckling piglets has been done with the infrared heaters in nests (wooden crates) in a separate part of the pen, however, this system has many faults, e.g. a limited area of the heat stream action, uneven warming up of the nest or an intensive effect of light distressing the new born piglets (Rokicki, Kolbuszewski 1996). Trying to create better thermal conditions for the animals, a floor heating of 18-21°C or overhead heating were installed. While analysing the microclimate in three types of piglets nests during 56 days of rearing when the piglets are kept together with the saw, it was noted that the microclimatic conditions were most even in nest 2 and a little less in nest 3 and 4, but still within the sanitary limits. The effect of the nest type on the health state of piglets and their death rate are presented in **Table 1**. It results from that table that the least number overlies the piglets by the saw was noted in nests 2 and 3 and the higher number of such cases in nest 1. Similar situation was observed in relation to the respiratory and alimentary tract diseases.

Conclusions

1. Nests with floor heating proved to be the best for piglets.

2. The use of electic energy in nests with floor and roof heating was lower by 50% than in nests with infrared heaters.

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Table 1. The per cent increase of the disease and death rate in suckling piglets depending on the management conditions.

Fig 1. Infrared heated nest for piglets.

Fig 2. Electricaly heated floor in nest for piglets.

Fig 3. Electricaly heated roof in nest for piglets

Table 1. The per cent increase of the disease and death rate in suckling piglets depending on the management conditions.

Causes of diseases and death of piglets	Additional heating of piglets		
	Infrared heater	Nests with heated	
		floor	roof
Overlies	20.20	3.81	3.93
Agalactia	3.82	3.45	3.42
Alimentary tract diseases	10.31	5.02	4.98
Respiratory system diseases	15.31	2.38	3.32

Fig 1 Infrared heated nest for piglets.

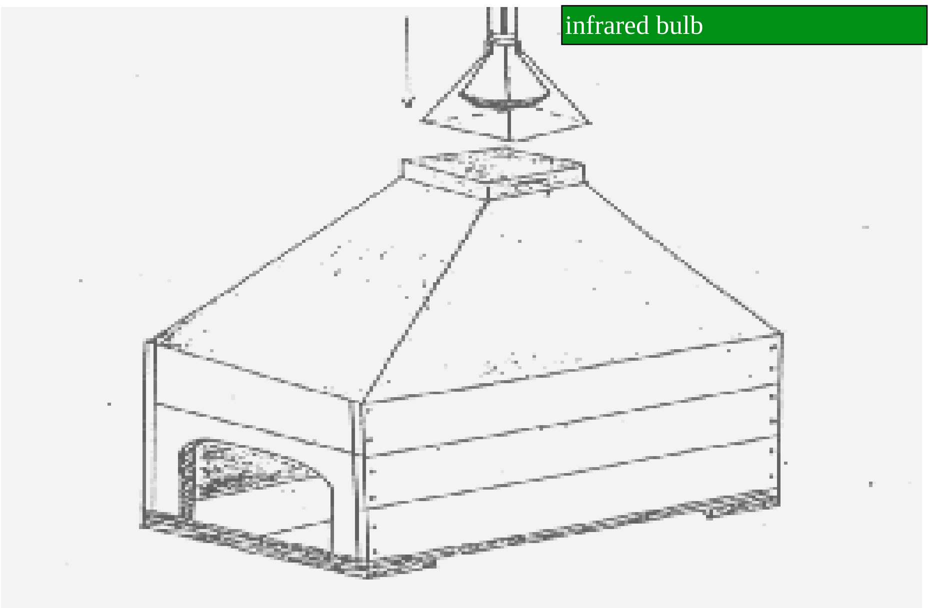


Fig.2 Electricaly heated floor in nest for piglets

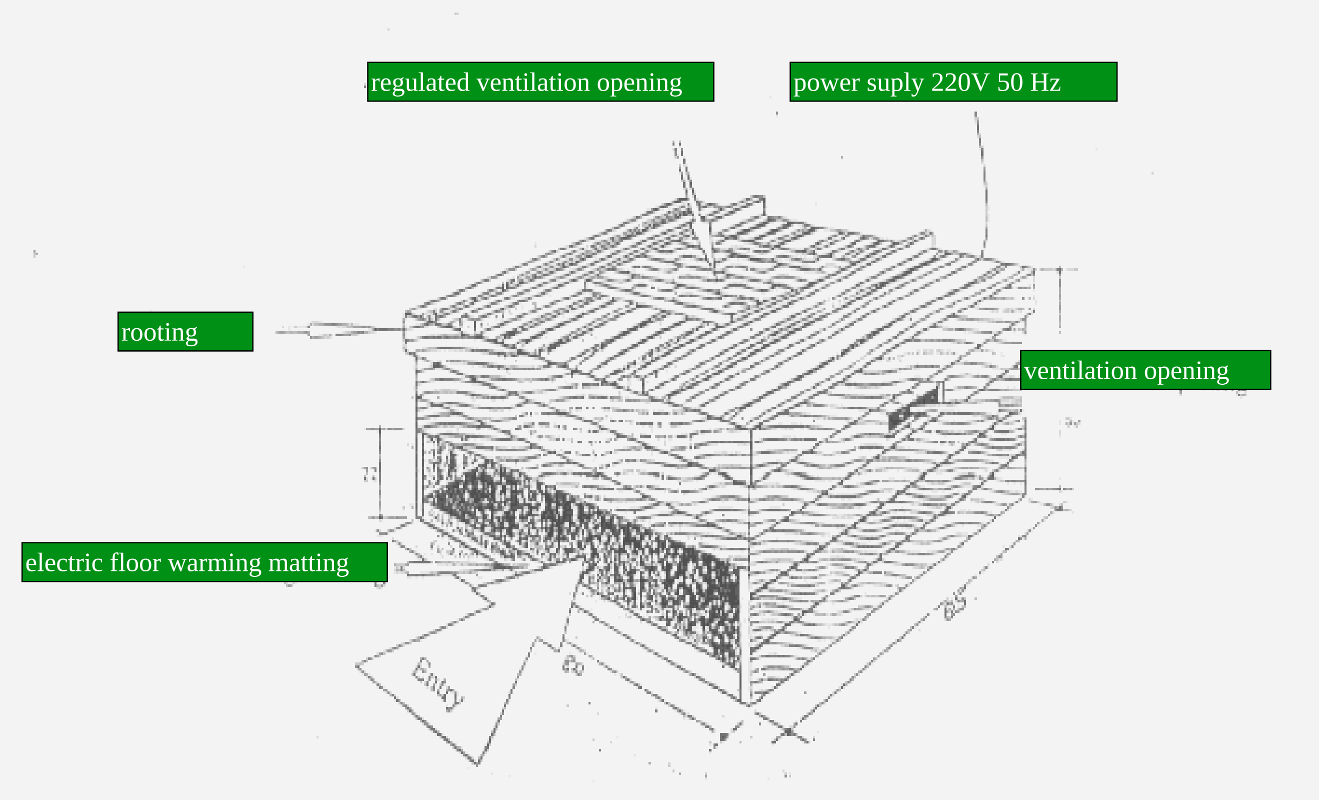
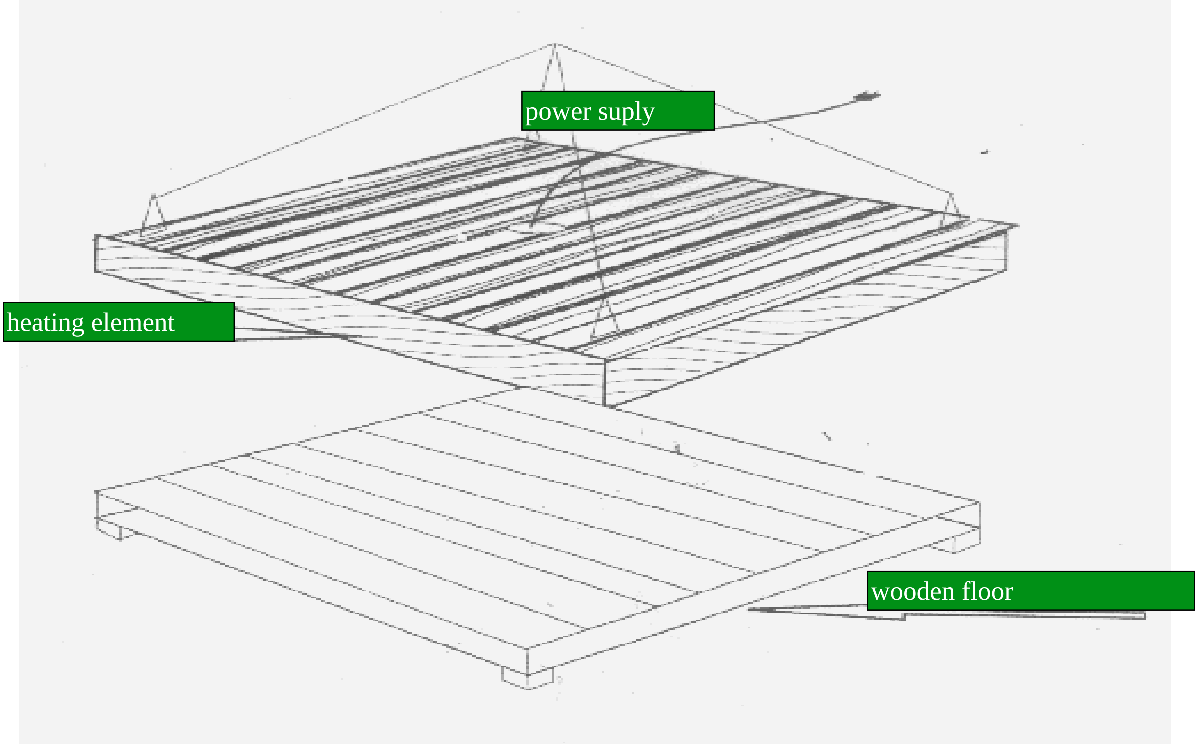


Fig.3 Electricaly heated roof in nest for piglets



Subpopulations of lymphocytes in piglets after oral administration of *Lactobacillus* and *E. coli*

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Summary

The systemic cell-mediated immune response after the oral administration of *Lactobacillus* and *E. coli* to piglets was calculated. The subpopulations of blood lymphocytes (CD2, CD4, CD8) were evaluated by flow cytometry. Eighteen conventional piglets were included in the experiment. They were divided in control and experimental groups. The control group were administered *E. coli* only, and the experimental group were first given *Lactobacillus reuteri* and then *E. coli*. Forty-nine-day-old piglets in the experimental group were given *Lactobacillus reuteri*, then both control and experimental groups were orally administered *E. coli* on day 54. Subpopulations of cells were evaluated on days 4 and 9 after the application of *E. coli*. Significant changes in the percentage number of CD8 lymphocytes ($P<0.05$) were found on day 9 after the application of *E. coli* in the experimental group.

Key words: conventional pigs, subpopulation of lymphocytes, FACS, *Lactobacilli*, *E. coli*

Introduction

The presence of *Lactobacillus* in the digestive tract is beneficial to the host animal. This microorganism also enhances the systemic immune response. It was demonstrated that *L. casei* and *L. acidophilus* are activators of mononuclear of fagocytic system (Perdigón et al., 1992). The application of lactobacillus increased the number of IgA producing B-cells as a result of T-cell stimulation of the intestinal mucous (Lorenzen et al., 1994). On the other hand Revajová et al. (in press) showed the decrease of CD3 lymphocytes in the lamina propria of the small intestine in piglets as negative results of long-term application of *L. casei*. In order to calculate the systemic cell-mediated immune response after oral administration of *Lactobacillus* and *E. coli* to piglets, the subpopulations of blood lymphocytes (CD2, CD4 and CD8) were evaluated by flow cytometry.

Material and methods

Animals. Eighteen healthy forty-nine-day-old piglets were included in our experiment. They were divided into two groups of control and experimental animals respectively. All the piglets were fed with the commercial diet ÈOS-2. *Lactobacillus reuteri* was orally applied to the experimental group day 49 of age for 5 days. On day 54, both groups were orally administered *Escherichia coli* 08:K88. Venepunctures of blood were made on the fourth and ninth days after the application of *E. coli*.

Primary monoclonal antibodies. Mouse anti-pig monoclonal antibodies anti-CD2 [CD2a MSA 4 (Lu/Ha)], Anti-CD4 [CD4a 10.2H2 (Lu)] and anti-CD8 [wCD8a^{b} 76-2-11 (Pe/Lu/Ss)] were kindly provided by Dr. Trebichavský (Institute of Microbiology The Czech Academy of Science, Prague).

Secondary monoclonal antibody. FITC-conjugated anti-mouse sheep immunoglobulin (Immunochemicals, Sigma).

Isolation of lymphocytes. Venous blood samples were collected from all animals and put into ethylene-diaminetetra-aceticacid (EDTA). Lymphocytes were separated by Ficoll-Hypaque gradient sedimentation (Boyum, 1974).

Procedure of flow cytometry (FACS). After the separation, the lymphocytes were twice washed with phosphate buffer (PBS) supplemented with 0.2 per cent sodium azide and once in immunofluorescent medium (RPMI 1640 supplemented with 5 per cent foetal calf serum and 0.2 per cent sodium azide). 50 μl of cellular suspension (1.10^6 lymphocytes in immunofluorescent medium) and 50 μl of specific or control MoAbs were mixed and incubated at 4^oC for 30 minutes. After incubation the cells were washed twice in the immunofluorescent medium (IFM) and pellets were mixed with 25 μl of FITC-conjugated anti-mouse sheep immunoglobulins and incubated in the dark as described above. The working dilution of monoclonal and FITC-conjugated anti-mouse sheep immunoglobulins (Immunochemicals, Sigma) was determined by titration and calculation of a resolution index. After being stained, the cells were washed twice in the IFM, once in PBS supplemented with 0.2 per cent sodium azide. The cells were resuspended in 0.5 ml of the same buffer.

Analysis of stained cells. The FACS system (Becton Dickinson) was provided with a 15mW argon ion laser. The analysis examined a dot plot of the leucocyte obtained by the forward and side scattering physical character of the lymphocyte population. The results are therefore expressed as the percentage of the lymphocyte population which was positive for a specific MoAb. An unrelated MoAbs of similar isotype was used as a control.

Statistical evaluation. For statistical analysis we used the paired T-tailed test.

Results

Table I shows the percentage of lymphocyte subpopulations (CD2, CD4, CD8 and CD4/CD8 ratio) in the experimental (*Lbc. reuteri* + *E. coli*) and control groups (*E. coli*) on the 4th day after the application *E. coli* (1st collection of blood). **Table II.** shows the percentage of lymphocyte subpopulations and CD4/CD8 ratio on the 9th day after application of *E. coli*. A significant change was recorded in the experimental group on the 9th day after the application of *E. coli*. The increase of CD8 lymphocytes were recordered in the experimental group (54.54%) on this day compared with experimental group on the 4th day after application of *E. coli* (48.01%) with a significance of $P<0.05$.

Conclusion

A significant increase in the number of cytotoxic lymphocytes on the 9th day after the application of *E. coli* in the experimental group was discovered. Together with application of *Lactobacillus reuteri*, it suggests protection against enteropathogenic microorganisms, in our case, *E. coli*. *Lactobacillus species* administered as probiotics could prevent E. *coli* diarrhoeogenic infections by increase the systemic cell-mediated immune response.

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Table I. 1st collection of blood

Subpopulation of lymphocytes %	Exper. animals (n = 9) (Lbc. reuteri + E. coli)	Control animals (n = 9) (E. coli)
CD2	77.18 ± 6.85	83.52 ± 8.53
CD4	48.31 ± 8.48	55.87 ± 13.83
CD8	48.01 ± 3.49	52.61 ± 9.93
CD4/CD8	1.01	1.06

Table II 2nd collection of blood

Subpopulation of lymphocytes %	Exper. animals (n = 6) (Lbc. reuteri + E. coli)	Control animals (n = 6) (E. coli)
CD2	79.66 ± 3.35	80.59 ± 4.14
CD4	53.06 ± 2.79	57.44 ± 12.75
CD8	*54.54 ± 3.07	56.59 ± 4.10
CD4/CD8	0.97	1.02

* P<0.05

Zoohygienic evaluation of arhitectural - planning decisions of lodgings for sows & piglets.

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Summary.

The number of researches showed that unsatisfactory conditions of microclimate, the lack of movement, insulation, contact with soil, prematurely decreased functional ability of basic organisms, and the systems of organism, and weakened the natural resistance in the organism of sows (1, 3, 11). As a result, in sows, placed in a broadly gabarit housing from iron-concrete construction, on the cast - iron grating floor, the terms of the effective using have been decreased, and the born offspring is characterized by a low vitality (10, 2, 6).

Taking to account the above written, the goal of our research was studying (of) the architectural planning decisions of particular sow - piggeries with different construction size, studying the process of microclimate forming, and the intensively of metabolic process in blood of sows, their health condition, productivity & quality of offspring.

Key words. Lodging; floors; microclimate; natural resistance; blood glucose; lactate; clinical indexes; sows.

The material & Methods.

The object of our research were sow - piggeryes with the construction size 51 m^3/head (typical) & 38.4 m^3 /head. Basic physical & chemical parameters of air environment, the lodging floors, particular metabolites of carbo - hydrate - phosphorus & blood composition of protein, the size & quantity of offspring, its morbidity & preservation. The researches were held in winter - spring period, according to method (5, 8, 4).

Research results & its consideration.

Most of sow - piggeries used in western region of Ukraine are conditionally divided on sections with 60 head of sows in each. The manure cleaning, which foresees the manure transportation, following its perimeter, ever through areas of new technological group of pigs. The terms of filling up such section with the animals, extend up to 15-20 days, which creates hardnesses in veterinary service of the live-stock, retrains the simultaneous weaning of young animals and reduces the time of sanitary - rupture. The floors in individual machines of these sections are either made of concrete, or partly covered with wooden shields. Because of unventilated zones, and aggressiveness of air environment which causes corrosion & premature run - out of control metallic air - tubes & the means of local heating, broadly sections gabarites make the effective use of it's had to keep the temperature & humidity we need in such conditions, which decreases the effectiveness of.

The research held in a sectional brick sow piggery #4, with isolated sections, with autonomous manure cleaning & construction size of 31.8 m^3 /head, showed, that in spite of significant vibration of the atmospheric air indexes, the conditions of microclimate were much better, and were held in limits of 4.5 points wish is optimal constructional - technological regime (**Table 1**).

Trying to keep the energy, the lodging was equipped with an air - heating system with heat recuperation, wish extracts by the air - tubes with anticorrosion covering. There were placed 26 individual OCM-120 machines with ability to transform, for each section. Machines have the floors made of moulded polymeric plates. The conterminal walls, made of polymeric materials, are solid, which provides warm & dry couch for the animals (9). There is a decrease in morbidity of state movement apparatus in sows in such conditions on average of 12% comparing to other types of floor.

Table 1 Microclimate of sow - piggeris with different construction size.

Indexes	$51m^3$/head		$31{,}8m^3$/head	
	parameters	points	parameters	points
Temperature, °C	16,2 18,0 -22,0	2,5	20,4 18,0 -23,0	5,0
Relative humidity, %	79,9 72,0 - 98,0	2,8	70,8 60,0 - 78,0	4,8
Amiac, mg/m^3	13,6 5.0 -21,0	5,0	12,5 6,0 -29,0	5,0
Bacterial pollution, tous. Micr. Body/m^3	60,5 22,0 - 98,0	3,9	41,4 20,0 - 74,0	4,8
Air speed, m/sec	0,2 0,03 -0,24	4,0	0,22 0,03 -0,39	3,2
Resors average point		3,6		4,5

The holding of sows in better conditions helped the rational functionality of heart and the vascular system & respiratory system and the high level of natural resistance. Found, that the frequency of heart contractions ranged in a very narrow limits 58...62 inm, the gasping frequency was analogical, and a body temperature raised on 0.2 - 0.3°C only at night. It was in a physiological norm limits, wish is a normal process of termoregulation, that provides stability of heat exchange between organism & environment (4). Sows, held in a sectional sow - piggery, predominated by a quantity of erythrocytes on 7 - 9 % hemoglobin - 8 - 10 g/1, eozynophyls - 18 - 23 %. The bactericide activity of blood serum reached 69.5 - 71.8 %. Protein concentration in organism of these animals reached 85 g/l, that is 8 - 10 g/l more. At the same time the gamma - globulin's contents whas 31.9 - 36.8 g/l (4). The difference between groups was also revealed by a particular indexes of carbohydrate - phosphorus metabolism. Therefore, the glucose level in the blood of sows from experimental group ranged from 3.24 to 3.34 mol/l, and was 18-25 % higher then in control. ATF+ADF by the contents of phosphorus the sows of experimental group, had predominated. It attests about high energetic provision of metabolic process. According to the data we have, the optimization of microclimate conditions helps with the run of carbo - hydrate - phosphorus metabolism.

The analysis of productivity & clinical observations showed, that from 60 sows, being held in a piggery with larger construction size, we've got 546 live piglets. On the same time in lodging with smaller construction size, we've got 3 % more, wish is 564. On the day of weaning the weight of one piglets was 7.7 kg. & 8.5kg. During the research period, the morbidity of young animals, in typical lodging reached 31.3 & in a lodging with smaller construction size it was 13.8 % only. In optimal conditions of keeping, the piglets preservations in an experimental piggery reached 92.6 %, when it reached only 85.6 % in a control one.

According to the data we have, its expedient to build & use, in Western region in Ukraine, the sectional sow - piggeries of a module type with the autonomous manure cleaning, air - recuperation, with the floors made of polymeric materials, with the holding capacity of no more than 180 sows.

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Diminishing the need of antibiotics in pork production

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Summary

Various methods to minimize the need of antibiotics in pork production, and the impact of these methods on production results, are discussed. The methods include: all in - all out production, health matching, diminishing the number of source herds by various methods (small batch size, group farrowings, sow pools, multisite, ekobox), tracking and eliminating the infection sources and optimizing housing and management. Most of the theories have been verified to work in practice, too.

Key words: health matching, all in - all out, antibiotics, sow pools, multisite, ekobox, quality chain

Introduction

Antibiotics have widely been used in pork production for treatment of infectious diseases, and also as growth promoters. This practice has become more and more undesirable from the consumers' perspective. Controlling swine diseases with medicines may decrease production costs but, it also results in a constant risk of residues in pork. Increasing usage of antibiotics promotes the development of resistant bacteria. Usage of antibiotics and growth promoters is no longer up to the individual farmer, veterinarian nor industry. Human health aspects must be taken into account.

In our paper, various methods to minimize the need of antibiotics in pork production, and the impact of these methods on production results, are discussed. The scope of discussion is in diminishing antibiotics usage in finishing units.

All in - all out

The ”all in - all out” concept is the most effective way to decrease the need of antibiotics in pork production. The finishing unit is cleaned and disinfected before the next batch of feeder pigs is taken in. This method effectively stops cumulating of microbes into the piggery. Age groups are separated from each other. Housing environment, managing and feeding can be adjusted according to the needs of each age group.

Health matching

The idea of health matching is simple; feeder pigs of different disease status are not mixed with each other. Health matched feeder pigs originating from different sources have about similar health status, which prevents disease outbreaks in finishing units (Tuovinen et al., 1994).

Diminishing the number of source herds

The ultimate source of an infectious agent is an infected animal. Purchasing feeder pigs from a dealer, derived from a wide variety of sources, is the least preferable system from the viewpoint of disease control (Alexander and Harris 1992).

Diminishing the number of source herds diminishes the risk of infectious disease. The probability of a finishing operation receiving infectious agents with purchased feeder pigs can be calculated by applying the formula for the probability of at least one success (Snedecor and Cochran 1980). The probability (P_1) of a finishing unit of receiving feeder pigs from one or more infected farrowing units (source herds) is a function of the herd prevalence (p_1) of the particular disease and the number (N) of source herds:

$P_1 = 1 - (1 - p_1)^N$ (1)

The probability (P_2) that one or more feeder pigs purchased from an infected herd are disease carriers, can be calculated by the same formula (p_2 = prevalence within the herd, and n = number of pigs purchased from that herd): $P_2 = 1 - (1 - p_2)^n$ (2)

The probability (P) that one or more of the purchased feeder pigs are infected, is the product of these two probabilities: $P = P_1 * P_2$ (3)

A small batch size, i.e., the size of the finishing department, is one way to diminish the number of source herds. E.g., in a department of 200 pigs, there are feeder pigs from 10 farrowing units (assuming an average of 20 pigs from each unit), while in a department of 800 pigs, there are feeder pigs from 40 units. If the prevalence of an infectious disease (say, swine dysentery) is 1 % of the farrowing units (p_1=0.01), the probability of the smaller department to receive feeder pigs from an infected farrowing unit (P_1) is 9,6 %, while it is 33 % in the larger department.

Group farrowings are another effective way to diminish the number of source herds. When the sows farrow in groups, there are more feeder pigs from one farrowing unit for one transport. Forty feeder pigs per source herd instead of twenty, diminishes the number of source herds by 50 %. The probabilities of an infection in the previous example would drop to 4,9 % and 18 %, respectively.

Sow pools are an effective way to carry out age segregated, all in - all out production including group farrowings. The number of source herds can be diminished substantially. The all in - all out finishing unit can be filled with feeder pigs of one or two satellite units.

There are some new, very effective systems to reduce the number of source herds to one, including the **multisite**-production and **stress free-** or **ekobox-**production. So far, we have no experience of applying these methods into practice. Theoretically, the ekobox-system should be ideal in diminish the need of antibiotics use, because both mixing and transporting are avoided.

Tracking and elimination of infection sources

Infected farrowing units (infection sources) can be tracked by the help of the finishing units. There must be an active follow-up of diseases arranged by the dealer to utilize this method effectively. This method makes it possible to eradicate some infectious diseases totally from the company or even from the whole country. The origin of, e.g., swine dysentery, enzootic pneumonia, atrophic rhinitis and mange can be tracked, and the infection be eradicated from the source herd.

Sorting feeder pigs by source herd to the finishing unit pens helps tracking of disease sources (e.g., mange, swine dysentery), and helps to treat infectious diseases effectively without the need to treat the whole batch (e.g., Glässer’s disease, edema disease). It would be ideal if the piglets of the same litters could be kept together.

Optimized housing and management

There are several environmental risk factors for swine diseases which have been reported (see, e.g., discussion by Curtis and Backstrom 1992). Avoiding the risky practices, and optimizing housing and management according to the current knowledge, are very effective manners to diminish the need of antibiotics in the finishing units.

Optimized management includes quick veterinary interventions (treatment, isolation etc.) when first signs of infectious diseases are seen. No ”welcome” treatments should be used.

Antibiotics are often used as a substitute for good housing and management but, according to our experience, no antibiotics can match the effect of good housing and management.

Theories tried in practice

Most of these methods described above have been tried in the member farms of LSO Foods, with good results. The methods have been applied at the LSO 2000 quality chain, where the need of antibiotics has diminished to one third - one fourth of an already low start level. About ninety percent of these pigs have been raised with no antibiotics. In the best finishing units, only under two percent of pigs show any signs and need to be treated. It has been shown that pork production with almost no antibiotics is possible.

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Effect of microclimate on productive parameters of fattening pigs in a conventional pig house

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Summary

Investigations were carried out for 2 years in a conventional housing object for pigs designed for 7500 animals, out of that 4800 fattening pigs. They revealed several constructional and operational shortcomings which resulted in microclimate conditions differing considerably from the optimum values. During the summer, fattening pigs were almost constantly exposed to temperatures exceeding the optimum value and air velocity higher than 0.3 $m.s^{-1}$ could not be reached even at maximum output of ventilation fans. During the winter pigs were housed at temperatures below the recommended optimum which was partly caused by unsuitable location of ventilation fans and supplemental heating. This was reflected in the feed intake, daily weight gain and death losses of fattening pigs housed.

Key words: fattening pigs, microclimate, productivity

Introduction

In addition to nutrition and genetic apparatus, the microclimate is an important factor for the productivity and health state of housed pigs. a microclimate as an important factor in pig houses. From the point of view of microclimate pigs belong among the most demanding farm animals. At low temperatures, mainly during winter, an increased feed consumption per unit of body weight gain is observed (Tobišková, 1988) and on the contrary, higher temperatures during summer result in a decrease in metabolism, loss of weight, decreased consumption of feed and the resulting decrease in productivity. Humidity of the air affects the release of heat from the body and its thermal balance. The combination of high humidity and low temperatures in pig houses is particularly unsuitable as it can, due to the excessive removal of heat, cause overcooling, metabolism disorders (hypoglycaemia), decreased immunity of a body to infectious and invasive diseases and as a result of that also the death of animals (Majerèiak, 1977, Sidor 1982, Doskoèil 1983). According to a number of authors (Hojovec and Zeman, 1973; Kovacs, 1975; Jagoš et al., 1975, Ondrašoviè et al., 1993 and 1994) the shortcomings that occur in large-capacity technologies can be eliminated only by means of continuous monitoring of the quality of the housing environment. The aim of our study was to evaluate the microclimate conditions for the JUZO construction system from the point of view of suitability to the animals housed.

Material and methods

The evaluation of microclimate was carried out in a house for fattening pigs on a farm with closed turnover of the herd system, housing 7 500 animals, out of that 4 800 fattening pigs. The JUZO animal houses have sendwich-type peripheral walls (concrete-polystyrene-concrete) and a light soffit (ezalite-concrete) supported by wooden beams. Pigs are housed in pens, 10-12 animals in each, with partially slotted floor. The feeding technology is designed for dry feed and peg drinkers are used. The house has negative-pressure ventilation with fans located in peripheral walls and supplemental heating equipment. The temperature-humidity regimen was registered for two years using thermohydrographs. The concentration of CO_2, NH_3 and H_2S in the air and aerial microbial contamination and dustiness were determined twice a month.

Results and discussion

Results of measurements of the temperature-humidity regimen are presented in **Tab. 1-Tab. 2**.

Tab. 1 The time the pigs were exposed to the following temperature humidity regime

Parameter	Period					
	Summer		Transitional		Winter	
Hours of investigation	504		814		836	
Internal temperature T_i	h	%	h	%	h	%
• lower then minimal	0	0	4	0,5	104	12,7
• lower then optimal	0	0	140	17,2	248	29,7
• optimal	0	0	552	67,8	452	54
• higher then optimal	504	100	122	15	32	3,6
• higher then maximal	263	46,8	0	0	0	0
Relative humidity Rh_i						
• lower then minimal - below 50 %	46	9,1	2	0,2	0	0
• optimal 50 - 80 %	435	86,3	778	95,6	47	56,2
• higher then optimal - above 80 %	19	3,8	34	4,2	353	42,2
• higher then maximal - above 85 %	4	0,8	4	0,5	13	16

Values of other microclimate parameters exhibited considerable seasonal variability. The CO_2 content was in the range 0.12 - 0.403%, total number of microorganisms in 1 m^3 of the air ranged from 710 000 to 858 000, and the air-flow was in the range 0.01 - 0.09 $m.s^{-1}$.

Tab. 2 Productive parameters of fattening pigs

I st year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
T - external	-10,7	-3,2	-3	8,4	12,2	16,9	19,4	15	13,8	8,4	4,4	-1,2
Weight gain (WG)	505	565	552	557	636	625	603	601	620	589	586	550
Feed cons. per kg WG	3,77	3,7	3,59	3,63	3,4	3,43	3,25	3,24	3,47	3,32	3,79	3,64
No. of dead anim.	22	12	13	20	5	10	21	7	7	11	20	22
Ave. Weight of dead anim.	38	42	46	55	50	55	88	61	47	56	55	44
IInd year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
T - external	1	0,4	1,2	7,2	13,8	16	19,2	17,1	13,7	6,5	-3,5	-1,1
Weight gain (WG)	595	5,99	562	558	609	686	602	575	599	555	563	618
Feed cons. per kg WG	3,56	3,63	3,55	3,55	3,53	3,49	3,55	3,57	3,6	3,57	3,55	3,58
No. of dead anim.	8	32	15	11	6	8	8	12	10	13	17	15
Ave. Weight of dead anim.	42	67	68	41	98	80	83	50	84	61	42	56

DISCUSSION

Results of measurements of the internal temperature in the summer period proved that the housed pigs were exposed to the temperatures exceeding the optimum temperature for almost the entire investigated period. The internal temperatures often exceeded 30^{o}C. The ventilation equipment failed to ensure air flow higher than 0.3 m.s^{-1} even at its highest output which is insufficient at high environmental temperatures as the increased air flow is frequently the only means of prevention of overheating of animals at such conditions.

The intake of warm air from the ceiling-roof space, where the temperature reached 40^{o}C during the daily peaks, through crevices and untightnesses in places where soffit boards and wooden beams come into contact had a negative influence on the overall comfort of animals at negative-pressure ventilation. Similar overheating of the air brought in through the above-roof metal-sheet inlet pipe occurred. Its temperature was 33.0 ^{o}C in the point where it entered the house, at T_{int} = 27.1^{o}C and T_{ext}=25.6^{o}C.

The relative humidity of the air in the summer and transitional periods was most of the time in the optimum range. The temperature of the air in the transitional period was affected by operation of the ventilation equipment based on subjective sensation of the tenders. Daily amplitudes T_{int} 10-12^{o}C were recorded.

The conditions in the winter period did not allow us to investigate the object at very low external temperatures. However, an unsuitable arrangement of ventilation and heating elements was noted. Exhaust fans were situated in openings of wall panels located directly above heating bodies which resulted in unnecessary heat losses during the heating season when the ventilation equipment was in operation. Unsuitable was the effort of tenders to ventilate the housing space by opening the doors to the manure disposal space at the end of the house. This increased the relative humidity inside the house.

An insufficient function of the ventilation equipment, or its inadequate utilization during the transitional and winter period was also indicated by the values of CO_2, numbers of microorganisms and amount of dust measured in the house environment.

CONCLUSION

The microclimate in the housing object JUZO was investigated and evaluated. The results obtained allow us to state that the house investigated had a number of constructional and operational shortcomings. As a result of this the optimum microclimate was not ensured for the housed pigs. In the summer period they were almost constantly exposed to temperatures above the temperature optimum required. During the winter period, despite mild winter, pigs were housed at temperatures below the optimum for considerable length of time. This was reflected in the weight gain and death rate of the pigs housed.

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Animal housing and management – prevention of poultry problems

Animal housing and management - prevention of poultry problems

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Summary

For a long time the poultry industry has aimed to improve productivity and reduce costs, and it has been very successful in achieving this. The first part of this paper proposes that some remaining poultry problems may be solved and some new problems even prevented using behavioural knowledge. Some examples are given where studies of bird behaviour can help the industry reduce costs. Nevertheless, despite its successes regarding productivity, the industry has been less successful in responding to consumer pressure for safe products produced in a way that is acceptable from an animal welfare point of view. As a result there have been specific occasions where sales have fallen dramatically. The second part of this paper presents the view that although preventing problems with product safety and poultry welfare may involve initial costs for the industry, in the long term it is probably necessary to maintain consumer confidence and so ensure a market for poultry products in the future.

Key Words: poultry industry, behaviour, welfare, consumer confidence

Introduction

Over the past 50 years the industry has focused its attention on improving production efficiency and reducing disease. It has been remarkably successful. Advances in nutrition and genetic selection techniques have played a major role, as has research on prophylactic measures and vaccines to reduce disease. The prospects are good that advances in these subjects will continue to save the industry money in the future. For this reason I will not talk about preventing poultry problems in these areas, but focus instead on preventing problems in the areas of poultry behaviour and consumer confidence in poultry products.

Birds do not always behave in the intended way. They sometimes lay their eggs on the floor rather than in the nest boxes, peck and cannibalise one another, or have reduced mating frequency so that fertility is reduced. Studies of bird behaviour can help solve some of these problems and in the process save money.

In countries where there is a shortage of food, production of any poultry product is of benefit for that society and the cheaper it can be produced the better. But in countries without these problems there is increasing consumer pressure to produce food of a good hygienic quality and to produce it in a way that is acceptable from an animal welfare point of view. This trend has important consequences for the poultry industry. If the method to producer a cheaper product is questioned by consumers then there may not be the expect demand for that product on the shops. Maintaining consumer confidence in poultry products is therefore a necessary investment for the future. One only needs to consider the cost to the beef industry in those countries where BSE has been identified. Outbreaks of Salmonella have resulted in some consumers losing confidence in the safety of certain poultry products and the reduced sales may never return to their previous levels. More recently the cage debate in several North European countries has affected the sales of eggs. Although taking these new hygiene and welfare concerns into consideration will cost the poultry industry in the short term, it saves money in the long term.

Using Poultry Behaviour to Advantage

In this section I will give two examples where knowledge of poultry behaviour has helped the industry. The first is the well known example of the importance of rearing and nest design on reducing the number of floor eggs. The second is the less well known example of research on mating behaviour in breeding flocks.

1) Reducing the incidence of floor eggs

Eggs laid on the floor can be a major problem in non-cage systems. They are more likely to be dirty and/or to be broken and they are time consuming to collect. Basic ethological research has increased the understanding of the factors which affect nest site selection. For example, the way birds are reared affects the development of their ability to move in 3-dimensions and so to jump up to the nest boxes. Flocks of birds given access to perches from at least 8 weeks of age lay more eggs in the nest boxes than birds reared without perches (Appleby et al. 1988). Studies on how far birds can jump in a horizontal direction has shown that the distance between perches and the nest boxes should not be more than lm (Scott and Parker 1994).

The nest boxes themselves should be the most attractive nesting place in the pen for the bird. Studies on the relative importance of different characteristics of a nest box have shown that enclosure is most important (Appleby and McRae 1986), although other factors such as presence of nesting material (Huber et al. 1985) and the presence of other eggs (Kite et al. 1980) are important in nest site selection.

2) Mating behaviour in breeding flocks

Poor fertility can be a problem, especially in older broiler breeding flocks. This can be due in part to the heaviness of the males, but it can also be caused by a behavioural problem. Dominant males may inhibit subordinate males from mating, so reducing overall fertility in the flock. Another difference is in the amount of courtship behaviour shown before mating. Broiler breeder males show less courtship than males
from laying strains. As a result hens crouch less for these males so leading the males to force copulation. In a study to compare different broiler and layer strains, broiler breeder males forced copulations with females in 47.8% and 50.0% of cases compared to only 12.5% forced copulation by males ofthe laying strain (Millman et al. 1996). It is likely that breeding companies have selected for more aggressive males in the mistaken belief that this will help improve fertility. Instead, the selection has resulted in deficiencies in the courtship behaviour. Behavioural knowledge such as this is changing the selection criteria in the male lines in some strains.

Addressing Consumer Concerns over Food Safety and Bird Welfare

With increasing income and variety of products in the shops, consumers are choosing to buy products they prefer or which they perceive as being better quality. Traditionally food quality was determined by freshness and taste, but reflecting the changing interest of society, food safety and ethical quality are now important quality criteria. A certain minimum quality standard is expected for all products and consumers are reluctant to buy those products they think do not reach that minimum.

Freedom from pathogens is one such standard and the poultry industry has suffered by not investing the money to ensure that this is the case. The Salmonella free and generally good health reputation of the Swedish broiler industry has economic benefits now, but it came at a cost. In 1987 in Sweden, sales of chicken meat decreased by 32% in a period of only 4 months as a result of a public debate about camphylobacter infections in broilers being transmitted to humans. The decline lasted for more than one a half years. To regain consumer confidence a quality and welfare programme was established. Producers at those farms with the highest points in the programme are allowed to have a higher stocking density. This rewards good producers and gives incentive to less good producers to improve. The programme is strictly enforced and consumer confidence has been restored. Today consumption of chicken meat in Sweden has doubled. The money gained by increased sales now covers the cost of the monitoring programme. Indeed, so successful has the programme been that the egg laying industry has initiated a similar control programme to try to improve its image in front of consumers.

In the same way as consumers expect food to be safe to eat, they expect the animals to be treated in a humane way with minimal pain and distress. An example here is the decreased demand for fur coats (especially sealskin coats), following media debate about the methods that are used. Intensive animal production has also been criticised in the media and the growing proportion of vegetarians probably reflects this. It is important that the poultry industry addresses consumers' animal welfare concerns or there is a risk of reduced demand for poultry products in some countries. The egg industry has already experienced criticism of the welfare of laying hens in cages and there is a growing demand for eggs from non-cage systems.

Behavioural freedom or opportunity to perform most types of natural behaviour, are phrases that often occur in animal welfare legislation. Behaviour is also a subject with which consumers can identify. One example that demonstrates this is the pressure to include a nest box in battery cages. If research shows that it a bird chooses to lay its egg in a nest (Duncan and Kite 1989), that it will overcome obstacles to get to the nest (Cooper and Appleby 1994) and that it shows behaviour indicative of frustration when the nest is closed (Duncan 1970), then the conclusion is that providing a nest will improve bird welfare. Providing nests will cost money, but the poultry industry in some countries may have to accept this smaller investment in order to prevent the more serious economic problem of reduced demand for their eggs.

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Reasons for the losses of laying hens in conventional and alternative housing systems

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Summary

Our institute investigates reasons for losses of laying hens in a farm, which is keeping laying hens in cages and in 4 alternative housing systems, during a year. We collected sickly and dead hens regularly. The reason for sickness and death were examined by autopsy.

The first results will be demonstrated in dependence on housing system. The main losses are caused by inflammation of the laying organs in all systems (20 %-68.9 %). The disturbances and diseases of metabolism (fatty degeneration - 2.3 %-35 %, osteomalacy - 0-9 %, gout - 0-8 %) reserve the second place. The evidence of parasites is higher in the alternative systems (app. 40 %) than in cages (app. 2 %). Birds of prey robbed a lot of layers in outdoor systems. Fractures of bones caused by faults of the technological system have been conspicuous in one of the alternative systems (64 %). The percentages refer to layers autopsied and housing systems.

Keywords: laying hens, losses, diseases, poultry housing systems

Introduction

Keeping in cages was introduced some decades ago with the aim of decreasing the expenditure of work per animal, increasing the population density per square metre of the hen-house base and finally achieving a diminution of diseases caused by pathogenes (LÖLIGER, 1985). However, nowadays caging is exposed to criticism by the animal conservationists. Even the consumers ask more and more frequently about the origin of the eggs, but they are only partially prepared to pay higher prices for eggs produced by alternative animal management systems.

Alternative animal management systems shall make it possible for the laying hens to perform their natural behaviour patterns (scratching, sand bathing, etc.). Due to econo-mic constraints it is required to concentrate animal management and to keep large flocks. Resulting from that old problems (parasitoses) of new quality just occur in management systems where animals are in contact with their excrement. By this study a comparison shall be made between 5 various alternative management systems and caging.

Material and methods

This study is being made at a layer hen farm with a stock of layers of approx. 60,000 animals. In this company caging was and is being replaced step by step by alternative systems. The total losses in the individual management systems could not be determined. The authors took out sick and perished animals at regular intervals from the following management systems:

⇨ 78 animals ➔ conventional caging, 3 storey

⇨ 48 animals ➔ management off the ground (a)

keeping over storage bins for excrements with 2-storey rows of nests and space to run about in (open field) during the summer half-year, apart from that only little space for scratching

⇨ 45 animals ➔ management off the ground (b)

keeping over storage bins for excrements with the possibility of erecting trees; without space for scratching and open field to run about in during the summer half-year

⇨ 43 animals ➔ voletage

7 tree-type storeys arranged for eating, drinking and resting, approx. 50 per cent of the ground surface is provided as space for scratching, as space to run about in (open field) during the summer half-year

⇨ 35 animals ➔ voliere

several storeys with additional sitting roosts for erecting trees, approx. 75 per cent of the hen-house base are provided as scratching space, space to run about in (open field) during the summer half-year

⇨ 19 animals ➔ conventional keeping on the ground

with space to run about in open field

The animals were taken to the institute for autopsy. The diagnosis was made pathologically and anatomically. Virological and bacterio-cultural methods of examination were not available. The intestinal contents was examined for parasites by means of NaCl-flotation.

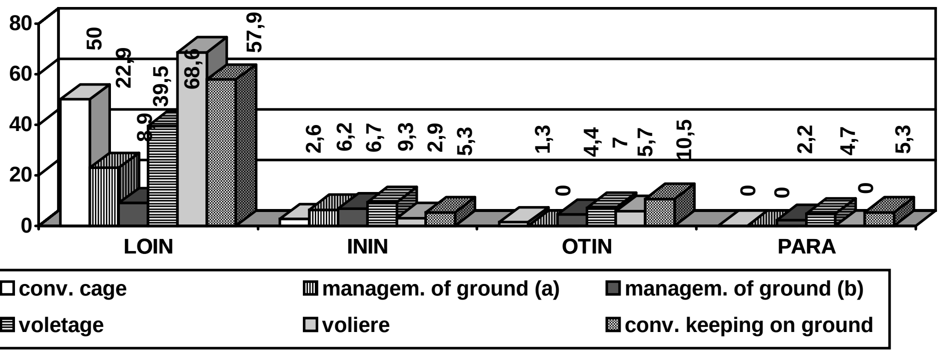
Results

The pathological and anatomical diagnoses are shown in comparison in the following Figure 1, 2 and 3.

Fig. 1: Reasons for losses in different housing systems, percentages of autopsies (infection and infestations)

Fig. 2: Reasons for losses in different housing systems, percentages of autopsies (metabolism diseases)

Fig. 3: Reasons for losses in different housing systems, percentages of autopsies (other reasons)



legend:

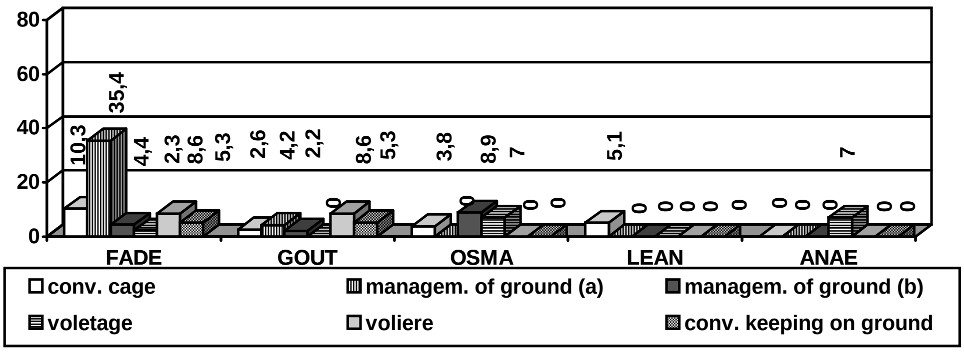
LOIN- infections of laying organs

ININ - infections of intestinum

OTIN - other infections

PARA- infestations by parasites

Fig. 1: Reasons for losses in different housing systems, percentages of autopsies (infections and infestations)



legend:

FADE - fatty liver-degeneration

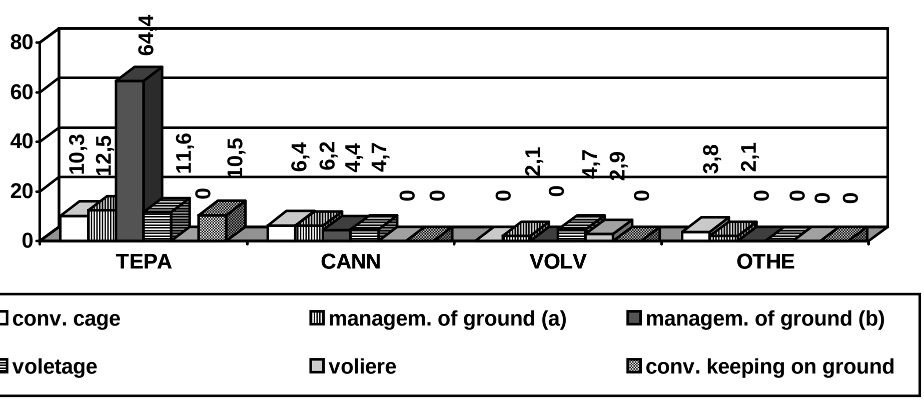
GOUT- gout

OSMA- osteomalcy

LEAN - leanness without other diagnosis

ANAE - anaemia

Fig. 2: Reasons for losses in different housing systems, percentages of autopsies (metabolism diseases)



legend:

TEPA- diseases caused by technological faults

CANN - cannibalism

VOLV - volvulus

OTHE - other reasons

Fig. 3: Reasons for losses in different housing systems, percentages of autopsies (other reasons)

In 3.4 % (10 of 295 autopsy) we did not found the reason for sickness or death.

Discussion and conclusions

Diseases of the laying organ (fibrinous Salpingitis/Peritonitis) is the number one reason for losses (22.9 % - 68.6 %) in almost all housing systems. Similar findings were documented by MORGENSTERN (1997). The housing system off the ground (b) was with 8.9 % clearly below the others. Here an extremely high rate of loss occurred due to technopathies (loss of metatarsi as well as cuts in the tarsal joint). These injuries were caused by hen-house facilities installed by the company itself. Fractures could also be seen very often in this housing system. They were favoured by osteomalacy which was often found as secondary result. Technopathies, however, occurred in the other housing systems (with the exception of volieres) as well. The animals were often jammed in the hen-house facilities.

Infections of the intestine were the cause of death for 2.6 % to 9.3 % of the autopsied hens, followed by other infections (0 to 10.5 %) with the higher values appearing in housing systems with litter.

The rate of infestation with parasites could be found, as expected, considerably higher in alternative housing systems than in cage housing (*coccidia* 5 % : approx.30 %, *A. galli* 0 %: approx.60 %, *H. gallinarum* 0 % : 50 % as well as C. obsignata (0 %: 10 %). The stock was replaced. The evidences of parasites are reported in another paper by METHLING et al.)

The infestation by *Eimeria sp*. (59.3 %) determined as the reason for losses in one keeping stage had been brought in from the breeding farm. The *Eimeria* infection caused a mass of deaths between the 1st and 2nd week of keeping.

These results show that parasitoses strongly increase with alternative housing systems, do not definitely lead to death indeed, but may affect the productivity considerably. Consequently effective preventive measures become required in order to produce hygienically perfect eggs with healthy animals in animal-friendly cageless housing systems of sufficiently economic efficiency. Bad habits (eating of feathers, cannibalism) can be shown more strongly, as well.

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Description and evaluation of a method for clinical inspection of laying hens

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Summary

A method for clinical inspection of laying hens in commercial farms was developed. The criteria for the method was to get a detailed description and analysis of bird health. The method involves scoring of general body condition, plumage and integument, comb status, foot condition and status of the cloaca and in total 36 different body parts are scored. To test the inter-rater agreement for independent observers using the scoring method, clinical scoring by two independent scorers was performed on 172 wing tagged ISA brown hens. The Kappa value for agreement comparing scores of foot condition was 0.59. This indicates good agreement considering there were eight possible categories of the variable.

Key words: poultry health, Kappa test, inter-rater agreement, clinical scoring, alternative housing systems, foot condition

Introduction

In order to meet the demand of the pre-testing of new alternative housing systems for laying hens, governed by the Swedish National Board of Agriculture, a method for scoring clinical health in individual laying hens was developed at the Section of Animal Hygiene, Department of Animal Environment and Health, Faculty of Veterinary Medicine, Swedish University of Agricultural Sciences. Different scoring systems for clinical inspections of laying hens regarding plumage (Adams et al. 1978; Tauson et al. 1984; Appleby et al. 1988) or the whole body (Simonsen et al. 1980; Taylor & Hurnik 1994) have previously been used. However, as we wanted to get more accurate descriptive information about the hens, we decided to develop a more detailed scoring system than those used previously.

The aim of this paper is to describe the method for scoring clinical health of laying hens. Further, an evaluation of the inter-rater agreement for independent observers, using the scoring method, is described.

Material and methods

Each hen in the sample from a flock is weighed and scored by the same experienced observer. In total 36 different body parts are scored. The variables are nominal and in some cases ordinal and reduction of categories for further analytic studies are possible from original scores.

General condition is scored as normal, lean, fat or emaciated, by palpation of size and shape of breast muscles of the hen. Keel bone deformation is quantified in millimetres and presence of bursitis or folliculitis is recorded. The head is scored regarding beak shape, mouth corners, eyes, eye lids, comb and wattles. Special attention is paid to the comb and the wattles for which size, colour and different skin disorders are recorded. The plumage is scored for 11 different body parts and each part is given scores for status of both feathering and integument. Feather cleanness is defined in degree and location. Scoring of foot status involves manure lumps on the claws and length of the claws, as well as if any claw is broken. Foot pad skin is scored in eight categories (normal, crust, excessive horn layer, papillae, bleeding chap, acute bumble foot, chronic bumble foot and corn-like lesion). Status and cleanness of the cloaca as well as laying status is scored. Presence of any lesion that does not fit into the scoring system is recorded separately to enable future analysis. A photo guide of the clinical features recorded using this method is presented by Gunnarsson et al. (1995).

In order to evaluate the usefulness of the method when applied by different people, clinical scoring by two independent observers was performed on 172 wing tagged ISA brown hens (55 weeks old) housed in an OLI Free aviary. Scores from each bird were filed for each individual observer in order to determine the inter-rater agreement.

The part of the body where the scoring system had most possible categories was foot pad skin, which comprised eight nominal categories. Thus foot pad skin was considered to be the variable that would be hardest to reproduce. To test the inter-rater agreement for independent observers an unweighted Kappa test was used (Altman 1994). In the interpretation of the Kappa test the number of possible categories of the variable must be taken into consideration. The rule of thumb is that a Kappa value of <0.50 indicates poor agreement, if variables with few categories are analysed.

Results and discussion

The Kappa value for agreement comparing scores of foot condition was 0.59 (95% confidence interval 0.46-0.70). This indicates good agreement between the observers considering the high number of possible categories and that Kappa is a conservative test, depending on the number of categories.

In the literature detailed descriptions of scoring methods are given (Simonsen et al. 1980; Appleby et al. 1988; Taylor & Hurnik 1994), sometimes with pictures of scoring categories (Adams et al. 1978), but the methods themselves are rarely evaluated. Tauson et al. (1984) presents a method for scoring of plumage in details with pictures and evaluation. The hens (n= 833) were individually scored in ordinal categories by two independent observers and data were pooled into 70 groups comprising 12-15 hens. For score of plumage of the whole body (variable treated as a continuous data), the Pearson‘s correlation coefficient was high between observers ($r=0.94$; $p<0.001$). In the same paper it was shown that observer did not have a significant effect in a GLM model analysing the effect of cage type on plumage condition.

In the present study we used nominal scores for scoring foot pad skin in hens. We chose the Kappa test because it can analyse nominal data. In order to test Pearson‘s correlation and Spearman‘s rank correlation, we treated the data as continuous and ordinal respectively. The Pearson‘s correlation coefficient (r) for foot pad skin was 0.71 ($p<0.001$) and the Spearman‘s rank correlation (rho) for foot pad skin was 0.82 ($p<0.001$). This indicates that a very high correlation coefficient between observers does not necessarily mean that the inter-rater agreement is very good. As scoring methods do not have a general standard, it is important that a proper evaluation of the inter-rater agreement of a method is performed to make sure that the method gives repeatable results.

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The effect of different litter moisture and perches on the incidence and severity of foot pad dermatitis in floor hens

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Summary

An experiment was conducted to determine whether different moisture levels of litter and perches of different hygienic conditions are involved producing foot pad dermatitis in white leghorn layers. Four different combinations of wet/dry litter and wet/dry perches were used. Ammonia and pH changes in the pens were monitored. There was a significant difference between the cumulative incidence of foot pad lesions in birds reared on dry litter (38 %) and in birds reared on wet litter (92 %) ($p<0.01$). There was a significant ($p<0.01$) effect of litter and perch moisture on the size of the foot pad lesions. There were no significant differences in litter pH or ammonia or in egg production between the four treatments when compared over the whole experiment.

Key words: laying hens, wet litter, hygiene, bumble foot

Introduction:

The literature describes a wide variety of foot pad lesions in laying hens, ranging from mild hyperkeratosis and discoloration to bumble foot infections. The bumble foot syndrome, with severe inflammation and swelling of the metatarsal foot pad, is regarded as the most severe type of foot pad lesion (Siegwart 1991, Gunnarsson *et al.* 1994, Tauson and Abrahamsson 1994). Examples of possible risk factors for foot pad dermatitis are nutritional deficiencies (Burger *et al.* 1984), strain/hybrid effects (Hill 1975, Roush 1983, Burger and Arscott 1984, Siegwart 1991, Tauson and Abrahamsson 1994), perch design (Appleby *et al.* 1992, Duncan *et al.* 1992, Oester 1994, Tauson and Abrahamsson 1994) and housing system (Simonsen *et al.*1980, Tauson and Jansson 1990, Siegwart 1991, Tauson and Abrahamsson 1994, Gunnarsson *et al.* 1995).

This experiment was conducted to determine whether different moisture levels of litter and perches of different hygienic conditions are involved producing foot pad dermatitis in white leghorn layers.

Materials and methods

The birds used in this experiment were 120 commercial cage reared white Hisex layers, who were 105 days of age at the start of the experiment. Four groups of 30 birds each were randomly allocated to four identical pens, divided only by wire mesh. White wood shavings from coniferous trees were used as litter material, and the perches were made of soft wood and were of rectangular shape (3 x 4 cm) with rounded edges. The perch space per bird was 15 cm.

Four different treatments were compared: 1: dry litter and dry perches; 2: dry litter and wet perches; 3: wet litter and dry perches; 4: wet litter and wet perches. In dry litter pens, the litter was changed once every two weeks. The wet litter was sprinkled with water every three days, and changed every second week. The dry perches were cleaned once every two week. The wet wooden perches were taken out from the pen once every day and put in a tube containing water, and were replaced by wet perches which had been in the tube for 24 hours.

The birds were examined for foot pad lesions once a week. Foot pad lesions were recorded on an eleven point scale, ranging from hyperkeratosis/thin crust to chronic bumble foot, and the size of the lesions were measured in millimetres.

Results

No significant differences in ammonia or pH in the litter were found between the treatments. There was no significant effect of treatment on total egg produktion. Similar types of foot pad lesions were seen in birds on both wet and dry litter. Lesions were seen mainly on the metatarsal pads, but also lesions on the digital pads were seen. No lesions on the interdigital pads were seen in any of the groups.

From the 12th week of the experiment and onwards, both the prevalence and severity of foot pad lesions in the wet litter treatment groups was significantly higher ($p<0.001$) than in the dry litter treatment groups. The cumulative incidence of foot pad lesions in birds kept on dry litter was 38 %, and in birds reared on wet litter 92 % ($p<0.01$).

In some cases, severe ulcers showed to develop in less than one week. In other cases, there were first small swellings, hyperaemia, hemorrhagic points (or excessive horn layer, abrasion, bleeding chaps) followed by a large swelling or large ulcers and scab the next week. Later during the experiment, most of these ulcers extended to a larger area of the pad. Instead of this further development, other birds showed signs of recovery with rapid healing of the ulcers.

The ulceration or scab area was significantly ($p<0.01$) larger in birds kept on wet litter than in birds kept on dry litter. When the litter condition was the same, birds from pens with wet perches tended to have larger lesions than the birds from pens with dry perches.

Conclusion

Litter moisture had a significant effect on the incidence of foot pad dermatitis in laying hens. Although the incidence of lesions was not significantly affected by the presence of wet perches, the area of the lesions was significantly larger in groups with wet perches than in groups with dry perches. It is suggested that litter moisture is an important contributing factor for the occurrence of foot pad dermatitis in laying hens. It is further suggested that wet perches contribute to the severity of such lesions.

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Infectional pressure through intestinal parasites in alternative housing systems for laying hens

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Summary

The presence of coccidia is demonstrated exclusively in conventional cages. On the other hand high concentrations of coccidia and later helminthes (*Ascaridia galli*, *Heterakis gallinarum* and *Capillaria spp.*) appear in alternative systems.

Key words: poultry housing systems**,** poultry parasites, poultry nematodes, coccidia

Introduction

In Germany housing for laying hens is currently dominated by the cage system in which in 1995 93,7% of the animals were still being kept (ZMP- Documentation 1996).This system which has been in existence for decades and which was introduced for economic and hygiene reasons, is increasingly exposed to the criticism of animal welfarists and consumers. In Germany alternative housing systems are gaining more and more interest. Included in the alternative developments are various prototypes of fitted out cages, grill housing with and without straw bedding, traditional floor management and housing systems which use the 3 dimensions of the hen house like an aviary or voletage (OESTER 1997).

The return to poultry housing on litter brings the fear of an accumulation of persistent parasite types (MATTER 1989). The advantages, from the point of view of ethology and animal protection, are countered by an increased risk of disease in certain areas of origin (MORGENSTERN 1997; ELLENDORF 1997).

Material and methods

The investigations* are carried out in a medium-sized poultry business with approx. 60.000 hens. The hen houses which were originally equipped with cages have gradually been replaced by alternative housing systems over the last few years:

* supported by the H. Wilhelm Schaumann Stiftung

- floor-far houses on plastic lattice (10 animals / m² surface area)
- voletage with run (Oli, Sweden) (22 animals / m² surface area)
- aviary with run (12 animals / m² surface area)
- traditional floor management with run (7 animals / m² surface area)

- cage housing (as a comparison) (25 animals / m² surface area)

The infectional pressure through intestinal parasites is recorded over several housing periods. In the 1st, 2nd, 4th, 8th, 12th, 16th, 20th, 28th, 36th, 42nd and 50th housing weeks 20 samples of straw and droppings are taken. Sick/dead animals from all housing systems are collected on the sampling days, dissected and pathologically-anatomically examined. In the course of this parasitological findings are ascertained (external and internal inspection of the content of the intestine). Straw, excrement and gut samples are analysed by means of the NaCl flotation procedure (d= 1,181 g/cm³), examined under the microscope and semi-quantitatively evaluated.

Results

In contrast to earlier investigations (HEINECKE and KERSTEN 1995) coccidia were detected in the **cage housing**. The results correspond to investigations by MAJARO (1980) as well as KUTZER et. al. (1980), who likewise established the incidence of coccidia in cage batteries. After the 12th housing week there were no further positive recordings (**Fig.1**). Helminths did not occur in the cage housing.

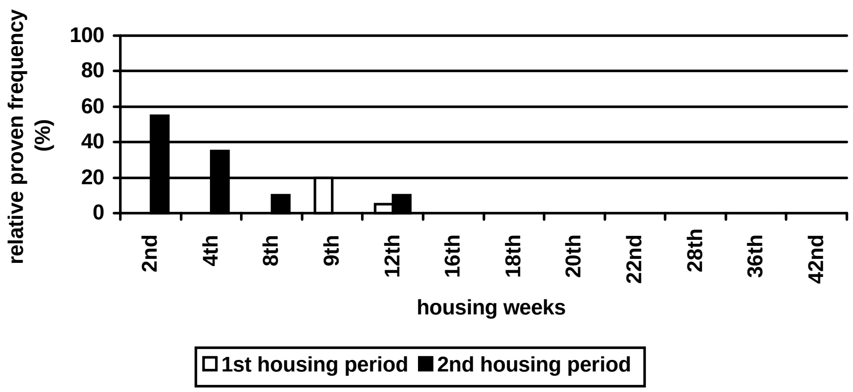

Fig.1 Relative proven frequency of coccidia in faecal samples - cage -

In the case of the laying hens from the **floor-far houses on plastic lattice** coccidia were detected over the entire housing period, with a greater intensity of infestation at the beginning of the housing period. In the samples from this housing system increased numbers of *Ascaridia galli* and *Heterakis gallinarum* were also observed.

In the **voletage housing** with run very high coccidia infectional pressure was diagnosed at the beginning of the housing period which in time was superseded by considerable rates of *Ascaridia galli* (**Fig.2**), *Heterakis gallinarum* and *Capillaria spp.* infestation. *Capillaria spp.* in the voletage housing was not noted until the 4th housing period surveyed from the 36th housing week onwards.

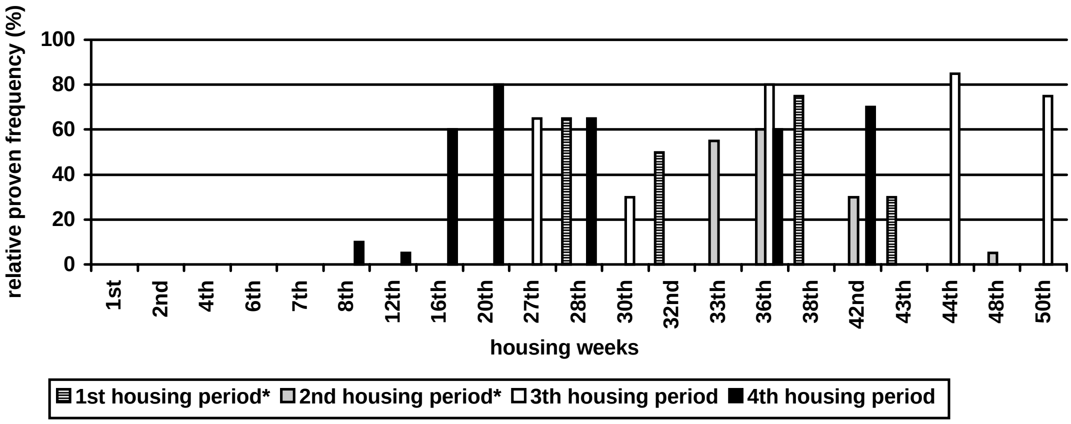

Fig.2 Relative proven frequency of *Ascaridia galli* in the faecal samples -voletage

* - origin: Heinecke, A. and. Kersten, A.(1995)

At animals from the **aviary housing** or **traditional floor management** with run the named species of parasite also occur. Opposite tendencies in the temporal occurrence of coccidia in the first part of the housing period and of helminths in the second are suggested, though the values in the 2 housing systems could not be recorded at the beginning of the housing period.

The parasites we identified were also found in investigations by MORGENSTERN (1997), with the exception of tapeworms which did not arise in our study.

Conclusions

1. In cage housing cocidia can occur at the beginning of the housing period. After the 12th housing week no further protozoa could be detected. There was no evidence of helminths.

2. In floor-far housing on plastic lattice the contact between the animals and reciprocal faecal intake also lead to the spread of *Ascaridia galli* and *Heterakis gallinarum.*
3. Straw housing systems with run give rise to an accumulation of coccidia and helminths such as *Ascaridia galli, Heterakis gallinarum* and *Capillaria spp.*.
4. The incidence of parasite infestation is subject to more or less regular dynamics. At the beginning of the housing period protozoa occur with increased frequency. As things develop these are superseded by infestations of helminth.

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Restricted feeding: a new management tool to control mortality in broiler production.

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Summary

Mortality on broiler farms in the Netherlands in 1995 averaged 5%, of which about up to 25% of the birds die from heart- and circulation problems (flip-overs, Heart Failure Syndrome and ascites). Recent research on restricted feeding at PP showed different results. In trail 1 (1995), restricted feeding resulted in a lower bodyweight, a better FCR, and lower mortality. In this trial, income over feedcosts was 0.04 Dfl. per bird higher for restricted feeding. However, in trial 2 (1996) restricted feeding resulted in a lower bodyweight with no difference in FCR and mortality. Income over feedcosts was 0.04 Dfl. per bird lower for restriced feeding. In both trials the specific mortality caused by heart- and circulation problems was significant lower for the birds on restricted feeding.

Interviewing 24 randomly chosen (independent) broiler growers showed that 16 growers implemented some kind of restricted feeding. Besides a lower average mortality, the flock data show that farms using restriced feeding compared to the farms not using feed restriction had significantly lesser flocks with a mortality exceeding 6%. Broilers in the Netherlands are housed in closed, environmentally controlled, buildings. Broiler growers indicate that restriced feeding in combination with good climate control are the main management tools to control mortality caused by heart- and circulation problems.

Keywords: mortality, restricted feeding, managements, broilers, economics.

Introduction

The modern broiler is selected on economic important production factors, such as growth rate, feed conversion and processing-yield. As a result the production performance has had a remarkable improvement over the last 25 years. It seems that an increased mortality rate can be a negative side effect of this development. Heart- and circulation problems (ascites, Heart-Failure Syndrome (HFS) and Sudden Death Syndrome (SDS) are a growing problem on some broiler farms. Mortality on broiler farms in the Netherlands in 1995 averaged 5%. Post mortem examinations at PP revealed that in trial with ad libitum feeding about 25% of the birds died from heart- and circulation problems. In many parts of the world research is carried out on factors causing ascites and SDS. Julian (1993) and Leeson et al. (1995) provide a good overview of the available information. In addition to the breed of the bird (genetic background) and hatchery practice, many management factors on the broiler farms are involved: lighting programmes, temperature, minimum ventilation rate, hygiene and health status of the birds (disease control) and quality and amount of feed.

In the Netherlands, in 1996, a three year research project was started by the industry, Ministry of Agriculture and several research institutes to find short term and long term solutions to control the mortality on broiler farms. In this article the results of two restricted feeding trials are summarized and the main results of a survey of 24 independent broiler growers on this subject is given.

Material and Method.

In 1995 and 1996 two trials were conducted in which 20.000 broilers were grown for 42 days in an environmentally controlled poultry house. Intermittent lighting was used with 4 hours light and 2 hours dark. A normal temperature schedule was used in which the housing temperature decreased from 33°C at the start to 19°C at 32 days of age. The main research factor was the amount of feed: ad libitum versus controlled feeding. From 15 days onwards feed, was supplied in fixed amounts per day in half of the pens.

A survey was carried out in the spring of 1996. Twenty four randomly chosen broiler farmers were visited and interviewed on their management of broilers. Mortality figures for several years were available from those farms and this information was used in the interviews.

Results

Table 1 gives the zootechnical results of the 1996 and 1995 trial comparing restriced feeding with ad libitum feeding. In the 1996 trail, restricted feeding gave a lower body weight, a higher feed conversion (after correction for the body weight) and a slightly lower mortality rate. In the 1995 trial, restricted feeding also resulted in a lower body weight, but feed conversion was decreased and mortality was cleary lower than the ad lib group. In both trials, the mortality caused by heart- and circulation problems was significant lower for the birds on restricted feeding. The economic result (income minus feed- and chick costs) for the broiler farmer was in the 1996 trial lower and in the 1995 trial higher for the group with restriced feeding.

In both trials the yield results in the processing plant were lower for the group with restriced feeding. Economic calculations show that the income for the processors, based on marketing of the parts, is decreased by Dfl 0.32 (trial 1) and Dfl. 0.26 per bird (trial 2) for the group with restricted feeding (see table 1).

The main results from the survey were:

- The individual farmer is familiar with his position on mortality rate compared to other farms.
- More than half of the farms use intermittent lighting schedules.
- Until five weeks, the differences in temperature are very small. Some farms lower the temperature in the wintertime at the end of the growing period to 17-18 degree celsius.
- Restricted feeding was used on 16 out of 24 farms. The actual method of restriction was different on every farm. There was a variation in: the starting week, combination with intermittent lighting, water restriction and the number of feeding periods per day.
- On some farms the climate control can be improved. Some farmers are not familar with the exact amount of minimum ventilation and didn t measure CO_2 concentration recently.
- Almost all farms did investments to reduce the mortality during the summer period. On most farms extra (tunnel-) ventilation was installed and others invested in fogging equipment.
- Heart- and circulation problems were not directly mentioned as important problems. In general, it was mentioned that increasing the minimum ventilation can reduce the incidence of ascites.

A comparison of mortality figures of 1995 from 12 farms with and 12 farms without restricted feeding shows that the mortality was 1 percent lower for the group with restricted feeding. Althought the variation between farms and flocks within one farm was large, it is clear that the group with restricted feeding had fewer flocks with a mortality above six procent.

Conclusions

The results from applied research demonstrate that restriced feeding gives a reduction in mortality resulting from heart- and circulation problems. A clear reduction in mortality is needed to compensate for the costs of the growth reduction and thus make restricted feeding an economic option for the farmer. Many Dutch farmers have already implemented management tools, such as lighting schedules and restricted feeding, to control mortality. Nevertheless further improvements can be made on several farms. Further research should focus and the development of methods of restricted feeding which give little or no reduction in bodyweight and yield for breast meat.

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Table 1. Zootechnical and economic results of two trial comparing restricted feeding with ad libitum feeding of broilers.(growing period 42 days).

	Trial 1996		Trial 1995	
	ad lib.	restricted	ad lib.	restricted
broiler farm:				
body weight (g)	2145	2043	2212	2018
feed conversion	1.69	1.68	1.69	1.62
feed conversion (at 2000 g)	1.63	1.66	1.60	1.59
mortality (%)	3.5	2.9	6.8	3.7
income-feedcosts (Dfl/bird) *	0.82	0.78	0.82	0.86
processing plant:				
carcass weight (g)	1315	1260	1391	1326
breast meat (% of carcass)	25.4	24.9	24.3	23.1
legs (% of carcass)	36.7	36.7	37.0	38.1
wings (% of carcass)	12.3	12.3	14.7	13.5
income parts (Dfl/bird) **	6.91	6.59	7.00	6.74

* income minus feed- and chickcosts. Bird price Dfl. f.1.55/kg

** income parts. Breast meat, legs and wings respectively f.12, f.5 and f.3,50/kg.

Influence of "Trampoline floor" in broiler houses on emission, animal performance and carcass classification

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Summary

Continuous aeration of faeces-litter mixture in broiler houses leads to a reduction of ammonia emission. In this trial the influence of continuous aeration by using a "Trampoline floor" in a broiler house on emission, animal performance and carcass classification is estimated. The statistical evaluation leads to following results: Animals reared on the "Trampoline floor" gained more weight, but also more animal losses were found in this compartment. Better carcass classifications of broiler housed in a stable with continuous aeration of the faeces-litter mixture could be established. Furthermore, in this compartment less ammonia emissions were measured.

Keywords broiler house, carcass classification, animal performance, ammonia emission, litter ventilation

Introduction

The effect of continuous aeration of faeces-litter mixture in broiler houses is described in Dutch publications. GROENESTEIN and MONTSMA (1991), VAN DER HOORN et al. (1992) and KROODSMA (1993) established a reduction of ammonia emissions upto 90 % by using litter ventilation. In most studies the consequences of this technique for animal health and performance are not mentioned. Therefore, the aim of the following trial is to investigate the influence of the continuous aeration of faeces-litter mixture on animal performance, animal losses and carcass classification.

Material and Methods

Comparative investigations were carried out in a double-storey stable. The only difference between the two compartments of this stable was the construction of the floor. In one storey the animals were reared in a conventional housing system, in the other storey the stable was modified by the "Trampoline floor" in order to ventilate the litter. In both compartments chopped straw was used as litter material.

The technique of litter ventilation was developed by the Dutch company “Hendrix“. The microbiell release of ammonia from urea is reduced by litter drying. For the realization of this litter drying a second floor, which was made of perforated texture, had to be build 0.3 m above the “original“ stable floor. The texture was covered with litter. Underneath this Trampoline floor air was sucked off and blown back into the stable-room. Because of the pressure gradient air out of the stable-room flew through the litter underneath the “Trampoline floor“ and absorbed moisture out of the litter.

The trial continued from December 95 to September 96. On the same day 7000 broiler of the same breed were stalled in into each compartment. Altogether, data of six fattening periods, which lasted 35 days, were registered. The influence of the “Trampoline floor“ on life weight (28^{th} day), finishing weight, carcass weight, animal losses, carcass classification and emission was investigated. Variance analysis was carried out using the Programm Package “SAS“ procedur “GLM“. As fix effects the number of fattening period and the housing system were taken in consideration.

Results

In comparison to animals housed in the conventional broiler house the animals reared in the stable with “Tampoline floor“ gained significantly more weight. These differences between the housing systems came to 38.7 g with life weight, 72.60 g with finishing weight and 37.5 g with carcass weight. An increase of 3 - 4 % higher weight gain can be relized by using the “Trampoline floor“ (Tab. 1).

These results are corroborated by VAN MIDDELKOOP and VAN HAARN (1995). They also found out, that animal housed with litter ventilation show a higher growth rate. Furthermore, they elicted a better food conversion with those animals.

MACKE (1997) measured the ammonia emission the stable descibed in this paper and established a 72 % reduction of this gas by using floor ventilation. In his point of view the decrease is mainly based on a reduction of the ammonia concentration in the stable. It seems, than the higher weight gains are due to the improved production conditions caused by better air quality.

However, in the compartment with litter ventilation significantly higher animal losses were observed. While in the conventional stable 2.68 % of animal died during the fattening period, the losses in the modified stable came to 3.10 %. Compared to the conventional housing animal losses in the stable with litter ventilation were 14 % higher.

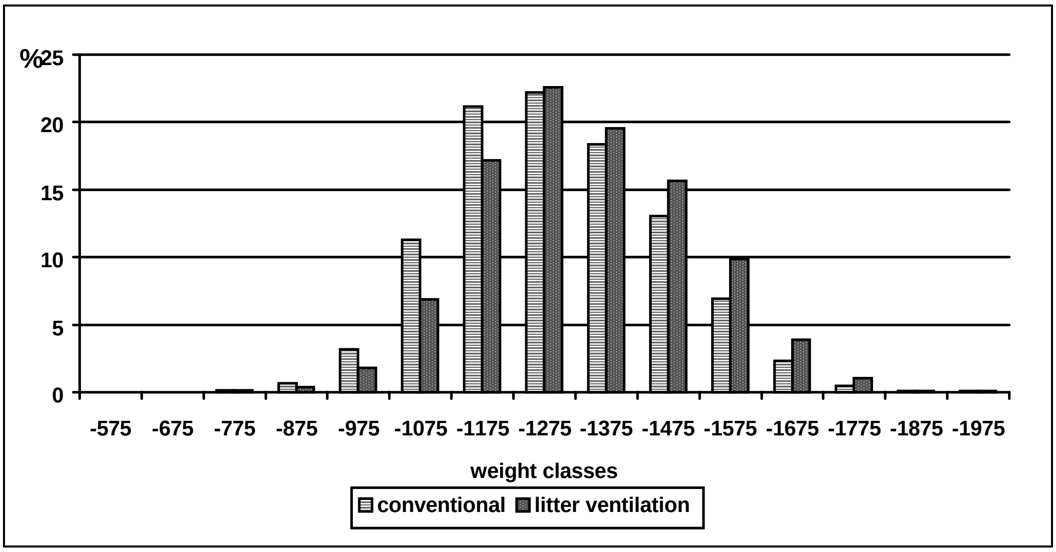
Table 1: Least square means (LSM) and standard error (SE) of life weight, finishing weight and carcass weight depending on the housing system (6 fattening periods)

	conventional stable		litter ventilation	
	LSM	SE	LSM	SE
life weight (g)	1324.6 [a]	8.4	1363.3 [b]	8.4
finishing weight (g)	1719.4 [a]	13.8	1792.0 [b]	13.8
carcass weight (g)	1167.0 [a]	15.5	1204.5 [b]	15.5

a,b: LSM with various letters are significant different ($P < 0.05$)

In order to classify the carcasses the weights were devided into 15 classes by 100 g steps. Figure 1 shows the distribution of these weight classes depending on the housing system. Clearly, the displacements of the classes to higher carcass weights can be observed with animals reared on “Trampoline floor“.

Figure 1: Distribution of the carcass weight classes depending on the housing system



Conclusions

The comparison between the stable with “Trampoline floor“ and the conventional stable leads to following results: The usage of “Trampoline floor“ in broiler houses reduced the ammonia emission upto 72 %. In the stable with litter ventilation significantly higher weight gains of the animals were observed, also better carcass classifications could be obtained. Nevertheless, significantly higher animal losses in the stable with “Trampoline floor“ could be established.

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Effect of a broiler watering system on the hygienic quality of litter*

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Summary

Three identical broilerhouses A, B and C were equipped with various drinker types: hand-filled trough drinkers (A), automatically filled cap drinkers (B), and nipple drinkers (C). The aim of the studies was to determine the effect of various drinker types on the hygienic quality of litter. The studies showed that nipple drinkers improved the hygienic quality of litter and decreased litter consumption. Introduction of nipple drinkers improved the final body weight of broilers and decreased water and straw intake per bird by 51 and 60%, respectively.

Key words: broiler chickens, drinkers, hygiene, litter

Introduction

The amount of water drunk by birds depends on genetic factors, production level, age, body weight, feeding, health and microclimate (Esmail 1986, Chołocińska and Wężyk 1994, Herbut 1996, Belyavin 1996). Lott (1994), Mennicken et al. (1994) and Roberts (1996) found a relationship between the amount of drunk water and ambient temperature and feed intake. The amount of consumed water must account for the drinker type, water drunk, water splashed about by birds and water used for technological purposes (Chołocińska 1996, Stamps and Andrews 1995). An overly easy access to the drinker leads to high water intake, excessive dilution of the feed and faeces/urine, and in consequence it increases the moisture of litter and enhances the excessive growth of bacteria and fungi.

The aim of the studies was to determine the effect of various drinker types on the hygienic quality of litter.

Material and methods

The experiment was carried out in three identical broilerhouses A, B and C (600 m^2 each), equipped with three drinker types: hand-filled trough drinkers (A), automatically filled cap drinkers (B), and nipple drinkers (C). Thirteen chickens per square metre of production area were kept on deep litter. Body weight, feed intake, mortality, amount of water drunk and water used for

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technological purposes (using water meters) and microclimate parameters were recorded in each broilerhouse. Litter was sampled three times in 3 places during rearing, and its moisture, bacteriological and fungal contamination were determined. The results were verified statistically by analysis of variance, and significance was determined using Duncan's test.

Results and their discussion

The drinker types under study were found (**Table 1**) to have no significant effect on feed conversion and mortality. The chickens drinking from trough drinkers (A) had a highly significantly lower final body weight than chickens drinking from cap (B) and nipple (C) drinkers. The lower weight gains resulted from high litter moisture and inferior environmental conditions of the broilerhouse. Potemkowska (1975) asserts that litter moisture in excess of 33% has a negative effect on the microclimate and thus decreases performance. The amount of water drunk is also affected by water quality, rate of its flow, and water surface in the drinker. When estimating rapid flow nipple drinkers, Carpenter (1992) found that broilers given rapid-flow water in the summer season had higher weight gains and were healthier. Moister litter was found in broilerhouses A and B, without significant differences in the other environmental parameters. Drinker type also influenced litter intake and litter quality. Owing to their construction, nipple drinkers (C) prevent broilers from splashing water and prevent litter from becoming moist. According to Dobrzański and Mazurkiewicz (1993), litter moisture at the end of rearing should not exceed 25-30%. Overly moist litter in broilerhouses A and B twice increased its consumption (it had to be re-bedded twice) but improved the hygienic quality of litter. Litter consumption in broilerhouse C was 60% lower. The greatest amount of water (0.307 l/bird) was used with trough drinkers (A), followed by cap drinkers (0.221 l/bird) (B) and nipple drinkers (0.152 l/bird) (C).

Litter samples taken on the first day of rearing were found to have no pathogenic microorganisms (**Table 2**), although they contained 4.5×10^5 g ammonifiers and 3000 spores/g toxin-producing fungi. Ammonifiers and toxin-producing fungi increased in number with chicken age. After fresh straw has been added in broilerhouses at 14 days of rearing, the number of toxin-producing fungi at 21 days increased to 3000 spores/g with 6×10^7/g ammonifiers. In broilerhouse C the number of toxin-producing fungi increased to 69667 spores/g. *E. coli* bacilli appeared in all broilerhouses, but 1.06% colibacillosis-induced mortality was only found in broilerhouse B. Straw was again added at 28 days of growth in houses A and B, thus decreasing the number of ammonifiers to 7×10^6/g, and toxin-producing fungi to 1033 spores/g. House C, where no straw was added to litter, was found to contain 1×10^7/g ammonifiers and 10333 spores/g toxin-producing fungi. Litter moisture at 49 days of age was 37.5% in house A, 32.5% in house B and 18.8% in house C.

Supplementation of straw in houses A and B improved the hygienic quality of litter. Regardless of the watering system and the hygienic quality of litter, no statistically significant differences were found in chicken survival.

Conclusions

The studies showed that nipple drinkers improved the hygienic quality of litter and decreased litter consumption. Introduction of nipple drinkers improved the final body weight of broilers and decreased water and straw intake per bird by 51 and 60%, respectively.

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Table 1. Performance, environmental parameters and feed and litter consumption in broiler chicken rearing

Table 2. Litter contamination in broilerhouses during broiler chicken rearing

Table 1. Performance, environmental parameters and feed and litter consumption in broiler chicken rearing

Item	Type of drinker (broilerhouse)		
	A	B	C
Performance			
Body weight at 49 days of age (g)	2130	2300	2283
Feed conversion (g)	2140	2380	2360
Mortality, 1-49 days of age (%)	4.6	7.4	7.0
Environmental factors			
Air temperature (°C)	19.70	20.89	20.08
Relative air humidity (%)	62.08	62.50	63.08
Gas impurities in air:			
CO_2 (%)	0.09	0.10	0.10
NH_3 (ppm)	9.25	12.25	8.00
Litter humidity (%)			
at 49 days of age	37.49	32.55	18.78
at 21 days of age	37.73	34.40	29.94
Water and litter consumption			
Water drunk, 1 to 49 days of age (l/head)	10.643	9.447	6.515
Water for hygienic purposes (l/head)	4.396	1.384	0.968
Water used (l/head)	15.040	10.831	7.484
Straw used per broilerhouse (kg)	880	880	352

Table 2. Litter contamination in broilerhouses during broiler chicken rearing

Type of contamination	Type of drinker		
	A	B	C
First day of age			
Pathogenic microorganisms	—	—	—
Ammonifiers	4.5×10^5/g	4.5×10^5/g	4.5×10^5/g
Toxin-producing fungi:			
Fusarium	5000 spores/g	5000 spores/g	5000 spores/g
Alternaria	3000 spores/g	3000 spores/g	3000 spores/g
Aspergillus	1000 spores/g	1000 spores/g	1000 spores/g
21 days of age			
E. coli bacilli	3×10^5/g	5×10^4/g	6×10^3/g
Ammonifiers	6×10^7/g	6×10^7/g	5×10^6/g
Toxin-producing fungi:			
Penicillium	5000 spores/g	3500 spores/g	136000 spores/g
Fusarium	4000 spores/g	7000 spores/g	63000 spores/g
Alternaria	2000 spores/g	2000 spores/g	—
Aspergillus	500 spores/g	—	10000 spores/g
49 days of age			
Ammonifiers	8×10^6/g	6×10^6/g	1×7^7/g
Toxin-producing fungi:			
Penicillium	3000 spores/g	1000 spores/g	6000 spores/g
Aspergillus	1000 spores/g	100 spores/g	20000 spores/g
Saprophytes	1000 spores/g	100 spores/g	5000 spores/g

Health state and productivity of broiler chicken depending on the temperature and altitude in Algeria

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Summary

An ecopathological study was carried-out in 1994 in 10 poultry houses for broiler placed at two different levels of altitude (sea level and 1800 meters). Three batches of broiler chickens were steadily followed in the same poultry sheds; the first batch in winter, the second in summer and the last in between seasons. The data which were collected concerned the production performances, declared diseases and the principal ways of breeding (management, poultry sheds, microclimate, alimentation, and hygiene). Among the results obtained, the temperature and altitude represented the most dominant parameters of risk. The high rate of mortality (23 ± 5,10 %) was recorder in summer at 1800 meters of altitude, while it was only at 10 ± 2,5 % at sea level. However, these rates of mortality were low (3,2 ± 1,60 % to 6,5 ± 1,5 %) in the other seasons (winter and between seasons). The pathological entity most frequent at 1800 meters was the *suden death syndrom* and *ascit,* but was more variable at sea level *(coccidiosis, salmonellosis, mycoplasmosis).* Feed conversion was about the same at the two levels of altitude, but was different during the seasons.

Key words: miroclimate, broiler, feed conversion, temperature, altitude, pathological entity.

Introduction

Poultry rearing is the field of animal production which has known a remarquable development in these two last decades in Algeria. But, this development is confronted always to some technico-econonomical and sanitary problems. Amongst the causes of non performances, the environment is one of the factors which has an influence on zootechnic performances and sanitary state of poultry. Many authors showed a tight relation between some diseases and medium where these birds live (Sauter 1989, Thiaucourt 1984, Teeter 1992).

The purpose of our study was the influence of environmental parameters, in poultry houses of the zootechnic-performances and the developement of pathological state in broiler chicks in two regions and different seasons in Algeria.

Materials and methods

Ecopathological investigation, during 1994 on 10 poultry houses (10.000 broiler chicken each) in two different regions:

- Six breeds located in the North-East of the sea level.
- Four breeds located in the Center-Est at 1800 meters altitude.

The observations were conducted through all the breeding cycles (49 days) on the same batch in each season. The birds were reared in the same batteries (identical equipements and constructions). They received commercialised feed that fulfill the required norms.

The breeding parameters were recorded everyday for each batch. For the study of microclimatic parameters, we have used Rokicki's method (1988).

We have evaluated also the zootechnic-performances (feed conversion, the mean live-weight, mortality rate) and pathologies observed in each batch.

The statistical analyses of all parameters of batteries environment were studied using the mean and the standard deviation; for production performances we used the variance.

In order to determine the pathological entities, an autopsy was performed to reveal all the particular lesions.The necropsic examination and the history permit to us to suspect a number of etiologies that we tried to confirm by laboratory examinations.

Results and discussion

Many authors recognize temperature as the most important parameter of all the microclimate agents in poultry rearing (Castello 1990, Charles 1981, Deaton 1978, Geraert 1991, Reece 1982). The conducted research showed that temperature distribution was not proper in all the cycles, compared to that recommended by Rokicki (1988). In summer, at sea level, temperature changed from the I-st week of fattening and VII-th week (34,15± 2,5°C - 29,75±1,7°C). However, in altitude 1800 m, it changed from 31,00±1,3°C and 26,75±2,6°C. This is due to the high external temperature (>40°C) recorded in summer.

Humidity is also a very important parameter in poultry rearing, and according to Le Menec (1980), be comprised in the interval of 50 - 75%. For all seasons, in sea level humidity oscillated within the range of 33±7,1% - 64± 6,0% (summer), and in altitude 1800 m, range of 37± 8,4% - 72± 4,0% (inter season). These values are in accordance with the norms, except for I- st week of rearing (<50%).

The thermo-humidity conditions determined the degree of pollution with dust and nocif gases mixture in a great exent. According to Rokicki (1988), the admissible content of CO_2 is 0,30% - 0,35%. These norms were conform to our results. However, the concentration of CO_2 in the living area of birds (VI-th week of rearing) is higher in inter season, altitude 1800 m (0,36± 0,08%).

Amonia (NH_3) is a very dangerous gas, as its high concentration may cause the damage of respiratory mucosa, altere the mucus secretion and egg laying (Nagaraja 1984, Reece 1980). In winter, a high concentration of this gas was noted for VII-th week of rearing in altitude 1800 m (35,10± 3,9 ppm). On the other hand at sea level the highest concentration was recorded in inter season (32,50±1,1 ppm).

Except for temperature parameter, all the factors did not have a negative influence on production. At the sea level and altitude 1800 m in summer values feed conversion was 2,90±0,28 and 3,01±0,7 respectively.

It has to be mentioned that in spite of better microclimate conditions (except for temperature) there was a greater death rate at the altitude 1800 m (23±5,10 %) compared to that obseved at sea level (10± 2,5%) in summer.

The pathological entity most frequent at altitude was the *suden death syndrom* and *ascite,* but was more variable at sea level *(coccidiosis, salmonellosis, mycoplasmosis).*

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Table 1. Microclimate conditions in poultry house (sea level)

Seasons	Week of rearing	Temperature (°C)	Humidity (%)	Speed of air flow , (m/s)	Cooling (mW/cm^2)	NH_3 (ppm)	CO_2 (%)
Winter	I	33,25 ± 1,7	34 ± 7,5	0,07 ± 0,01	10,51 ± 3,9	5,70 ± 1,6	0,03 ± 0,009
	II	25,70 ± 2,2	46 ± 5,9	0,14 ± 0,03	15,90 ± 2,8	7,90 ± 2,1	0,05 ± 0,013
	III	24,00 ± 1,2	54 ± 10,1	0,25 ± 0,01	13,00 ± 4,7	10,30 ± 1,1	0,04 ± 0,015
	IV	26,50 ± 2,6	49 ± 8,9	0,17 ± 0,01	11.85 ± 8,3	20,42 ± 2,0	0,08 ± 0,031
	V	22,30 ± 1,4	61 ± 10,2	0,14 ± 0,09	14,70 ± 4,5	18,50 ± 3,6	0,05 ± 0,018
	VI	24,50 ± 1,3	58 ± 9,5	0,20 ± 0,03	21,90 ± 3,6	29,72 ± 2,0	0,10 ± 0,012
	VII	21,70 ± 1,3	62 ± 8,4	0,21 ± 0,05	17,19 ± 7,5	31,90 ± 2,1	0,12 ± 0,040
Inter season	I	32,75 ± 2,1	41 ± 12,1	0,25 ± 0,04	13,05 ± 4,1	8,90 ± 2,1	0,05 ± 0,013
	II	33,60 ± 1,9	48 ± 10,5	0,l3 ± 0,09	11,83 ± 3,1	10,70 ± 2,7	0,03 ± 0,018
	III	29,50 ± 1,7	53 ± 6,7	0,22 ± 0,05	14,70 ± 7,3	12,90 ± 2,6	0,09 ± 0,016
	IV	28,45 ± 2,6	59 ± 9,5	0,39 ± 0,01	19,42 ± 8,7	21,50 ± 1,9	0,07 ± 0,022
	V	27,20 ± 2,3	62 ± 7,8	0,29 ± 0,04	19,61 ± 6,3	19,70 ± 1,7	0,10 ± 0,030
	VI	23,12 ± 1,0	57 ± 4,1	0,36 ± 0,09	25,42 ± 4,2	**32,50 ± 1,1**	0,12 ± 0,020
	VII	20,75 ± 1,7	60 ± 7,9	0,32 ± 0,10	26,37 ± 3,1	31,70 ±0,9	**0,20 ± 0,080**
Summer	I	**34,15 ± 2,6**	35 ± 4,9	0,41 ± 0,12	15,05 ± 7.2	8,12 ± 2,1	0,03 ± 0,010
	II	33,17 ± 3,2	**33 ± 7,1**	0,48 ± 0,09	18,98 ± 6,3	6,00 ± 1,7	0,05 ± 0,012
	III	30,90 ± 2,.9	41 ± 9,2	0,50 ± 0,16	20,05 ± 9,1	7,50 ± 3,2	0,02 ± 0,010
	IV	28,75 ± 3,9	48 ± 5,3	0,49 ± 0,12	21,05 ± 8,5	12,50 ± 2,3	0,06 ± 0,017
	V	27,75 ± 1,4	55 ± 9,6	0.62 ± 0,33	18,20 ± 7,9	14,50 ± 1,7	0,08 ± 0,020
	VI	30,10 ± 2,6	60 ± 7,2	0,77 ± 0,16	26,19 ± 12,1	22,50 ± 2,2	0,09 ± 0,018
	VII	2**9,75 ± 1,7**	**64 ± 6,0**	0,80 ± 0,19	34,99 ± 13,2	19,70 ± 1,9	0,18 ± 0,013

Table 2. Microclimate conditions in poultry house (altitude 1800 meters)

Table 3. Performances of production and pathologies observed in poultry houses

Table 2. Microclimate conditions in poultry house (altitude 1800 meters)

Seasons	Week of rearing	Temperature (°C)	Humidity (%)	Speed of air flow , (m/s)	Cooling (mW/cm^2)	NH_3 (ppm)	CO_2 (%)
Winter	I	30,50 ± 1,7	38 ± 6,0	0,13 ± 0,03	12,10 ± 3,1	6,70 ± 1,5	0,09 ± 0,010
	II	30,50 ± 2,6	46 ± 4,9	0,12 ± 0,01	14,20 ± 2,9	8,10 ± 2,2	0,08 ± 0,010
	III	29,70 ± 1,4	57 ± 9,1	0,17 ± 0,02	17,40 ± 6,1	10,12 ± 2,0	0,15 ± 0,020
	IV	29,00 ± 3,9	47 ± 5,3	0,22 ± 0,06	18,20 ± 7,1	12,50 ± 3,5	0,18 ± 0,021
	V	27,20 ± 2,9	52 ± 9,3	0,36 ± 0,09	24,10 ± 8,9	25,30 ± 4,5	0,25 ± 0,031
	VI	26,70 ± 3.2	67 ± 7,2	0,19 ± 0,03	21,90 ± 3,7	31,70 ± 6,2	0,21 ± 0,027
	VII	22,50 ± 2,6	66 ± 6,1	0,28 ± 0,09	29,30 ± 6,1	**35,10 ± 3,9**	0,30 ± 0,035
Inter season	I	29,00 ± 2,3	**37 ± 8,4**	0,12 ± 0,05	15,61 ± 4,2	5,80 ± 1,2	0,09 ± 0,002
	II	27,50 ± 1,7	54 ± 6,0	0,09 ± 0,01	16,32 ± 7,1	5,50 ± 1,7	0,09 ± 0,006
	III	26,50 ± 2,2	56 ± 7,2	0,16 ± 0,03	19,50 ± 6,5	6,10 ± 2,1	0,11 ± 0,080
	IV	25,00 ± 1,2	55 ± 4,1	0,17 ± 0,09	20,l0 ± 7,2	15,20 ± 3,2	0,17 ± 0,050
	V	23.00 ± 2,5	61 ± 7,8	0,09 ± 0,01	18,35 ± 8.6	17,50 ± 4,3	0,22 ± 0,030
	VI	21,50 ± 1,4	**72 ± 4,0**	0,14 ± 0,06	25,72 ± 6,3	25,50 ± 2,9	0,36 ± 0,080
	VII	20,70 ± 2,7	69 ± 7,1	0,20 ± 0,09	28,25 ± 7,9	32,40 ± 6,5	0,34 ± 0,060
Summer	I	**31,00 ± 1,3**	39 ± 8,1	0,13 ± 0,04	7,00 ± 3,1	3,50 ± 1,2	0,07 ± 0,012
	II	32,10 ± 1,7	37 ± 9,5	0,19 ± 0,08	14,12 ± 6,5	5,70 ± 2,9	0,09 ± 0,020
	III	30,50 ± 2,2	49 ± 7,8	0,l2 ± 0,0l	18,25 ± 4,3	8,10 ± 1,8	0,08 ± 0,030
	IV	29,00 ± 1,2	48 ± 6,7	0,20 ± 0,07	25,12 ± 9,1	10,15 ± 6,5	0,12 ± 0,040
	V	28,12 ± 2,0	47 ± 12,1	0,25 ± 0,09	26,80 ± 12,2	15,50 ± 4,7	0,18 ± 0,050
	VI	29,70 ± 2,5	59 ± 10,1	0,33 ± 0,07	29,20 ± 6,7	18,25 ± 6,1	0,21 ± 0,070
	VII	**26,75 ± 2,6**	62 ± 13,2	0,51 ± 0,05	19,70 ± 7,2	22,41 ± 5,9	0,22 ± 0,060

Table 3. Performances of production and pathologies observed in poultry houses

		Body weight (kg)	**Feed conversion (kg/kg)**	**Mortality rate (%)**	**Dominant pathologies**
Sea level	**Winter**	1,56 ± 0,19	2,74 ± 0,40	3,2 ± 1,6	C++ S++
	Inter season	1,62 ± 0,15	2,63 ± 0,32	5,0 ± 1,7	S+++ +
	Summer	1,34 ± 0,21	**2,90^{a} ± 0,28**	**10,0^{A} ± 2,5**	M+++ S+++
Altitude 1800 m	**Winter**	1,75 ± 0,12	2,62 ± 0,27	6,5 ± 1,5	SDA+ +
	Inter season	1,62 ± 0,17	2,71 ± 0,25	4,9 ± 1,8	SDA+ +
	Summer	1,51 ± 0,23	**3,01^{b} ± 0,70**	**23,0^{B} ± 5,1**	SDA+++++

A , B - p< 0,01; a ,b - p< 0,05
C+: coocidiosis S+: salmonellosis M+: mycoplasmosis
SDA: sudden death syndrom and ascit

Effect of Experimentally Induced Coccidiosis, on some Blood Parameters and its Treatment with Three New Anticoccidial Drugs in Broilers

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Summary

One hundred and fifty day and broilers were reared and given coccidiostat free feed. At the age of 26 days the birds were divided into five groups A,B,C,D and E. The D and E are control groups, D infected but not treated, while E non infected and treated. The birds infected with 75000 sporulated oocyst in 2 ml normal saline solution except E group. The group A, B and C were treated Clopidol, Monensin and Salmomycin respectively. In hematological estimation the average values of haemoglobin, erythrocytic count were lower post infection as compared to normal values. The total leukocytic count was increased in all groups except E. Out of these three drugs Monensin proved best.

Key words: Broilers, Coccidostat, Oocyst, Clopidol, Monensin, Salmomycin, Hematological.

Introduction

In Pakistan poultry industry is developing at the rate of 15 percent per annum and 12 percent of the total meat consumption is from poultry birds (Qureshi, 1992). Coccidiosis is an important disease of poultry and is characterized by cecal and intestinal hemorrhages with relatively higher mortality. Recently, for the control of this disease some new drugs have been introduced into local market.

The present project was designed to study the comparative efficacy of Clopidol, Monensin and Salinomycin and effect of this disease on some blood parameters.

Materials and Methods

This project was designed to find out the comparative efficacy of Coyden (Clopidol), Elanchban (Monensin) and Salinopharma (Salinomycin) against coccidiosis in broilers and its effect on some blood parameters.

Groups

Group A: 30 birds infected and treated with Clopidol (Coyden 25 RHOONE POULENCE) 125 mg/kg body weight in feed for 3 days then two days off and again same dose for 2 more days.

Group B: 30 birds infected and treated with Monensin (Blancoban, EASIERN AGENCHES). 100 mg/kg body weight in feed in same manner of group A.

Group C: 30 birds infected and treated with Salinomycin (Satinophatrma VET. MED). 90 mg/kg body weight in feed in same manner as of group A.

Group D: 30 birds infected and non medicated.

Group E: 30 birds non infected and non medicated.

The birds from groups A, B, C and D were infected with 75,000 oocyst per bird in 2 ml of normal saline solution introduced directly into the mouth of birds by help of dropper (Alvair et al., 1982).

Medication

On the onset of clinical symptoms and alter confirmation by faecal examination, drug trial were conducted. The efficacy of drugs were determined on the basis of reduction of oocyst in the faeces by adopting McMaster modified technique (Arakawa, 1991).

Blood Examinations

On 1st, 5th and 9th days of medication, blood from 5 birds randomly selected from each group was collected from wings vein in Beju bottles containing a few drops of 1% EDTA for further processing for Haemoglobin (Coles, 1986). Total erythrocytic count, Total leukocytic count and Differential leukocytic count (Benjamin, 1979).

Results and Discussion

Oocyst count was checked on zero day of infection then on 1st, 5th and 9th day of medication in all groups. The result proved that Monensin was better as compared to Clopidol because it effectively controlled the oocyst excretion, in accordance with Braunius et al. (1984). While Monensin was better to Salinmycin having least mortalities, coinciding with McDougald and Ried (1991) and Nabi (1987).

Raether and Dost (1985) studied the efficacy of different anticoccidial drugs and noted that Monensin and Clopidol are rotatory to each other.

In haematological studies the average erythrocytic count of A, B. C, D and E was 2.17. 2.5, 2.23, 1.9 and 2.9 million/µl in haemoglobin the average values of A, B. C and D were lower as compared to E. Which are 5.96, 6.36, 6.46, 5.56 and 8.93 (normal) respectively. The results were in accordance with Oikawa et al. (1971). The total leukocytic count of A, B. C and D significantly increased as compared to E. The average values were 29.74, 31.42, 29.65, 33.37 and 19.83 thousand/µl. in accordance with Sharma et al. (1973). The total serum protein in groups A, B. C and D were decreased post infection as relevant to E. The average values were 2.45,2.3,2.66,1.76 and 3.63 respectively.

In differential leukocytic count the lymphocyte decreased in groups A, B. C and D the average values in percent were 30.06, 34.43, 37.3, 38.8 and 59.56 respectively. The heterophil increased and there average values were 51.6, 52.0, 19.2, 52.2 and 30.2 respectively. The monocytes increased as compared to group E. The average values in percent were 9.9, 10.5, 10.0, 11.5 and 5.9 respectively. The eosinophil showed variation in groups A, B. C, D and E. The values were 1.4, 1.4, 1.2, 1.6, and 2.3 respectively while basophil also showed variation like eosinophil. The average values were 0.3, 0.3, 0.5, 0.2, and 1.2, respectively in groups of A, B, C, D and E.

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The effect of ground water pollution on the health and reproduction indexes in geese

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Summary

It was proved that the clearest water was in wells which were sunk, the quality of water was slightly worse in wells which were dug with a water-supply system, whereas the worst quality of water was in wells which were dug with a windless. The quality of water influenced on the hematologic blood picture in geese. The higher contamination of water the lower hematologic indexes and worse egg laying in reproduction geese.

Key words: water, wells, contamination of water, geese health, egg laying

Introduction

Among others the animal production results depend on the quality of water. Farms usually supply themselves with water from wells which were either dug or sunk, seldom - from water supply service. In many farms the utilizations of human and animals' sewage is inappropriate. It results in the chemical and bacteriological contamination of water in wells and the decrease in animal production and health (Karaczun, Indeka 1996).

The aim of the work was to define the effect of water quality in different types of rural wells on the health and egg laying in reproduction geese.

Material and method

The White Italian breed aged one and two years were used as an experimental material. The study was carried out in on Podlasie region in 15 farms which numbered from 250 to 700 birds. The analysed farms supplied themselves with water from wells which were sunk or dug (with a water-supply system or a windless). The chemical analyses of water contained as foloows: the concentration of nitrate, nitrite and ammonium nitrogen, as well as the contamination of chloride and the oxidation. The amount of Escherichia cold bacteria and an index were estimated in the bacteriological studies. The chemical and bacteriological water analyses were carried out according to the method which was given by Janowski (1979) and by the official gazzette announcing current legislation (1977). The hematologic studies (erythrocyte, hematocrit and hemoglobin) were estimated after the method which was given by Stankiewicz (1973) as well as Klopocki and Winnicka (1987). The production results were defined on the ground of the control of egg laying.

The obtained results were shown as an extremum (a range), arithmetic means ($\bar{x}$) and coefficient variations (%) (Oktaba 1980).

Results

In **table 1** it was shown the chemical and bacteriological contamination of water in rural wells. It was found that the norms of nitro-compounds (N-NO_3, N-NO_2, N-NH_4) were exceeded in wells which were dug as well as had both a water-supply system and a windless. However, it was not proved any ntro-compounds in water from wells which were sunk. In comparison with the norm 250 mg/dm^3 (Anusz 1984) the concentration of chloride was exceeded in the analysed simples of water from dug wells and with a windless. In the most of analyses the water oxidation which characterizes the level of organic-compounds contamination, did not correspond with the norm, i.e. 3.0 mg/dm^3 (Anusz 1984). The water from dug wells and with a windless was characterized by the highest oxidation (2.4 - 14.0 mg/dm^3), whereas the lowest one were obtained in sunk wells (0.7 - 2.8 mg/dm^3). The bacteriological results also indicated high contamination of water in dug wells (to 205 E. coli bacteria) in opposition to sunk wells (to 13 bacteria). The obligatory norms reported that it should not be more than 100 colonies in 1 m^3 of water (Anusz 1984).

In table 2 the results of hematologic studies and egg laying were presented. From the figures it appeared that there were higher hematologic indexes in geese which drank water from sunk wells. The water contaminated with chemical and bacteriological compounds in dug wells decreased the level of erythrocytes, hematocrit and hemoglobin, which negatively influenced on the production results. The egg laying 49 - 68 eggs per one laying goose was found in the farms in which birds drank good quality water, whereas geese which drank bad quality water had lower egg laying by 24 eggs.

Conclusions

1. Quality of water effects on geese health and their egg laying.
2. Water from wells which were sunk corresponds with sanitary and hygienic norms, whereas water from dug wells in not drinkable in most of cases.
3. The worse water quality the lower hematologic indexes and egg laying.

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Table 1. Chemical and bacteriological contamination of water according to the type of wells and the way of taking water

Table 2. Effect of water quality from wells on hematologic indexes and egg laying in reproduction geese

Table 1. Chemical and bacteriological contamination of water according to the type of wells and the way of taking water

Type of contamination	Statistical measurements	Sunk well	Dug well with water supply system	Dug well with windless
Nitrate (mg $N\text{-}NO_3$/ dm^3 H_2O)	range $\bar{x}$ V%	not found	1.0 - 39.0 23.4 37.8	12.5 - 90.0 38.2 55.4
Nitrite (mg $N\text{-}NO_2$/ dm^3 H_2O)	range $\bar{x}$ V%	not found	0.00 - 0.09 0.04 16.5	0.01 - 1.20 0.08 31.0
Ammonium nitrogen (mg $N\text{-}NH_4$/dm^3 H_2O)	range $\bar{x}$ V%	not found	0.02 - 1.8 0.10 16.9	0.6- 5.3 2.1 37.8
Chloride (mg Cl/ dm^3 H_2O)	range $\bar{x}$ V%	14.6 - 90.0 40.2 24.5	26.0 - 140.8 62.6 40.8	34.1 - 323.3 128.7 43.2
Oxidation (mg O_2/ dm^3 H_2O)	range $\bar{x}$ V%	0.7 - 2.8 1.3 17.4	2.3 - 6.6 5.4 32.5	2.4- 14.0 8.4 45.6
Amount of bacteria in 1 cm^3 H_2O after 24 hours	range $\bar{x}$ V%	0.0 - 13.0 4.7 32.2	2.0 - 164.0 111.7 46.5	32.0 - 205.0 189.3 77.6
E. coli index in 100 cm^3 H_2O	range $\bar{x}$ V%	0.0 - 9.0 5.6 22.8	12.0 - 198.0 141.3 46.6	11.0 - 372.0 228.9 72.2

Table 2. Effect of water quality from wells on hematologic indexes and egg laying in reproduction geese

Analysed indexes	Statistical measurements	Sunk well	Dug well with water supply system	Dug well with windless
Erythrocyte (10^{12}/1)	range $\bar{x}$ V%	2.7 - 3.4 3.1 8.6	2.2 2.3 11.4	1.6 - 2.3 1.9 17.5
Hematocrit (1/1)	range $\bar{x}$ V%	0.34 - 0.53 0.41 7.2	0.28 - 0.41 0.32 9.4	0.19 - 0.30 0.22 1.07
Hemoglobin (g/l)	range $\bar{x}$ V%	136- 191 163 15.7	120- 148 138 20.4	116- 134 125 20.1
Number of eggs per one laymg goose (eggs)	range $\bar{x}$ V%	49 - 68 57 6.4	39 - 53 43 7.6	18 -42 23 9.5

The animal hygiene conditions and the egg laying indexes according to the heat-preservation in poultry house

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Summary

Inside the poultry houses the optimum animal hygiene norms relating to the temperature and relative humidity were exceeded. It testified to low heat-preservation of these buildings. The significant effect of the external climate on the variability of temperature inside the poultry houses was found (b_{yx} = 0.28 - 0.41). The animal hygienic conditions inside the poultry houses effected on the production indexes in laying geese (30.5 - 37.5 goslings per one laying goose).

Key words: microclimate, air temperature, relative humidity, heat-preservation, reproduction geese, egg laying

Introduction

In Poland the White Italian breed is of great importance in production of geese hatching eggs. The breed is characterised by high egg laying in a year, good fertilization and hatching ability (Mazanowski 1980). Relatively low production level is obtained in farms breeding and inappropriate animal hygienic conditions are thought to be the main reason for it. Wolski (1988) says that it is possible to obtained the optimal microclimate in barns using heat-preservation.

The aim of the experiment was to compare the management conditions of geese in poultry houses with different constructions and densities as well as to determinate their influence on egg laying.

Material and method

The experiment was carried out on reproduction geese of the White Italian breed at the age of one and two years in separate farms od Podlasie region. Three farms (A, B. C) were selected. Number of geese ranged from 400 to 760 birds. Geese were kept on deep litter in a building A and B, whereas on wooden gratings in a building C (table l).

An animal hygienic survey in the buildings was made according to the method by Janowski (1979). Heat-preservation was stted on the ground of the thermic characteristic index (TCI). It is the heat emission from animals/the sum of heat loss across baffles and ventilation ratio (Wolski 1988). The heat balance in poultry houses was calculated in relation to the temperature of the 4th climatic zone in Poland (t_z = - 20°C). The temperature and relative humidity in winter were recorded by means of a thermohigrograph (continuous measurements) and Assmann's psychrometer (temporary measurements). The regression coefficients (b_{yx}) and simple correlation coefficients (r) for average twenty-four hours' observations were calculated to investigate the dependence between temperature and relative humidity inside (Y) and outside (X) the poultry houses (Oktaba 1980).

The production results were estimated basing oneself on the Control Cards of Egg Laying and Goslings Hatching.

Results

From the animal hygienic survey it followed that density of geese (1.16 - 1.54 birds/m^2) and cubature indexes (1.63 - 1.98 m^3/bird) in poultry houses were different (table 1). It may effect on the heat balance and microclimate. The value of the thermic characteristic index (TCI) ranged from 32.8% in the building C to 58.9% in the building A (table 2). It is assume that the minimum value of TCI should not be lower than 70% in the building A (with an useful attic) and 85% - in the building B and C (with a flat roof) (Kolbuszewski et al. 1973). From the data in table 2 it appeared that the essential heat-preservating requirements were inappropriate and microclimate in winter did not reach optimum values (table 3). The temperature in poultry houses ranged from -1.6°C (farm A) to + 8.7°C (farm C). Low temperature in poultry houses caused the increase in relative humidity (73 - 97%) and in moistness of walls and ceilings. It was found that simple correlation coefficients between outside and inside temperature were highly significant. The regression coefficient was 0.28 - 0.41, then the increase in temperature outside the poultry houses by 1°C caused the increase in the parameter inside by 0.28 - 0.41°C. It was not proved that there was an effect of the relative humidity outside on the parameter inside the poultry houses.

Low air temperature and high relative humidity in poultry houses influenced on the production results (table 4). In tested farms, different egg laying (46.4 - 51.7 eggs per one layer), fertilization (83.8 - 93.0%) and hatching indexes (75.1 - 84.7%) were obtained.

Conclusion

1. The effect of climate outside the poultry houses on the variability of air temperature inside was proved.
2. The optimum norms of temperature and relative humidity were exceeded. It was due to low heat-preservation in poultry houses, too large cubature and inappropriate ventilation.

3. Different animal hygienic conditions in poultry houses influenced on the reproductive indexes in laying geese.

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Table 1. Characterization of poultry houses

Item	Farm A	Farm B	Farm C
Number of geese (birds)	400	460	700
Keeping system	on deep litter	on deep litter	on wooden gratings
Density (birds/ m^2)	1.54	1.31	1.16
Cubature (m^3/bird)	1.63	1.68	1.98
Ventilation (m^3/h/kg) body weight)	0.98	0.85	1.17

Table 2. Thermic characteristic index (TCI) in poultry houses (at t_z = - 20°C)

Item	Farm A	Farm B	Farm C
TCI (%)	58.9	35.5	32.8
Minimum TCI (Kolbuszewski et al.,l973)	70.0	85.0	85.0

Table 3. Extremum thermic and humidity conditions in poultry houses and outside as well as regression (b_{yx}) and correlation (r) coefficients.

Parameter	Farm	Range inside	Range outside	b_{yx}	r
Air temperature (°C)	A	-1.6 - +6.9	-17.8 - -1.6	0.34	0.873^{xx}
	B	-1.4 - +7.3	-16.8 - +0.9	0.28	0.622^{xx}
	C	-0.4 - +8.7	-16.0-+3.6	0.41	0.832^{xx}
Relative humidity (%)	A	86 - 97	70 - 92	- 0.09	- 0.174
	B	79 - 97	72 - 93	0.11	0.099
	C	73 - 91	73 - 91	- 0.21	- 0.231

^{xx}- highly significant difference at P≤ 0.01

Table 4. Production results in geese

Item	Farm A	Farm B	Farm C
Number of eggs per 1 raying goose	48.9	51.7	46.4
Number of hatching eggs per 1 goose	46.4	50.1	44.8
An average per cent of fertilized eggs	93.0	90.2	83.8
Hatching from fertilized eggs (%)	84.7	78.1	75.1
An average number of goslings per I laying goose	37.7	36.6	30.5

Performance of chickens depending on supplementation of probiotic and preprobiotic in their drinking water

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Summary

The study was carried out with 390 one-day-old chickens (Plymouthrock x Cornish) of both sexes, divided into three groups, with equal live weight. The compound feed given to the chicks of all groups until the 14th day after chicken's hatching contained 21.4% protein and 2990 kcal/kg metabolizable energy (ME) and for the period from 14th to 25th day - 19.2% and 2870 kcal/kg, respectively. The chickens from IInd group received drinking water with preprobiotic (16ml/l) plus probiotic (10 ml/l) from 1st to 7th day after hatching. These from the IIIrd group - drinking water with preprobiotic (16 ml/l) only in the same period. At the end of the experimental period the chickens from IInd and IIIrd group had 14.5 and 11.9% higher live weight respectively, compared to the control group. The highest activity of GSH-px was determined for the IInd group. In the same time the highest value for PREL were observed for the control.

Key words: chicken, probiotic, preprobiotic, drinking water, live weight, feed conversion, GSH-px, PREL

Introduction

The disturbance of chick's gut microflora balance leads to worse digestibility and utilization of feed, poor growth, worse feed conversion and often to a high risk of diseases. In the modern poultry breeding the probiotics find application as the products for regulation of gut microflora (Nurmi and Rantala 1973) and growth promoters (Fuller 1989, Ganguli 1988).

Vladimirova and Surdjiyska (1996) used Yeasacc and Lactosacc in the combined feed of chickens and found significantly higher increase of live weight with 11%. Durst, Friedrichs and Eckel (1995) reported for 2.4-3.8% increase of average daily weight gain of chicks receiving probiotic.

The application of probiotics and other biological additives in poultry breeding in Bulgaria is in the beginning. The influence of new Bulgarian (experimental) probiotic and a preprobiotic on the performance of chickens was investigated in the present study.

Material and Methods

The study was carried out with 390 one-day-old chickens, (Plymouthrock x Cornish) of both sexes, divided into three groups, with equal live weight, floor reared under controlled microclimate. The compound feed given to the chicks of all groups until age 14th day contained 21.4% protein and 2990 kcal/kg ME and from 14th to 25th day - 19.2% and 2870 kcal/kg, respectively. The chicks from control group received no additives with the water. The chickens from IInd group received drinking water with preprobiotic (16ml/l) plus probiotic (10 ml/l) from 1st to 7th day after hatching, these from the IIIrd group - drinking water with preprobiotic (16 ml/l) only, in the same period. The preprobiotic used in this experiment represents a complex of sugars with dry matter 80%. The used probiotic consists strains of lactobacilli and enterococci isolated from the digestive tract of one-day-old chicks and possessed high inhibitory activity (more than 80%) against Salmonella and E. coli (Kondareva 1994). The live weight and feed consumption were controlled at the 14th and 25th day during the trial. At 25th day were taken blood samples for determining of GSH-px (Rotruck et al., 1973 and modified by Noguchi et al. 1973) and PREL (Goranov et al. 1987) activity of whole blood.

Results and Discussion

The data received for the live weight, feed conversion, GSH-px and PREL activity are given in **Table 1**. Addition of preprobiotic plus probiotic in the water of II group increased live weight with 14.6% and for the III group (only preprobiotic) with 11.9% as compared to the chickens from the control group. The effect of combination preprobiotic + probiotic is 2.7% higher than the effect of using only preprobiotic. The feed conversion was with 3.2% better for the III group and with 1.3% better for the II group as compared with the Ist one. The difference between experimental groups (II and III) of this index is insignificant.

Our results for increasing of live weight and better feed conversion find confirmation in the results of Hamid et al. (1994) and Vladimirova and Surdjiyska (1996). The activity of GSH-px in the whole blood of chickens treated with probiotic and preprobiotic (II) and only with preprobiotic (III) was higher with 33% and 22% respectively as compared with the control group. In the same time the highest value of PREL was determined for the control group.

Table 1. Results of the experiment

Indices	I group (control) water without additions	II group water+probiotic +preprobiotic	III group water+preprobiotic
Live weight, g(%)			
- on 1st day	44.2 (100)	44.3 (100)	44.4 (100)
- on 14th day	152.2 (100)	159.5 (104.5)	161.2 (105.9)
- on 25th day	268.7 (100)	307.8 (114.6)	300.6 (111.9)
%		100	97.7
Feed per 1 kg gain, kg(%)			
1-14 day	1.977 (100)	1.995 (100.9)	1.989 (100.6)
15-25 day	2.198 (100)	2.120 (96.5)	2.057 (93.6)
1-25 day	2.092 (100)	2.065 (98.7)	2.026 (96.8)
%		100	98.
PREL, E	70 ± 11	62 ± 9	66 ± 10
GSH-px, mU/mgHb	9 ± 4	12 ± 3	11 ± 3

Conclusions

Addition of preprobiotic and probiotic to the drinking water of chicks increased their live weight at 25th day with 14.6%, and only of preprobiotic with 11.9% as compared to the control group. Feed conversion is better also for the experimental groups but the values are not very high - 3.2% for the III group (only preprobiotic) and 1.3% for the IInd group.

The results of GSH-px and PREL activity shows that use of probiotic and preprobiotic increase resistance to physical and psychological stress in intensively reared chickens.

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Effect of air humidity on negative ion concentration in broiler chicken rearing

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Summary

The effect of low 55% and high 85% air humidity versus optimum 70% humidity on ion concentration during 42 days of growth of broiler chickens was investigated. Negative artificial ionization of air was applied in the groups of chickens with low and high air humidity.

The studies have shown that high air humidity has a detrimental effect on the concentration of negative ions as it decreases them by about 25%. The concentration of positive ions in the sheds equipped with ionizers was found to be on the verge of measurability. Air dustiness began to increase from 4 weeks of growth in the group with low air humidity, thus decreasing the small ion concentration in this shed to 600 ions/cm^{-3} at 6 weeks. This was reflected in the concentration of thyroid hormones and in performance.

Key words: air humidity, ionization, broiler chickens, performance

Introduction

Ionization, understood as a concentration of ions of specific polarity and electric movement in air, refers to the spatial image of electromagnetic fields of the biosphere and exerts a direct influence on biological life (Kellog 1984, Nizioł 1987). Ions affect animals' body through the respiratory tract and skin. In agreement with research findings (Asaj 1987, Bagley 1980, Herbut et al. 1996, Krueger 1985), the negative ions have a favourable effect on living organisms.

The negative ion concentration in animal houses is largely affected by equipment, stocking density and physical characteristics of air such as air humidity. The aim of the studies was therefore to determine the effect of air humidity on negative ion concentration, thyroid hormones and performance of broiler chickens.

Material and methods

600 weighed and wing tagged chickens were divided into 3 groups according to the layout shown in Table 1. Each group was kept in a separate shed under standard conditions. The treatment factors were varied air humidity during 42 days of growth and artificial air ionization (by ionizers) applied throughout the experiment in groups I and II. The chickens were kept in 5-tier batteries of heated cages until 21 days and in 4-tier batteries of unheated cages until 42 days. Each tier was occupied

by 40 chickens (2 subgroups), with a density of 20 birds/1 m^2. The basic microclimatic conditions were under constant control.

The concentration of ions was measured at 1, 3, 4 and 6 weeks of growth using equipment from the Institute of Nuclear Physics and in accordance with the method of Nizioł et al. (1986). The equipment included a forced airflow capacitor, called an ion counter, and an electrometer. Blood was sampled from 10 chickens of each group at 3 and 6 weeks of growth to determine triiodothyronine (T_3) and thyroxine (T_4) concentrations. Thyroid hormones were determined by radioimmunoassay using $RiAT_3$ and $RiAT_4$ sets. Body weight of individual birds and feed intake in subgroups were checked every week throughout the experiment.

Results and discussion

The artificial ionization applied in sheds with a reduced (55%) and increased (85%) air humidity showed the concentration of negative ions at higher humidity to be lower by more than 25% (**Tab. 2**). This means that high air humidity has a detrimental effect on negative air concentration. In an earlier work Herbut et al. (1996) showed that higher air temperature (37°-23°C) during the growth of chickens also had a detrimental effect on negative ions. With low air humidity, however, the higher concentration of ions persists until the third week of growth. From four weeks the concentration of negative ions is decreasing markedly. This is probably related to the increased dustiness and low air humidity. Group III, with optimum humidity but no air ionization, was found to have the lowest proportion of negative ions, with a concurrent presence of minor- and major-movement positive ions. In the first period of growth, the chickens from this group had a significantly lower triiodothyronine concentration (**Tab. 3**). These differences became even more marked in the second week of growth, which is evidence of greater sensitivity of young birds.

The poultry studies so far have shown that negative air ionization has a favourable effect on almost all life functions of birds (Herbut et al., 1995; Janowski et al., 1989; Kirk et al., 1980), as confirmed by our own studies of body weight, feed intake as well as health of chickens (**Tab. 4**). Negative air ionization was found to offset the negative effect of non-optimum environmental factors (air humidity) in our experiment.

Conclusions

1. Higher (85%) air humidity during the growth of chickens has a detrimental effect on negative ions.

2. Negative air ionization offsets the negative effects of low and high humidity on chickens.

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Table 1. Experimental layout (n=200)

Item	Group		
	experimental		control
	I	II	III
Experimental factor	decreased humidity 55% with ionization of air	increased humidity 85% with ionization of air	optimum humidity 70% without ionization of air
Number of subgroups	10	10	10

Table 2. **Table 3.** **Table 4.**

Table 2. Concentration of (-) negative and (+) positive ions (ion cm^3) with minor (n) and major (N) movement from 10^{-3} [cm^{2}V^{1}S^{-1}]

Week of growth	Ion	Group		
		I	II	III
1	n- n+ N- N+	$4.11 \cdot 10^4$ $4.5 \cdot 10^4$	$3.0 \cdot 10^4$ $4.2 \cdot 10^4$	$4.0 \cdot 10^2$ $5.0 \cdot 10^2$ $3.5 \cdot 10^3$ $3.7 \cdot 10^3$
3	n- n+ N- N+	$1.6 \cdot 10^4$ $3.3 \cdot 10^4$	$9.3 \cdot 10^3$ $2.12 \cdot 10^4$	$2.1 \cdot 10^2$ $4.9 \cdot 10^2$ $3.7 \cdot 10^3$ $4.2 \cdot 10^3$
4	n- n+ N- N+	$8.2 \cdot 10^2$ $1.92 \cdot 10^4$	$4.9 \cdot 10^3$ $2.05 \cdot 10^4$	$2.0 \cdot 10^2$ $6.0 \cdot 10^2$ $5.8 \cdot 10^3$ $6.0 \cdot 10^3$
6	n- n+ N- N+	$6.0 \cdot 10^2$ $2.56 \cdot 10^4$ $1.3 \cdot 10^3$	$1.32 \cdot 10^3$ $2.05 \cdot 10^4$	$2.0 \cdot 10^2$ $3.1 \cdot 10^2$ $4.7 \cdot 10^3$ $5.1 \cdot 10^3$

Table 3. Concentration of triiodothyronine (T_3) and thyroxine (T_4) in the blood plasma in broiler chickens

Item	Week of growth	Group		
		I	II	III
T_3	3 6	1.98±0.14Aa 1.34±0.28a	1.69±0.13a 1.20±0.20a	1.42±0.13Ba 1.78±0.41a
T_4	3 6	22.34±2.56a 26.46±2.01a	24.15±0.98a 28.41±0.43ab	28.41±1.99b 24.99±1.33ac

a,b,c - $P \leq 0.05$
A,B - $P \leq 0.01$

Table 4. The performance of broiler chickens

Week of growth	Body weight (g)			Feed consumption per 1 kg body weight gain (g)		
	Group			Group		
	I	II	III	I	II	III
0	36.1	36.0	35.9			
1	115.6	112.8	117.1	1070	1080	960
2	316.0ab	308.7a	328.7b	1800a	1790a	1650b
3	642.0ab	623.6a	658.4b	2060	2080	2050
4	1093.1	1076.0	1080.6	1900	1930	1970
5	1475.6	1446.1	1447.4	2660	2700	2650
6	1882.4	1838.2	1830.0	2780	2760	2990
0-3				1800ab	1810a	1730b
4-6				2410	2430	2510
0-6				2170	2190	2220

a,b - $P \leq 0.05$

Efficacy of various chemotherapeutic agents against experimentally induced avian mycoplasmosis in broiler chicks.

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Summary

A total number of 200 day old chicks were procured to determine the drug efficacy of tiamulin, tylosin and oxytetracycline against *Mycoplasma gallisepticum* infection, in-vivo. Birds were divided into 5 groups each having 40 birds. The birds of all groups were infected experimentally except group A birds. On the appearance of symptoms of Chronic Respiratory Disease (CRD). Group C, D and E were treated with tiamulin, tylosin and oxytetracycline, respectively. The birds of group B were kept as untreated control. The efficacy of each drug was based upon morbidity percentage, mortality percentage, case fatality, clinical symptoms, feed-intake and necropsy lesions on postmortem. The tiamulin proved superior over other two drugs as only one birds died unlike tylosine-treated group D which recorded 2.5 % mortality. The oxytetracycline treated group E showed 7.5% mortality with the death of 2 birds. A total of 29 birds revealed no pathological lesions at necropsy in contrast to group E birds showing 27 birds without necropsy lesions of CRD.

Key words: Mycoplasma gallisepticum, tiamulin, tylosin, oxytetracycline, mortality, morbidity, fatality, necropsy.

INTRODUCTION

Among the infectious causes Mycoplasmosis plays an important role in the commercial poultry production. Mycoplasma gallisepticum causes chronic respiratory disease (CRD) of chicken and infectious sinusitis of the turkeys. Clinically Mycoplasma gallisepticum infection is characterized by tracheal rales, nasal discharge and coughing. Pathological it is characterized by catarrhal exudate in the nasal and paranasal passage and by air-sacculitis (Jordan, 1989). In Pakistan, meagre research has been reported particularly on the drug efficacy against mycoplasmosis in poultry. In this way farmer or the field practitioner has to go for hit and trial to find out a suitable drug. The main object of the present project was based on the same idea that a drug could be specified for the treatment of Mycoplasmosis in broiler chicks, so that after the diagnosis of the disease a drug of choice should be available. There was a variety of drugs available in the market but three drugs of choice mentioned in the materials and methods were administered at a dose rate prescribed by the manufacturer. Although the drugs mentioned were being tried tremendously in the field yet no data base had so far been reported on the scientific grounds.

MATERIALS AND METHODS

The in vivo examination was conducted on broiler chicks using 3 different antimicrobial drugs. For this purpose, a total of 200 day old broiler chicks were purchased from a local hatchery and rared upto one week of age. The birds were provided with balanced feed and fresh running water. At the age of one week, the birds were divided into 5 groups designated as A, B. C, D and E of 40 birds each The confirmed pathogenic strain of *Mycoplasma gallisepticum* was cultured in PPLO broth at 37°C for 24 hours. After determining the total viable count, the broth was diluted and 1.2×10^8 per ml. of bacteria were used for experimental inoculation. A quantity of one ml was inoculated intra-tracheally (I/t) and intra-nasally (I/n) i.e. 0.75 ml I/t and 0.25 ml I/n, with the help of Institute syringe.

The three antimicrobial drugs used in this project were Tiamulin 250 mg/L, Tylosin 0.5 gm/L and Oxytetracycline 1 gm/L of drinking water to groups C, D and E respectively. Group D was infected and untreated control group which group E was infected and untreated control group.

RESULTS AND DISCUSSION

All the groups were kept under close observation for the development of clinical signs. In above mentioned infected groups, clinical signs appeared after 48 hours. After medication, the chicks were examined at 48 hours 72, 96 and 144 hours post treatment. Morbidity, Mortality and Case fatality were also recorded. The Morbidity percentage, Mortality percentage and Case fatality percentages were recorded.

Group A: In this control group, therefore, the morbidity percentage, mortality percentage and case fatality percentage was remained zero throughout this project. The feed intake was remained normal besides the behaviour of birds. No lesions of CRD were found on postmortem performed on 30 birds after 144 hours of post medication.

Group B: The morbidity percentage calculated was 95 % in infected and untreated group. Only five birds died in 144 hours post inoculation with mortality percentage of 12.5% only. The case fatality recorded was found to be 13.1%. On 144 hours post treatment, a total of 28 birds showed lesions of CRD whereas remaining 2 birds revealed no specific lesion of CRD when examined on post-mortem.

Group C: In the Group C, no bird died during the experiment i.e. no mortality. The morbidity percentage was found to be 92.5% whereas mortality percentage and case fatality percentage was zero. On 144 hours post treatment, only one birds showed slight air sacculitis whereas 29 birds revealed no pathological lesions i.e. percentage of clearance of lesions was 93 %.

Group D: After 144 hours of treatment, only three birds revealed slightly pathological lesion in air sac, and trachea while remaining 27 birds showed no lesions on post mortem. The mortality percentage recorded was found to be 2.5 % whereas case fatality percentage was very low i.e. only 2.7%. No clinical symptoms of CRD were noted on 144 hours post infection. The birds showed normal feed habit.

Group E: The overall morbidity percentage was 97.5 %. The mortality percentage after experiment was 7.5% whereas the case fatality was 7.6%. After 144 hours of inoculation, 7 birds showed pathological lesion while remainig 23 birds revealed no lesion on postmortem examination carried out on randomly selected 30 birds.

The results of present study is also in agreement with Blake and Sanger (1962) who recorded 9% mortality whereas Formina reported that mortality percentage and morbidity percentage were 16% and 30% respectively. No mortality was observed in Group C medicated with Tiamulin alongwith 96% of clearance of lesions. This is in agreement with the result of Baughn et al. (1978) who reported 95% clearance of lesions confirming effectiveness of tiamulin. Stipkovits et al. (1979 and 1988) also evaluated the efficacy of tiamulin in chickens and Turkeys. Tiamulin showed a superior efficacy, as measured by clinical symptoms, pathological lesions and microbiological findings and recommended it both for treatment and prophylaxis.

On the basis of morbidity, mortality, case fatality percentage, clearance of lesions, feed intake and clinical symptoms, tiamulin proved to be a drug of choice against *Mycoplasma gallisepticum* infection. This was advocated by Baughn et hi. (1978) who stated that tiamulin is 2 times as active as tylosin and 3 times as active as chlortetracycline Stipkovits et al. (1979) found that tiamulin is superior over tylosin tartrate. Montagna and Mirizzi (1987) found that tiamulin was most effective in vitro of five antibiotics against 15 strains of mycoplasma including tylosin and oxytetracycline On the whole. tiamulin and tylosin were the effective chugs (Montagna and Mirizzi, 1987).

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Experimental study of Cd accumulation in poultry organism

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Summary

Laying hens were divided into three groups per 6 animals. The group 4. was control. In the first three experimental groups, $CdCl_2$ was administered per os as follows: group 1.- 0.3 mg.kg^{-1}l.w. - 5 months; group 2. - 10.0 mg.kg^{-1}l.w. - 50 days; group 3. - 15.0 mg.kg^{-1}l.w. - 30 days. A significant elevation of Cd levels was found mainly in the liver and in kidneys where a long-term chronic action of Cd caused an elevation of Cd levels in liver (9,33 mg.kg^{-1}) and in kidneys (26,34 mg.kg^{-1}) in group 1. Cd levels in spleen and ovary in group 1. were at mean 15.1 times and 21.6 times higher when compared with the control. In groups 2. the highest Cd levels were found in kidneys (63.92 mg Cd.kg^{-1}) and in liver (27.38 mg Cd.kg^{-1}). In groups 3. a subabacute Cd intoxication of animals was found out. Cd accumulated firstly in liver and then kidneys. In liver, Cd levels in group 3.- 109.66 mg Cd.kg^{-1} and in kidneys was 54.10 mg .kg^{-1}. Cd levels in spleen were at mean 482 times higher and in ovary 179,6 times higher in comparison with control.

Key words: heavy metals, cadmium, poultry

Introduction

The aim of the experiment was to observe the levels of accumulated Cd in the muscles and organs of the laying hens.

Materials and methods

Laying hens 10 months old, laying hybrid of Tetra SL, were included into experiment. The birds were divided into three groups per 6 animals. The group 4 was control. In the first three experimental groups, $CdCl_2$ was administered per os as follows: group 1 0.3 mg.kg^{-1} l.w., group 2 10.0 mg.kg^{-1} l.w., group 3 15.0 mg.kg^{-1} l.w.

The feed mixture for laying hens as well as later obtained biological material were mineralized along with reference material in a muffle furnace for 8 h at 450^{o}C. All measurements were done on an atomic absorption spectrometer of SOLAAR 939 equipped with graphite cuvette with background correction. All metal concentrations were expressed in mg.kg^{-1} of wet matter.

Laying hens of the first experimental group were administered the lowest doses of Cd throughout five months. After 30 days of Cd administration, the laying hens from the third group (the highest dose of Cd), and after 50 days the laying hens from the second group were bled by jugular section. A pathological-anatomical necropsy was carried out and Cd levels were determined in the samples of organs and muscles as well as control group.

Results

Accumulation of Cd in the poultry organism is presented in **Table**.

In our experiment, after 5 month exposure of poultry to Cd, in experimental groups 1 an elevation in Cd levels was found both in breast and femoral muscles when compared with control group. In that group, there were moderately elevated Cd concentrations in the femoral muscle when compared with breast muscle. In group l, a marked elevation in levels of this element in particular in liver and in kidneys was found due to long-term chronic action of Cd on poultry organism (9.33 and 26.34 $mg.kg^{-1}$, respectively) whereas in the control group the mean Cd concentrations were 0.13 and 0.29 $mg.kg^{-1}$, respectively. In group 1, Cd levels in spleen and ovary increased at mean 15.1 and 21.6 times when compared with the control group. The similar course of the accumulation was found also in groups 2. Again, higher Cd accumulation in femoral muscle was found when compared with breast muscle; at the same time, however, lower Cd levels in breast muscle as well as in femoral muscle were found. The highest Cd values were recorded in kidneys (63.92 mg $Cd.kg^{-1}$) and in liver (27.38 mg $Cd.kg^{-1}$). In groups 3suppplemented with 15 mg $Cd.kg^{-1}$, the picture of subacute intoxication of animals with Cd was obtained. In experimental animals, Cd predominantly accumulated in liver and only then in kidneys. In liver, Cd levels in group 3 were determined - i.e. 109.66 $mg.kg^{-1}$and the mean Cd concentration in kidney was 54.10 $mg.kg^{-1}$. Relatively high Cd accumulation was found in spleen and in ovary where after 30 day Cd administration, Cd levels have elevated in group 3 at mean 482 and 179.6 times, respectively, when compared to the control.

There is a number of studies dealing with absorption and accumulation of Cd in various organs of animals (Sharma 1979, Mayack 1981, Stanchev 1989, Kleczkowski 1995, etc). Our conclusions that Cd levels in the observed organs depend directly from the amount of administered Cd are confirmed also by Pribilincová (1995) who found the highest level in liver (0.774; 25.508 mg $Cd.kg^{-1}$) and in kidneys (1.54; 56.78 mg $Cd.kg^{-1}$) following the 60 day Cd intake by laying hens at a dose of 3 and 20 mg $Cd.kg^{-1}$. She has found relatively low level in muscles (0.162; 0.473 mg $Cd.kg^{-1}$); the body weight of laying hens remained at the level of control group. The results of our analyses can be compared with those of Bokori (1995) who after 3 week Cd administration at the concentrations of 2.5; 10.5; 30.0 mg $Cd.kg^{-1}$recorded its elevation in all observed organs depending from increasing Cd concentration. At the concentration of 10.5 mg $Cd.kg^{-1}$ in the form of aqueous solution, this author recorded the highest Cd accumulation in kidneys - i.e. 315.75 mg $Cd.kg^{-1}$, in liver - 142.25 mg $Cd.kg^{-1}$, and in muscles 0.95 mg $Cd.kg^{-1}$. In contrast to the results of this author, our results are markedly lower (Table).

Conclusions

The contribution of the experimental studies with poultry consists in the observation of the Cd influence on poultry organism during long-term and short-term exposure. Information on levels of cumulated Cd in muscles and organs of laying hens was obtained and the response of the organism to the supplemented Cd has been observed.

Results presented in this paper were obtained within solving the project No. 95/5195/575 and 1088/94.

Cd levels in laying hens after exposition of organism by cadmium

mg.kg^{-1}

Material	n	Control	1. gr.	2. gr.	3. gr.
Breast muscles	6	0,02	0,11	0,46	0,75
leg muscles	6	0,03	0,20	0,71	1,31
heart	6	0,04	0,31	5,34	4,53
liver	6	0,13	9,33	27,38	109,66
kidneys	6	0,29	26,34	63,92	54,10
spleen	6	0,06	0,91	15,75	28,97
ovary	6	0,05	1,08	7,96	8,98
stomach	6	0,11	2,60	31,31	64,94

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Effectivity of using natural minerals in cooking of dry foods

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Summary

We elaborated the methods of cooking dry animal foods on base of the meat-bonemeal which include absorbing natural minerals such as "vermikulit". "Zeolite" and "kizelgur". It permits to solve a number of economic, technological, ecolological, hygienic and biological questions. The doses of introduction of minerals in animal rawstuff for the production of a new kind of food are grounded.

Industrial tests for giving new food to chikens-broilers and laying hens have shown high affectivity of the results. The inerease of vitality and productivity of poultry, improvement of quality of poultry production and also the possibility of prevention of alimentary diseases were noted.

Key words: dry food, meat-bone-meal, natural minerals, zeolite, "vermikulit", "kizelgur", broiler chickens, laying hens.

Introduction

Nowadays about 40 kinds of zeolites are known. These natural minerals have absorbing and ion exchange capacity (Ronald 1985). After numerous researches the expedience of using natural zeolites in cattle - breeding (Цицишвили 1990), poultry farming (Водолажченко 1991) and veterinary medicine (Kusnetsov 1991) was proved.

Using of zeolites in cooking of dry vegetable and animal foods represents the great interest. Natural absorbing minerals exert influence on quality of the foods and also have shown biological effect under giving it to animals and poultry; as a result they bring economic gain (Водолажченко).

But there are another natural absorbing minerals besides zeolites, such as "vermikulit" and "kizelgur" which not yield in efficiency to alumosilicates.

Materials and methods

Natural minerals "ceolit", "vermikulit" and "kizelgur" were taken for the researches. Their physical, chemical and absorbing properties were studied. The comparative analysis of received data was made.

Experimental samples of dry animal foods on base of the meat-bone-meal which include different doses of these minerals were coaked:

1) control sample without absorbing minerals
2) animal raw-stuff 90% minerals 10%
3) animal raw-stuff 85% minerals 15%
4) animal raw-stuff 80% minerals 20%
5) animal raw-stuff 75% minerals 25%
6) animal raw-stuff 70% minerals 30%
7) animal raw-stuff 60% minerals 40%
8) animal raw-stuff 50% minerals 50%

Physical and chemical analysis of the samples of fodder meal and sanitary and hygienic appraisement of food after 6 months of keeping were made.

In industrial conditions of poultry farms of Leningradskaya region experimental batch of food was tested on broiler chickens ("broiler-6" - 100,3 thousands chickens) and laying hens ("zarya-17" - 800thousands hens).

During the experiments survival of poultry, health condition (dinical and hematological index), productivity (chicken's daily weight gain, egg productivity), quality of poultry production (meat, eggs) were taken into consideration. Economic efficiency was also determined.

Results

After the analysis of experimental samples of fodder meal which include 3 different minerals the best of them was chosen. It was "vermikulit".

The chemical index of experimental samples of meal with "vermikulit" are shown in **table 1**.

After 6 months of storage the hygienic index of the new food were better then in control sample: the acid number was 21,4-33,6% lower, bacterial contamination - 42,984,6% lower.
Experiments on broiler poultry farm (**table 2**) have shown the increase of chicken's daily weight gain on 3%, receiving of meat rise on 4% and meat quality rose on 9%.

Biological effeciency of the food was determined also in laying hens. The egg production rose on 3-25% and shell's durability rose on 10-15%. Yolk"s pigmentation rose on 16% and energy of the egg rose on 2%.

So the effective way of using natural minerals in cooking of dry animal foods was elaborated.

The invention has author's certificate N 1732907 (1992).

This method con solve a number of questions: the improvement of food quality during the storage, the increase of productivity in broiler chickens and laying hens and also the improvement of meat and egg quality.

The expenses were paid from 2 to 5 times.

Table 1: The chemical composition (%) and nutritional qualities of 1 kg of fodder meal

Index	Control sample	Samples of food with "vermikulit", %					
		10	15	20	30	40	50
		With natural moisture:					
1. Moisture	1,01	1,30	1,95	2,43	2,50	1,47	1,15
2. Nitrogen	5,22	4,73	4,27	3,38	3,13	2,67	2,48
3. Protein	32,63	29,56	26,69	21,13	19,56	16,69	15,50
4. Fat	14,00	14,00	14,00	11,40	11,40	10,20	10,40
5. Cellulosa	2,96	3,44	3,10	1,74	2,06	1,18	1,33
6. BEV	20,37	23,30	27,67	27,09	27,00	28,71	20,50
7. Ash	29,04	28,40	26,59	36,22	37,48	41,75	51,12
8. Calcium	4,20	4,00	4,60	7,20	4,40	3,60	3,80
9. Phosphorus	2,35	2,35	2,05	2,15	2,05	1,90	1,40
10. Digestible protein	22,84	20,69	18,68	14,79	13,69	11,68	10,85
11. c.ed.	0,82	0,81	0,81	0,70	0,68	0,64	0,57
	In dry matter:						
12. Protein	32,96	29,95	27,22	21,65	20,06	16,94	15,68
13. c.ed.	0,83	0,82	0,83	0,72	0,70	0,64	0,57

Table 2: The results of industrial tests of fodder meal in broler poultry farming

Index	Versions	
	control	experimental
1. The number of broiler chickens, heads	97860	100300
2. The survival of chickens, %	86,4	86,8
3. Live body mass of one head, g	1237	1312
4. Total increase of weight, tons	100,91	110,50
5. Broiler's daily weight gain, g	19,3	19,8
Production of broiler's meat:		
6. in live body mass, tons	104,62	114,31
7. chicken's weight after drawing, tons	74,31	85,96
8. Meat of the first category, %	39,3	47,9
9. Meat of the second category, %	56,4	48,8
10. Unstandard meat, %	4,3	3,3
11. Expenditure of food on 1 ton of increase, feeding units	34,3	34,6

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On some aspects of bioenergetics of a chicken broiler farm ecotechnical system

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Summary

An experiment with chicken broilers covering the time span of 56 days has been conducted. The birds were kept under simulated conditions according to the technological requirements. The following energy flows were determined: feed energy intake (FEI), heat production energy (for homeostasis) (HP) and the biomass energy (BE). Two methods were used in parallel to determine the HP energy - indirect colorimetry and a microcomputer program.

Both methods showed results for FEI, HP and BE in the corresponding range for the hybrid used, with close values between each other (most of them at $p<0.05$). The microcomputer program was recommended for use in the poultry production to monitor the distribution of energy in broiler organism, in respect to environmental conditions and at any moment of the production process.

Key words: Chicken-broilers, Bioenergetics, Ecotechnical system, Energy, Environment.

Introduction

From an ecological point of view the modern chicken-broiler farms are artificial ecotechnical systems with high anthropogenic transformation. To function normally, they need introduction of energy with bird's rations, for maintaining of optimum microclimate in buildings, for transportation and servicing, etc.

The optimum usage of energy introduced depends on many factors (building construction, ventilation and heating system, rearing technology, etc.) and after all determines the efficiency of production (Hurwitz et al., 1980; Danilov, 1980; Mac Leod, 1985; Ensminger, 1992).

Baykov (1995) points that the study of energy flows of poultry farms for meat and eggs can provide farmers with possibilities to seek practical resolutions for decreasing of energy introduced without aggravating of housing conditions and performance.

The aim of the present study was to investigate some aspects of bioenergetics in an ecotechnical chicken broiler system to find possibilities for its monitoring and regulation.

Materials and Methods

The experiment included 500 chicken broilers for a period of 56 days at the University Experimental Farm. Birds were kept under model conditions according to the technological requirements for the individual age periods. Microclimate parameters in the building were: temperature - 32.8 - 20.4°C, relative humidity - 52.8 - 76.6%, air velocity - 0.040 - 0.122 m/s, CO_2 - up to 0.18%, NH_3 - up to 10 ppm, lighting - 5 - 10 lx.

Broilers received complete feed which contained 11760 kJ/kg of metabolizable energy (ME) and 21% crude protein (CP) until the 28th day and for the second age stage (29th - 56th day) - 12 100 kJ/kg and 18%, respectively.

The following energy flows were determined: feed energy intake (FEI), homeostasis energy (HE) and biomass energy - in gain and faeces (BE).

FEI was determined by the chemical composition of forage, HP - by indirect colorimetry and a microcomputer program (Petkov et al., 1988) with input data for the building construction, microclimate parameters in the building and some biological traits of birds and BE was the difference between FEI and HP.

Data were processed by STATISTICA for Windows, version 4.5.

Results and Discussion

The experimental data are given in **Table 1**. All of them were in the limits for the hybrid used. For 56 days broilers reached 1.602 kg average body weight at 2.506 kg forage consumption per kg gain and average percent HP to BE ratio 70%:30%. For the individual age periods (weeks), this ratio remained unchanged, with higher variation of the indirect colorimetry values. The comparison between data obtained by the two methods indicated their similarity (conformability) and significance at $p<0.05$ for the greatest part of the period. This gives us reasons to consider that the microcomputer program for HP calculation can be used under industrial conditions to determine the energy flows in broiler organism and to avoid the other slower and more expensive methods. In this way it is always possible to estimate the efficiency of energy usage in birds depending on the environmental conditions.

Conclusion

The monitoring of organism bioenergetics in broiler organism, as part of whole ecotechnical system energetics at any moment of production process, provides possibilities for searching of practical resolutions decreasing the energy requirements of the ecosystem, especially in the energy - environment sense.

Table 1. Data on the traits monitored in chicken broilers for the individual age periods

Age (weeks)	T°C	Body weight g	Feed intake g/24 h	Feed energy intake FEI, kJ/24 h	Heat Production (HP)		Energy in biomass kJ/24 h	
					Indirect colori-metry (HPIC)	Micro-computer Program (HPMP)	HPIC	HPMP
I	32.8	79	12.5	145.0	108.8a	101.5a	36.2	43.5
II	29.4	202	21.6	250.6	180.2	170.4	70.4	80.2
III	27.6	344	40.1	465.1	313.6a	315.5a	151.5	149.6
IV	25.3	538	76.5	925.6	650.3	642.9	275.3	282.9
V	24.5	811	88.2	1066.0	750.7a	751.2a	315.3	314.8
VI	24.1	1088	102.3	1237.8	857.3a	860.5a	380.5	377.3
VII	22.6	1295	113.6	1374.6	958.8a	962.4a	415.8	412.2
VIII	20.4	1602	130.5	1579.0	1100.5a	1118.3a	478.5	460.7
Total		1602	4097.1	49305.9	34458.9	34441.4	14847.0	14864.5

a - Values with differ at $p<0.05$.

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Comparative study of oral and paranteral therapies of experimentally induced spirochaetosis in broiler chicken

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Summary

One hundred and twenty healthy chicks at the age of four weeks were divided into six equal groups, namely A, B. C. D, E and F.

Group A was non infected non medicated kept as control

Group B was infected and non medicated, it showed heavy infection.

Group C was infected and medicated with penicillin G paranterally.

Group D was infected and medicated with oxytetracyclin paranterally. It had curative rate of 100%.

Group E was infected and medicated with oxvtetracyclin mixed with feed. It had curative rate of 80 %.

Group F was infected and medicated with amoxycillin (clamoxyl) orally. It had curative 100%.

It could be concluded that amoxycillin (clamoxyl) was drug of choice.

Key words: infected, medicated, oxytetracyclin. amoxycillin, drug of choice.

Introduction

Spirochaetosis is a highly fatal septicaemic disease commonly found among chicken. geese. ducks and turkeys in tropical and sub tropical regions.

Conventionally penicillin and oxytetracyclin are being used paranterally for the treatment of this disease in Pakistan. The present project was designed to find out some other effective and administrable medicine (oral). For this purpose oxytetracyclin (parental and oral), penicillin G (paranteral) and amoxycillin (oral) were used.

Materials and methods

<u>Groups</u>

At the age of four weeks 120 healthy birds free from any infection and specially from Borrelia anserina were picked up and randomly divided into six groups i.e., A, B, C, D, E and F; each group was marked with different colours to identify them and were kept in separate compartments.

Group A	20	birds (non-infected, non-medicated), kept as control.
Group B	20	birds (infected and non-medicated)
Group C	20	birds (infected and medicated with penicillin G parentally).
Group D	20	birds (infected and medicated with oxytetracyclin parentally).
Group E	20	birds (infected and medicated with oxytetracyclin orally).
Group F	20	birds (infected and medicated with amoxycillin orally).

Blood smears were examined before & after medication.

Result and discussion

The birds of group B (infected, non-medicated) showed heavy infection and exhibited typical symptoms of spirochaetosis. This is in line with Marcos et al (1946). The mortality rate in this group was highest (40%). Similar findings were observed by Hoffman (1946).

Group C had mortality rate of 20%, the response to treatment was good after 96 hours. There was 100% absence of spirochaete from the blood. This is in agreement with the result shown by McNeil (1949).

Group D had a mortality rate of 25% but curative rate after 96 hours was 100%. This is in line with Shkarian (1975).

Group E had mortality rate of 30% and curative rate of 80% at 96 hours.

This is in accordance with Tiwari and Metha (1973).

The mortality rate of Group F was only 15% which was the lowest of all the groups. The curative rate was 100% after 96 hours. This is in agreement with Brander et al, (1982).

Amoxycillin (clomaxyl) was emerged as the drug of choice on the basis of efficacy and less mortality and easy to use therapy.

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Veterinary sanitary for analyses of quality of poultry meat.

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Summary

Aerosol treatment of premises against ectoparasites in the presence of hens by 0.02% aqueous emulsion of deltametrin was performed twice at the rate 50 mL/m^2 twice with interval of 7 days. Veterinary sanitary analyses of poultry meat from experimental and control hens were determined. We determined pH value, microbial contamination, histomorphological indices, vitamin A and C content in liver, chemical toxicological analysis of deltametrin residue, and biological assay. The analyses of meat and organs of experimental and control hens were similar, except for pesticide content in experimental poultry subjects. The highest level of preparation was registered 24 hours after the treatment (ppm) in feathers 20.8, liver 1.5, skin 1.1, muscles 1.1. Deltametrin was not detected 7 days after the treatment of hens.

Key words: aerosol treatment, deltametrin, hens, ectoparasites, poultry meat tests.

Introduction

The adverse impact of pesticides on environment and human health depends on the techniques of their application. Manufacturers of pyrethroids and a number of researchers including G.B.Braithwaite (1984), S.D.Pavlova *et al.* (1988), L.Yu.Selivanova *et al.* (1989), D.I.Raad (1991), V.I.Chaika (1993), A.N.Mitasov (1994) state that post-treatment consumption of milk, slaughtering of animals and poultry for meat are not time-limited. On the other hand, other researchers detected the pyrethroid residues in meat. In view of the leading role of synthetic pyrethroids in the system of ectoparasite protection of animals and poultry, it becomes necessary to focus on the quality of produce and develop less labor-intensive but efficient techniques of their application.

Materials and Methods

Experimental subjects included hens aged 135-170 days and 12 months. Lab experiments used 50 hens, those held at a poultry farm, 4000 ones. The aerosol treatment of premises by 0.02% aqueous emulsion of deltametrin against ectoparasites was performed in the presence of hens and at the rate 50 mL/m^2 twice with interval of 7 days. Blood and products obtained after the slaughtering of hens were analyzed. Organoleptic, physico-chemical, biochemical, and chemical toxicological indices were determined, as well as the presence of micro-organisms (GOST 7702.2-74). The poultry meat was analyzed for pH value, amine-ammonia nitrogen, vitamin A and C content of liver. The presence of residual pesticides was determined on Tsvet - 106 chromatographer. The impact of deltametrin on tissue structure was established by histological studies. The meat analyses were determined after the first and the second treatments of premises in the presence of hens. Hens were slaughtered l, 2, 3, 4, 5, 6, and 7 days after the treatment. The harmlessness of meat was established by biological assay on fruit flies. 20 fruit fly larvae were placed on minced poultry meat with added deltametrin in different concentrations. In 15 minutes, they were transferred to dishes with nutritional medium at temperature 22-24°C. The experiment was repeated thrice until the emergence of fourth-generation fruit flies.

Results

Experimental and control hens had identical hemoglobin, lymphocyte, eosinophil, and monocyte levels, as well as white and red blood cell counts. Organoleptic, physicochemical, and bacteriological analyses of experimental hens did not differ from those of control group. pH value of meat from experimental and control bird's carcasses ranged within 6.12±0.05— 6.18±0.02, amine-ammonia nitrogen amount 1.01±0.05-- 1.13±0.1 mg per 10 mL of extraction. The reduction of vitamin A and C content in liver were registered at the first post-treatment day. No histomorphological changes have been detected. The results of chemical toxicological analysis are presented in the following Table.

Deltametrin Accumulation and Distribution (ppm)

Object	Post-treatment time in hours				
	24	48	72	120	168
Feather	20.8±0.08	20.1±0.06	10.3±0.07	Not determined	
Skin	1.1±0.06	0.73±0.09	0.05±0.02	0.05±0.02	0
Lungs	1.0±0.03	0.7±0.04	0	0	0
Heart	0.5±0.01	0	0	0	0
Liver	1.5±0.03	1.0±0.05	Traces	0	0
Kidneys	0.75±0.01	0.43±0.01	0	0	0
Spleen	1.3±0.04	Traces	0	0	0
Muscles	1.1±0.02	1.0±0.03	0.05±0.01	0	0
Fat	0	0	0.06±0.02	0.01±0.08	0

Discussion

Our study has established that organoleptic, physico-chemical, biochemical, and microbiological analyses of meat from experimental hens did not differ from those of control ones. Biological assay has demonstrated that 0.05 ppm content of deltametrin is harmless for fruit flies (4 generations were obtained). Still, our findings indicate that the poultry meat becomes deltametrin-free only 7 days after the treatment. This may be related to its application technique. We should also note that our data agree with research findings of A.R.Frank *et al.* (1984), A.Croucher *et al. (* 1985), Z.Mardyev (1988), N.P.Kekuk (1992) indicating the presence of pyrethroids in the internal organs, muscles, blood, skin, milk, as well as excretion of the preparation within 3-21 days. Therefore, it follows from our data that poultry should be slaughtered 7 days after the treatment to obtain environmentally safe produce.

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Comparison of alternative keeping systems with laying hens

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Summary

Fear and stress were studied in a certain type of colony cage in comparison with the conventional floor pen and the battery cage system.TI-test was used as a fear indicator and H/L ratios for environmental stress. No significant differences were found between the three groups.

♦ **Key Words:** laying hens, colony cages, tonic immobility, heterophile/lymphocyte responses

Introduction

The welfare problems of laying hens are the target of growing criticism in Finland as well as elsewhere in Europe, and ethiological aspects are often mentioned in discussion. The small battery cages are commonly used in Finland; about 90 % of our layers are in cages.

In this experiment, a certain type of colony cage was designed and its applicability to layers and egg production was tested. The experiment took a year. Three different keeping systems were compared; colony cages, normal battery cages and conventional litter floor.

Materials and methods

The following experimental groups were examined:

1. 384 hens in double-tier battery cages, four hens in each cage, 480 cm^2/hen
2. Colony cages, 30 hens in each, totally 360 hens, 750 cm^2/hen
3. Pen with peat litter, 324 hens, 6 hens/m^2

In groups 2 and 3, perches and nests were used. The colony cages were equipped with sandbaths. Groups 2 and 3 had chainfeeders, and group 1 was fed with a hopper moved by hand. Groups 1 and 2 were watered with nipple drinkers and group 3 with bell-type drinkers.Water and feed were offered ad lib.

The birds were white LSL hens.They were transferred to the experiment room at 16 weeks of age, and the experiment started when the birds reached the age of 19 weeks.

In addition to the egg production, feed intake, egg quality and mortality recordings, animal behaviour (especially laying behaviour) was monotored, and welfare and stress were studied as well.

During the one-year experiment, a certain amount of hens in each test group were examined for weight, clinical health status and condition. In clinical inspection, 10 different aspects in each hen were studied, and 1-4 points were given for them. The same birds were tested twice with Tonic Immobility (TI) test, which is generally accepted to measure fear (Gallup 1979). Tonic Immobility is defined to be a fear-potentiated response induced by physical restraint and characterised by reduced responsiveness to external stimulation. Tonic immobility was adapted to the method described by Jones at al (1981).

Some days after TI-testing, blood samples were taken for calculating heterophile/ lymphocyte (H/L) responses of the same hens as before.Those responses are considered to be a sensitive index of chronic stress, although they are applicable only for mild to moderate stress (Maxwell 1993). The H/L ratio appears to be a more reliable indicator of the long-term changes in the enviroment and of the social stress than the plasma corticosteroid levels, which are better indicators of extreme stress (Gross 1983). H/L ratio was counted from the blood smears, which were stained with May-Grunwald-Giemsa stain.The total leucosytes were counted, about 100 cells for each ratio. The heterophile/lymphocyte (H/L) ratios were determined by dividing the number of heterophils by the number of lymphocytes.

The results were handled using a variance analysis.

Results

<u>TI-testing</u>

The induction times and the duration of Tonic Immobility were compared between different groups in two tests and in each group at two different times. The first time, there was no significant difference between the induction times and the duration of Tonic Immobility of the three groups at 0,050 level. Similar results were achieved in the second test.

	battery cage	colony cage	floor pen	all together
test 1 TI-time	538,1	381,2	397,0	442,4
test 2 TI-time	305,1	430,0	375,3	370,0
test 1 induction	1,4	1,3	1,5	1,4
test 2 induction	1,4	1,5	1,4	1,4

H/L ratio

The H/L ratios were compared between different groups in both tests, and among each group at two test times.No significant difference was seen in variance analysis at 0,050 level in any test situation.

	battery cage	colony cage	floor pen	all together
test 1 H/L ratio	0,2	0,3	0,3	0,3
test 2 H/L ratio	0,2	0,2	0,2	0,2

Mortality and condition

The mortality was highest among the floor pen hens, but the differencies could not be statistically ascertained. No differencies were found between the keeping systems in the inspection of the general condition.

Tibia breaking strength differed significantly ($p<0,05$) between the cages and the floor pen. The values were 207 N (Newton), 207 N and 288 N for battery cages, colony cages and floor pen, respectively.

The plumage was the poorest in group 1, the difference was significant at the 0,050 level and the scores were 2,8, 4,0 and 3,8 for battery cages, colony cages and floor pen, respectively.

Discussion

TI-testing showed no significant differences between or among three groups. In the first test, the battery cage hens had the longest TI duration; the same kind of results have been described before (Appleby 1991). At the second test time, one could notice slightly diminishing fear in comparison with the first test.

At the second test time, the H/L ratios had decreased, which has in earlier studies been explained to be caused by habituation (Maxwell 1993).

There might be some effect from all the groups being housed in the same room, next to each other, so that the animals could at all times see the other groups.The test hens were caught and handled several times also for clinical inspection and weighing.

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GLOBULIN LEVELS IN THE DIFFERENT CHOLINESTERASE GENOTYPES OF FOWLS KEPT IN CAGES AND ON HARD FLOOR

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Summary

The different cholinesterase genotypes (Es_4AA, Es_4BB, Es_4AB and Es_5AA, ES_5BB, ES_5AB) of fowls of Cornish breed and of White Plymouth Rock breed were studied. Results showed that the birds of the heterozygotic cholinesterase genotypes Es_4AB and Es_5AB have higher globulin level than the homozygotic genotypes Es_4AA, Es_4BB and Es_5AA, Es_5BB. Fowls kept on hard floor showed higer globulin levels than the caged fowls. The Cornish birds possessed higher globulin levels than the White Plymouth Rock birds.

Key words: hard floor, cages, globulines, cholinesterases, genotypes.

Introduction

Two main technologies of rearing, on hard floor and in cages, are applied in poultry production. Technologies often don´t keep very close to the biological requirement of poultry, which is accompanied by reduction of their resistance of diseases and increaed mortality in the flocks. Two are the possibilities according to Bogner (1982) to the manage this problem. On the one side, adjustment of the conditions of reasing to the biological requirements of birds and, on the other side, genetic control by using birds of high adaptations abilities.

Some authors (Sinden 1979, Trujillo and Pampin 1986) belive that genetic improvement in chicken - meat production can be achieved not only by increasing their productivity, but also by increasing their abilities to adapt to different technologies of rearing.

The serum esterases in fowl have been the object of studies by several authors (Scuca and Petrovsky 198, Shabalina and Iotova 1976).

The objective of our studies was to determine the level of globulines of fowls of Cornish breed and White Plymouth Rock breed with different cholinesterase genotypes kept on a hard floor and in cages.

Material and methods

The experiments were carried out with 645 fowls of Cornish breed and White Plymouth Rock breed. Cholinesterase genotypes were studied by the method of Wieme (1959). Fowls of different cholinesterase genotypes (Es_4AA, Es_4AB, Es_4BB and Es_5AA, Es_5AB, Es_5BB) were separated and each group grown by the two technologies, on hard floor and in cages.

Results and discussion

Globulin levels in the various cholinesterase genotypes of fowls, kept on hard floor and in cages, are shown in **Table 1.** The highest globulin level with the Es_4 and Es_5 loci was observed in the heterozygotic AB genotype compared to the homozygotic BB and AA genotypes. Differences were significant at $p < 0,01$ - $p < 0,001$.

Highest globulin level was observed with the Cornish fowls when inter-breed comparisons in each cholinesterase genotype were carried out. With the exception of the insignificant difference in the globulin level of genotype Es_5BB when the two caged breeds were compared, differences were significant at $p < 0,05$ - $p < 0,01$.

Higher globulin levels were obtained with the on-floor kept breeds. This trend is inconformity with the on-floor kept breeds. This trend is inconformity with earlier results of differing adaptation abilities of the different blood group genotypes of birds raised in cages and on hard floor (Stoyanchev 1994).

The fact that certain poultry genotypes possess higher globulin levels is proving the genetic control on the globulin level. However, it is more a case of advantage of the heterozygotic than the homozygotic genotype, rather than a case of an allele control.

Results showed that the birds of the heterozygotic cholinesterase genotypes Es_4AB and Es_5AB have higher globulin level than the homozygotic genotypes Es_4AA, Es_4BB Es_5AA, Es_5BB. Fowls kept on hard floor showed higer globulin levels than the caged fowls. The Cornish birds possessed higher globulin levels than the White Plymouth Rock birds.

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Table 1. The globulines of different cholinesterase genotypes chickens, grown in two technologies, hard floor and cages

Groups	Geno- types	In cages n	 Globulines (%)	On floor n	 Globulines (%)	
Cornish						
Es4	AA	16	23,11	14	34,61	
	AB	38	30,65	32	42,12	
	BB	18	26,37	16	40,18	
Es5	AA	15	23,31	15	33,31	
	AB	35	30,11	46	39,71	
	BB	25	25,43	23	35,47	
White Plymouth Rock						
Es4	AA	26	19,65	17	32,08	
	AB	34	27,12	26	37,15	
	BB	17	23,42	14	33,71	
Es5	AA	12	14,12	14	16,18	
	AB	36	26,61	25	28,12	
	BB	27	23,52	14	20,73	
		317		256		673

The effect of different management systems on rearing performance and health of Turkeys

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Summary

These studies were aimed at evaluating the effect of management on grate made from mesh and bedding on rearing performance and health of white broad breasted turkeys from two genetic groups: paternal pedigree J-22 and medium type triple cross WAMA-2.

There were less profitable gains in body weight and a higher number of mortality (in both 16 and 23-week old birds), in groups that were reared on grate. It was observed that the reasons for mortality were not connected with the type of floor used. However, in the case of culling, the type of floor can be considered as a contributory factor, especially in groups that were more than 16 weeks old. There was an increased number of culling in groups reared on grate, and this was due to broken legs, cysts in the breasts and deformation of the hock joints.

The obtained results indicate that the rearing of male turkeys for longer than 16 weeks should not be carried out on grate made from mesh.

Key words: turkeys, management, type of floor, grate, bedding, body weight, health

Introduction

The type of floor used for rearing of tyrkeys can be an influencing factor on the health of the stock, especially during the early phases. Bedding has effect on the microclimate of the pen and can be a medium for growth of microorganisms, including patogennic species. Moreover, eggs and larval forms of internal parasites and oocysts of coccidia can be found in bedding. Grate makes it possible to isolate birds from litter and also to improve the microclimate by reducing the amount of NH_3, CO_2 and dust (Bolder et al. 1992, Muirhead 1992), but at the same time there is the problem of injury to legs and cysts in breasts (Andrews et al. 1990, Ferket 1992, Wójcik et al. 1994).

The aim of this study was to evaluate the rearing performance and health of turkeys that had differing body weights, after rearing on bedding and grate.

Material and methods

Two genetic groups of white broad breasted turkeys were used: paternal pedigree (J-22) and medium type triple cross (WAMA-2), reared on grate (wire mesh of 3 mm thick wire and 20 x 20 mm holes) - group I (J-22) and group III (WAMA-2); and on bedding - group II (J-22) and group IV (WAMA-2). Turkey hens were reared up to 16 weeks and cocks up to 23 weeks according to technology described by Faruga and Jankowski (1996). The microclimate in the building was regulated and the health of the turkeys continually checked throughout the experiment. Birds whit distinct disease symptoms were culled and the reasons for same, including mortality was always noted.

Results and discussion

The body weights of J-22 turkeys reared up to 16 weeks (table 1) were the same in both groupe (8.28 kg), however,WAMA-2 hens reared on grate (group III) were lighter by 0.55 kg (P<0.05) than hens reared on bedding (group IV). Males reared up to 23 weeks on grate (groups I and III) had lower body weights than males on bedding:
J-22 by 1.21 kg (P<0.05) and WAMA-2 by 1.73 kg (P<0.05). Feed consumption in both cases was higher in group where males were reared on grate.

There were more mortalities in both the 16 and 23 week groups (**table 1**) rearing on grate (groups I and III). The following was diagnosed as reason for mortality: diseases of the circulatory system, inflammation of umbilicus and vitelicle, gastroenteritis and leg fractures (**table 2**). There was no evidence of the floor type used as being a reason for mortality. However, in the case of culling, it can be said that disorders were directly linked with the floor type used, especially after 16 weeks of rearing. The fact that there was a marked increase in the number of cullings in turkeys reared on grate (groups I and III) is evidence of this (twice among J-22 males and three times among WAMA-2 males). Leg fractures, breast cysts and deformation of hock joints is an indication of some of the disadvantages of rearing on grate. Culling due to paralysis of legs and breast cysts, occuring during rearing on grate was also mentioned by other authors (Andrews et al. 1990, Cholocinska 1988, Jankowski and Faruga 1982).

Conclusions

1. Management of turkeys on grate produced less advantageous rearing performances.
2. It was observed that no diseases were directly linked with the type of floor used.
3. The main reasons for culling of turkeys reared on grate were leg fractures, breast cysts and deformation of the hock joint.

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Table 1. Chosen indices for rearing of turkeys
Table 2. Reasons for mortality and culling of turkeys

Table 1. Chosen indices for rearing of turkeys

Specification		J - 22		WAMA - 2	
		I-grate	II-bedding	III-grate	IV-bedding
Body weight	16 weeks	8.28	8.28	6.57^a	7.12^b
(kg)	23 weeks	12.61^a	13.82^b	10.30^A	12.03^B
Feed consumption	0 - 16 weeks	3.22	3.03	3.27	3.06
(kg/kg)	0 - 23 weeks	3.38	3.16	3.72	3.21
Mortality	0 - 16 weeks	6.75	4.05	4.17	4.05
(%)	0 - 23 weeks	8.11	6.76	8.33	5.54
Culling	0 - 16 weeks	4.05	5.41	1.39	2.70
(%)	0 - 23 weeks	8.11	6.76	5.56	5.41

A,B - $P<0.01$; a,b - $P<0.05$

Table 2. Reasons for mortality and culling of turkeys

Specification	J - 22		WAMA - 2	
	I-grate	II-bedding	III-grate	IV-bedding
MORTALITY				
Inflammation of umbilicus and vitelicle	16.7	20.0	-	25.0
Circulatory insufficiency	33.3	40.0	16.7	25.0
Round heart disease	16.7	40.0	16.7	25.0
Gastroenteritis	33.3	-	16.7	-
Leg fractures	-	-	16.7	-
Other accidents	-	-	33.3	25.0
CULLING				
Pendulous goiter	-	40.0	-	25.0
Cachexia	-	-	-	25.0
Perosis	-	20.0	50.0	50.0
Leg fractures	33.3	40.0	25.0	-
Breast cysts	33.3	-	25.0	-
Deformation of hock joints	33.3	-	-	-

The influence of Bioclimate in pheasant-farming

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Summary

Our main intention was to study the influence of temperature, and sunshine at the reproduction of pheasant. In our experiment we proved singnificant influence of environmental temperature and sunshine to the biological and economical indicies of pheasant-farming.

Key words: pheasant, temperature of environment, sunshine, egg-laying

Introduction

This popular game bird originate in Central and South-east Asia and was introduced into Europe some 2000 years ago. Recently we know about 34 varieties, these hybrids result from breeding of the Ring-necked with other races. The nest made by the pheasant hen, is usually a scrape on the ground lined with grass and down. 6-18 eggs are olive-brown.

Pheasant farm production occurs not only as a specific task of gamekeepers, but also as an additional form of animal production. In this case the producted pheasant is introducted to the open space for hunting. The aim is to eliminate the seasonality of farm work and instability of egg laying during the year.

Methods

Our main goal was to study daily and monthly egg-laying activity of pheasant hen (Phasianus colchicus colchicus) during May, which is the month of the highest production, for 5 years. We worked at Southern Moravia region, where the average year temperature has been 9 - 9,5^{o}C, rainfall 480 - 5.550 mm, and sunshine 2.000 hours per ear. Cages with sand bed and web roof as protection barrier were used for breeding flock on the farm. Pheasant had free access to water and food.

Results

All results are presented in two graphs, all relations are shown in per cent rate. **Graph 1** shows relations of production of egg during 24 hours in correlation with temperature and sunshine. **Graph 2** shows monthly dynamics of egg-laying production in correlation with average day-and-night temperature and sunshine. Nonparametrical statistical analysis proved by Spearman correlation coefficient significant correlation of temperature of environment and time course lying, duration of sunshine and time course lying, as well as the correlation of temperature of environment and sunshine.

Conclusion

Better utilisation of facilities for hatching, rearing, and of other equipment diminishes production cost. The main factors influencing the profitability of farm production of pheasant are: average optimum of egg-laying, age of laying hens, consumption of food, price of food, seasonality of egg-laying, organisation of work, mortality, regular sale of products.

In future it will be necessary to introduce an objective evaluation of the economic effectivity of pheasant production in farms for bird game, based on theoretical analysis.

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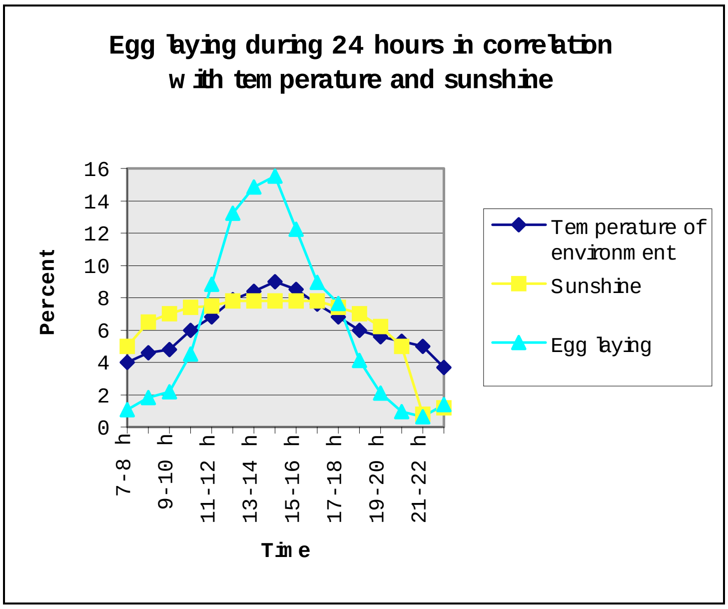
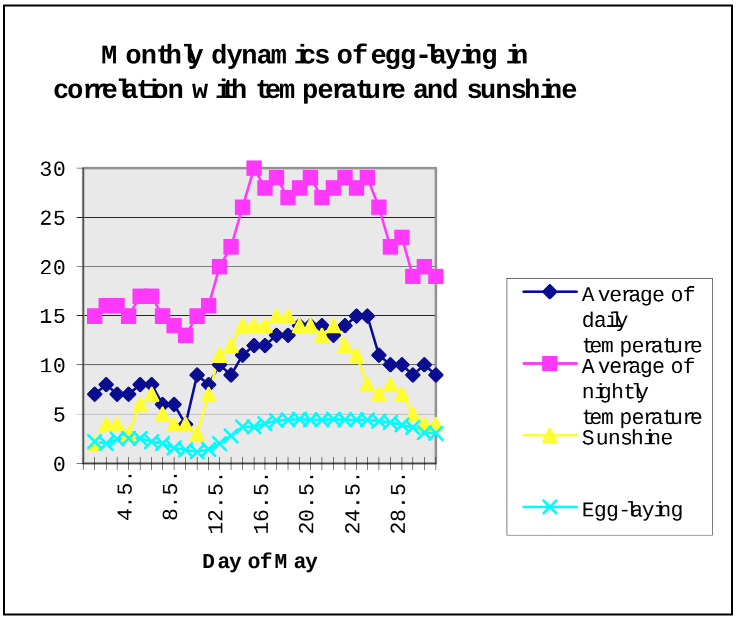
Graph 1. Egg laying during 24 hours in correlation with temperature and sunshine.



Graph 2. Monthly dynamics of egg-laying in correlation with temperature and sunshine.



Animal behaviour as an indicator of animal welfare in different housing and management systems

Animal behaviour as an indicator of animal welfare in different housing and management systems

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Summary

Measurements of animal behaviour can give information about the extent to which animals have difficulties in coping with problems in life, failure to cope with adversity, and the importance of various resources and sensory inputs to the animal. Hence they can tell us something about the feelings of animals, their health and their welfare in general. In scientific studies of animal welfare, measurements of behaviour should be combined with those of physiological and immunological state, injury, disease, growth, reproduction and life expectancy. Normal behaviour must be known before the degree of abnormal or emergency response can be evaluated. Short-term pain, fear and other aspects of poor welfare in brief periods can be assessed by one set of behavioural measures whilst long-term problems such as frustration and lack of control require a different set of measures. Quantitative measures of the strength of aversion and positive preference are of particular value in the design of housing and management systems.

Key words Welfare, stress, abnormal behaviour, suffering.

Welfare and stress

The term *welfare* is applied to all animals including humans, those in the wild, those kept in farms, laboratories or zoos and those kept for working or as companions. We do not talk about the welfare of plants, micro-organisms or inanimate objects but the word stress is applied to plants. A definition of welfare which can be used in the scientific, legal and public domains is: *the welfare of an individual is its state as regards its attempts to cope with its environment* (Broom 1986). In other words, how well does the individual fare or go through life. This definition refers to a characteristic of the individual at a time, not to something which is given to the individual. Welfare will vary over a range from very good to very poor.

When facing problems in life, the individual may fail to cope, in that it dies or is unable to grow or reproduce, or it may cope but only with difficulty. In either case, welfare is poor. Many aspects of attempting to cope involve brain mechanisms. Failure to cope and difficulty in coping are therefore associated with psychological consequences, often together with bad feelings. There may also be behavioural, physiological, immunological and disease incidence changes when welfare is poor. When there are no problems, welfare will be good. Positive feelings occur on many occasions when welfare is good and are associated with certain physiological consequences. Some authors (Duncan and Petherick 1991) limit the meaning of welfare to considerations of feelings but most people would include aspects of disease, injury or immunosuppression as part of welfare whether or not feelings are involved (see later).

Stress is one aspect of poor welfare. To most people, stress means something bad but the use of the term stress to mean "something which causes adrenal cortex activity" or "any perturbation of homeostasis" have led to considerable confusion in its use. Adrenal cortex activity can occur in normal or good situations as well as in those which have potentially adverse effects on the individual so it is not biologically useful to equate all of such activity with stress. Similarly, the word stress is of little or no value if it is merely equated with stimulation which affects basic body functioning. It is better to reserve the word stress for situations where there is some real adversity resulting from a failure of the control systems which exist in the brain and other parts of the body. The ultimate measure of adversity is impairment of biological fitness so a definition is: "*stress is an environmental effect on an individual which overtaxes its control systems and reduces its fitness or appears likely to do so*" (Broom and Johnson 1993).

Hence stress is that part of poor welfare where the individual cannot cope with its environment. Not coping will ultimately mean severe adversity to the point where there is reduced fitness. However, in many circumstances where stress is being assessed there is an indication of failure to cope rather than a direct measure of fitness reduction. Welfare may be poor in situations where there is no stress because the individual is coping with its environment even though it is with difficulty. Whilst welfare can be good, however, stress cannot be good. This has been one of the confusing aspects of the other definitions of stress mentioned above. Varied early experience and some exposure to a variety of events in the world is good for an individual because it helps in the development of effective coping systems but the experiences are not stress and stress is never "good for you".

Another term which is related to welfare is *health.* Health refers to coping with the pathological impact of the environment so it is a narrower term than welfare. Health also varies from very good to very poor so health is included within welfare and concerns the presence or absence of pathology and disease. Poor health will always mean poor welfare but there could be good health combined with some other problem so that welfare is not good overall.

Wherever poor welfare involves bad feelings there is *suffering*. Feelings are biological mechanisms which have evolved like any other mechanism. (Dawkins 1977, Broom in press). Feelings such as pain, malaise, fear or anxiety are often adaptive but still indicate poor welfare because they occur when the individual is having difficulty in coping with the environment. However, poor welfare can be indicated by other coping difficulties such as immunosuppression or injury whilst asleep, in which cases there is no suffering. Similarly, a variety of positive feelings can occur when welfare is good but will not always do so. The topics discussed in this section are explained further by Broom and Johnson (1993) and Broom (1996).

Assessing welfare

Animals have problems when needs are not satisfied so we should try to find out about needs. They also have problems when there is a direct adverse effect of the environment such as something which can or does cause an injury or an attack by a pathogen. The specification of the freedoms which we should give to animals provides a good general guideline for how to minimise poor welfare but in many species of animals, scientific studies have progressed to the point where we can be more precise, considering needs and assessing welfare directly.

The range of welfare indicators listed in Table 1 includes some measures of stress. Both **Table 1** and **Table 2** refer to behavioural and non-behavioural measures. In order to assess welfare effectively, a wide range of measures is needed and these must be combined if the complete range of coping mechanisms and the complete array of adverse effects of the environment on individuals is to be taken into account.

Table 1 Measures of poor welfare

Reduced life expectancy
Reduced ability to grow or breed
Body damage
Disease
Immunosuppression
Physiological attempts to cope
Behavioural attempts to cope
Behaviour pathology
Self narcotization
Extent of behavioural aversion shown
Extent of suppression of normal behaviour
Extent to which normal physiological processes and anatomical development are prevented.

(from Broom and Johnson 1993)

Table 2 Measures of good welfare

Variety of normal behaviours shown
Extent to which strongly preferred behaviours can be shown
Physiological indicators of pleasure
Behavioural indicators of pleasure

(from Broom and Johnson 1993)

In animals like vertebrates which have elaborate mechanisms for trying to control their interactions with their environment, there will almost always be psychological aspects of welfare problems so behavioural measures must always be a part of comprehensive attempts to assess welfare. Where individuals are trying to cope, or are failing to do so, brain changes will affect: brain chemistry and electrical activity, various physiological systems, immune systems and behaviour.

When a sensory input to nociceptive systems occurs there are various changes in the peripheral nervous system and spinal cord but the sensation of pain involves changes in the brain and various brain systems will be involved in most painful experiences. Hence pain is likely to affect behaviour, as are many feelings of malaise, fear or anxiety. Whenever there is some degree of specific frustration or more general lack of control over interactions with its environment, the individual will be functioning in a different way psychologically from an individual which does not have such welfare problems. The same is true of individuals which have such a lack of environmental variety that they feel boredom, or those subjected to specific deprivations or some degree of sensory or processing overload. In most cases there will be potentially measurable behavioural changes. At the other extreme, absence of problems could be associated with feelings of happiness, pleasure or joy. The psychological indicators of such good welfare are lack of any behavioural coping behaviour, or a wide range of normal behaviour, or particular behaviours or physiological states which occur only when welfare is good. Good feelings must normally involve the knowledge that coping is effective and not difficult and some particular additional sensations.

Examples of the use of behavioural indicators of welfare

Normal and preferred behaviour

In order to recognise abnormalities of brain functioning, body physiology or behaviour it is essential to know what is normal. Those who have watched or otherwise investigated normal animals closely are much more likely to detect the abnormal in each of these different areas. Many authors have described the normal behaviour of animals in appropriate complex environments. For example, Stolba and Wood-Gush (1989) studied pigs kept in an area of field, trees and bushes and described how sows spent the daytime period. They spent much time grazing and rooting and were considerably more active than most housed sows. More specialist studies of what constitutes normal behaviour include the work of Ketelaar de Lauwere and Smits (1989) who described the various postures adopted by calves whilst lying and compared these with postures adopted whilst confined in a crate. Calves most commonly adopted a position partly on their sides with the legs partially extended and the head turned sideways to rest on the legs. All calves also adopted at some time a side-lying posture with the legs stretched out. In the narrow crates, neither of these postures was possible but a third lying posture, sternal lying, was used for most of the time. Since animals usually carry out behaviours and adopt postures because it is important to them to do so, welfare is likely to be less good in conditions where such behaviours are impossible.

Experimental studies can also be used to find out what are the strong preferences of animals. The strength of a positive preference for a resource or for the opportunity to carry out an activity can be quantified by making the animal work for it or forego some other important resource such as food or social contact in order to obtain it. Such studies do not indicate welfare directly but they provide information upon which to evaluate it since welfare will be better in the circumstance where strongly preferred activities can be carried out.

Abnormal behaviour

If an individual is unable to carry out preferred behaviour, or if it is frustrated, frightened or depressed, its behaviour is likely to be abnormal. The abnormality may be in quality or in quantity. Examples of behaviour abnormalities associated with having to live in inadequate conditions are: inactivity, apathy and unresponsiveness, stereotypies, extra aggression and self mutilation.

An example of a situation where welfare is poor and psychological problems result in abnormalities of behaviour is the pain associated with castration in young piglets. In a study by Wemelsfelder and van Putten (1985) the behaviour of handled piglets was compared with that of piglets which were handled and surgically castrated without an anaesthetic. The castrated piglets showed an immediate vocal response in that they produced higher pitched squeals with more variation in pitch. For some time after castration the piglets showed abnormal standing, walking and lying behaviour. For two or three days, they moved in such a way that tension was not exerted on the cut scrotal region. They slid the legs rather than moving them normally and their movements during lying down and standing up were atypical. With other types of pain, different behaviour changes occur. Species vary in the extent to which they show behavioural responses to pain, for example sheep show small behavioural responses but large physiological responses to the mulesing operation in which an area of skin 50 cm^2 in area is cut off their perianal region with scissors (Shutt *et al* 1987). These sheep, which showed little behavioural response at the time of the mulesing, did show abnormal posture and locomotion some time after the operation and strongly avoided the people who had restrained them during the operation (Fell and Shutt 1989).

Chronic pain may result in clear behaviour changes such as limping or lethargy. In many cases, the use of analgesics can reveal whether or not the behaviour change is a consequence of pain in that analgesia makes the abnormal behaviour disappear. For example, Duncan *et al* (1991) suspected that large male breeding turkeys suffered from leg pain. They recorded the behaviour of the turkeys in a general activity test and in a test in which the males were exposed to breeding females. The behaviour of these particularly heavy male turkeys was greatly affected by the analgesic in a way which indicates that the turkeys were normally considerably affected by leg pain. They showed 75% more walking and feeding, approached females with 70% less latency and at 60% greater speed and attempted 55% more mounts.

When animals are frightened the psychological changes affect both their physiological and behavioural responses. Whether the response is freezing or active escape, adequate assessment requires measures of behaviour, adrenal and heart rate changes. A single measure may not give sufficient information about the degree of fear and it is better to look for both active and inactive responses using a range of measurements rather than for example, just measuring the duration of tonic immobility.

Lack of control over the events which seriously affect the life of an individual results in particularly poor welfare. Domestic animals have complex systems for regulating their lives (Broom and Johnson 1993) and the psychological effects of failure of these systems can result in a variety of behavioural, physiological and brain chemistry abnormalities. Short term frustration, such as inability to reach a regularly supplied food source in hens (Duncan and Wood-Gush 1972) and inability to build a nest prior to egg-laying in hens or farrowing in sows, is indicated by stereotypies such as pacing or bar-biting. Long term confinement, with its many frustrating consequences, can also result in a high level of stereotypies. Confinement and lack of specific stimuli or general environmental variety may also lead to apathy which is indicated by reduced activity and lack of responsiveness. Specific deprivations such as absence of a teat in young calves, or absence of material to manipulate in pigs, often lead to sucking at inappropriate objects and tail-biting respectively. Some behavioural abnormalities can be linked to changes in the densities of mu and kappa opioid receptors in the brain (Zanella *et al* 1996) and many long term problems for animals are associated with immunosuppression and constitute what Moberg (1987) has described as a pre-pathological state.

Indicators of good welfare

Good welfare, which is often associated with feelings of contentment or happiness may result in recognisable behavioural and physiological changes which allow the recognition of the state. However some apparent indicators are sometimes false. A person who smiles may be acting as if happy when actually not happy and a dog which wags its tail may be indicating subservience to a human rather than happiness. However, careful studies should allow the evaluation of such measures. As mentioned in **Table 2**, the breadth of normal behaviour and the proportion of strongly preferred behaviour which can be shown are also important indicators of good welfare.

Conclusions

A lot of welfare problems, including many of the most serious problems, involve brain functioning and so are likely to affect behaviour. Information about psychological responses comes from many indicators, including measurements of body physiology, brain function and behaviour. Even indicators of poor welfare such as injuries, immunosuppression and extent of disease will have important effects on the brain. Hence a high proportion of welfare assessment necessitates the measurement of effects on behaviour.

Many different measurements can be used in the assessment of welfare and the best studies will utilise a range of relevant measurements. Measures of physiology, behaviour, disease etc. should be made and their results integrated in order to decide how good or how poor the welfare of an individual is.

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Ways to improved animal welfare - more regulations or more information, education, research or subsidies?

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Summary

Animal welfare regulations are the usual means for improving the animal welfare situation, and indeed have had particular effects for the benefit of animals. Nevertheless, a common criticism is that the rules and their application are not sufficient. During recent years, other means have been established and introduced in some countries, including adequate information for farmers or pet owners, and improved education of farmers, animal guardians, veterinarians, agronomists, national authorities for animal welfare, persons performing animal experimentation and others. In some cases, farms with recognised good housing conditions for animals are supported by subsidies. Some examples of such new means for improving animal welfare, and some experiences with them, are presented in this paper. These means should be further developed, elaborated and applied, but they do not replace regulations. Research has been and remains the scientific basis for animal welfare regulations.

Key words: animal welfare, education, information, legislation, subsidies, farm animals

1. Introduction

Animal welfare regulations at the national and international level are the usual and well-known means for improving the situation of animal welfare. At the national level, many European countries have elaborated new animal welfare legislations, or revised existing legislations. The EU has elaborated directives in several fields of animal welfare, while the Council of Europe has edited five European Conventions and numerous recommendations concerning different aspects of animal protection. The regulations have had certain effects for the benefit of animals, and progress in animal welfare can be observed, to different degrees, from country to country. Nevertheless, it is often criticised that such rules, and in particular their application, are not sufficient. Therefore, improvement, enlargement and completion of animal welfare legislations is often demanded by animal welfare organisations, politicians and administrations.

2. Information and education

Animal welfare cannot be applied through legislation alone. Regulations must be understood by all concerned: the farmer, the pet owner, the scientist etc. One of the main difficulties in applying animal welfare regulations is transmission of the legislation to "the front": to the farmer, animal keeper, etc. An additional problem lies with how to inform the relevant recipients in a convincing, understandable and practice-oriented manner (Steiger 1992 b). Consequently, during recent years, more emphasis has been placed on adequate information for farmers or pet owners, and improved education of farmers, animal guardians, veterinarians, agronomists, authorities for animal welfare, persons performing animal experimentation, and others.

It is also necessary that the state, i.e. the government and local authorities, must " better sell their ware", and more effectively transmit their message concerning animal welfare to the recipient. This must be done with adequate modern means of information dissemination, including visual and acoustic means, as used in marketing by private organisations. Such means include booklets, photos, graphs, practical examples of good husbandry systems, videos, films, slide shows and overhead transparency lectures. Recipients would be veterinarians, agronomists, consultants to lecture on training courses for farmers. Short television presentations, as well as publication in agricultural journals and official gazettes would be advantageous. Due to the fact that such texts of legislation are often dry, sometimes complicated, disturbing and long, their presentation must be in a modern, lively, attractive and agreeable manner, with the help of professionals experienced in information techniques. Carefully planned information contributes to adequately informing the addressee (Steiger 1992 b) as well as to understanding and supporting changes. An example of effective information ist that presented to the people in the town of Basel, in an appeal not to feed pigeons. This helped reduce considerably the population of these animals (Haag 1995). Another example is the phoning of 505 farmers and 730 pet owners to determine their knowledge on animal welfare and the sources of information (Bhagwanani 1995). This latter reference also mentions "Scan", an information campaign in Sweden.

Essential elements of successful programmes of information are analysis of the situation, planning, performing, evaluation of the actions, co-operation with other interested groups, clear and adequate messages, well defined aim groups, repetition of information.

The training of farmers, pupils in agricultural schools, veterinarians, agronomists, people in agricultural consulting services, persons performing animal experimentation, pet owners, etc. must also be improved and amended, through courses on animal welfare, including aspects of ethology. In many cases, national authorities can influence such training programs, because they are at least partially regulated and also financed by the State. Although the previously mentioned means of modern information are strongly recommended, it must also be noted that probably the best means both to convince, for example, a farmer of the importance of animal welfare, and to inform him adequately, is the direct contact on the farm with a veterinarian, an agronomist, or a consultant (Steiger 1992 b). Ruth Harrison in her book "Animal machines" (1964) wrote: "Legislation alone will not provide the animals with an adequate charter. We need to reassess our basic attitude towards the animals which are bred solely for human benefit. Here again education is needed throughout the whole fabric of our society." In a project in Switzerland, it was noted that master farmers had better housing conditions for calves than other farmers (Sommer 1992). The European Convention for the Protection of Pet Animals of 1987 places special emphasis on information and education programmes: "The Parties undertake to encourage the development of information and education programmes so as to promote awareness and knowledge amongst organisations and individuals concerned with the keeping, breeding, training, trading and boarding of pet animals of the provisions and the principles in this Convention."

Not only animal welfare organisations and national authorities, but also organisations of farmers, pet shops, agronomists and veterinarians could do much more concerning information and education, for their own benefit and image improvement. Agricultural organisations are often reacting in a defensive manner, instead of declaring animal welfare as a serious and official aim. A change in strategy, and more support for animal welfare by these organisations would contribute to solve many of the problems.

3. Subsidies and research

In some countries, farms with recognised good housing conditions, above and beyond the minimal level required by the animal welfare regulations, are supported by subsidies from the State, e.g. by direct payments. In many cases, housing conditions of animals kept for label products are also on a standard above the minimal level of the legislation. These programs doubtlessly contribute to improve animal welfare.

Research on animal welfare - in particular ethology concerning farm and other animals, physiology concerning slaughter animals, and research on alternatives to animal experimentation - has today its recognised place (Steiger 1992 a). It remains the scientific basis upon which animal welfare regulations, and objective judgement of animal welfare questions, can be founded.

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LOSSES IN INTERNATIONAL TRANSPORT OF ANIMALS AS INDICATORS FOR ANIMAL WELFARE

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Summary :

There are discussed the Animal Welfare, well-being of animals on transport as well as the losses during the transport under different environmental conditions and different means of transportation.

There were gathered 14 traits of influences on animals during transport. The traits which have significant influence on losses of transported animals were:

overcrowding, distances, types of vehicles, means of transport, watering, feeding, strewing, seasons, years and species of animals.

There were gathered particulars from about 427.000 transported animals and 1090 casualties of death by sections.

The losses on transport differed from 0,028 - 7,6 %.

By the method of multiple regression analysis there has been established a rang list of influences and interactions between them.

Key words: transport, cattle, horses, losses by international transport, indicators of welfare, well-being.

INTRODUCTION

Animal welfare and animal well-being during manipulation of animals before and on the transport, we are able to estimate by different means of measurements. So we can get information about the mood, how animals are capable to adapt on the different conditions in the environment (4,7,8).

Management and technology in the farms before transportation have an influence on animal welfare during the later transport.

The environment in which animals find themselves, when they are transported is new. They loose contact with the known environment. The loading and unloading, pushing trough corridors, driving etc. cause great difficulties at animal (1). It is the question how well do the farm animals cope with their environment during transport. This influences on the losses of animals and lesions, we can esteem as indicators of animal welfare.

In Europe there are transported yearly over 8,800,000 pigs, 4,217,916 cattle, over 7,000,000 sheep and 250,000 horses etc.

In Slovenia there were transported in the year 1995: 178,000 cattle in transit and 325,250 cattle for fattening, as well as 32.536 horses by road and 129.122 by railway.

Council of Europe has formulated in the year 1972 Convention No.65 for protection for all species of animals on transport (2), but there is yet much work to do, according to this convention.

As we know the most technologies are not adapted with the needs of transport and some authors (1) listed the minimal conditions to minimise stress and achieve better conditions for animal welfare (10).

Measurements for animal welfare on transport:

- behavioural responses to confrontation with the environmental influence
- physiological measurements

- death, losses, lesions
- meat quality

Animals do not answer on every influence in the same manner, what we can see at the transport of sheep (1).

Some authors listed some indicators of welfare as:
body temperature, pulse, reaction of the cortex of adren, enzymatic activity etc. (9).
Because of many reasons we have had the possibility to investigate direct losses on cattle and horses transported through Slovenia, but it was not possible to investigate indirect losses. The losses are different regarding the species. So some authors (1,5,6) report of losses at pig transport of up to 0,7 %.
There is technology too which influences on the losses on transport.
Animals from different social structure influenced the frequency of fighting (5).
Type of vehicles and management on transport as well as care of animals are influence factors too.

MATERIALS AND METHODS

In our investigation we have analysed about 430,000 cattle and horses which have been transported in the years 1980 - 1995 by road or railway through Slovenian on the border to Italy.
There were registered 1090 animals, who died on these transports.
We registered animal losses according to following traits :

- time, season
- species, age, category, of animals
- mean of transportation
- density of loading regarding to: quantity, (bulk) kg, burdening of animal per m^2, scarcity of place according to our regulations, overcrowding over our regulations
- transport of animals according to: year, season, month, distance, duration of transport, care, compulsory slaughtering, death of animals, diagnosis by autopsy

By adequate statistical methods of entered datas, we used SPSSX statistical package, with different subprograms.

RESULTS

In the years 1980 - 1995 there were transported through Slovenia on the border to Italy 171,000 cattle by road and 129,222 by the railway, as well as 32536 horses by road and 129123 by raliway.
Different influences on transport of animals and animal welfare conditions and losses by compulsory slaughter and death,have been examined.
The losses amounted in all consignments 0,028 - 0,497 %, but in consignments where losses were ascertained the amount reached 2,526 - 7,653 % of animals. The impact of influences on losses have been analysed.
Taking in consideration the significance of interactions between the influences and multifactorial connection with 14 environmental impacts on animals, a list of influences on cattle and horses on transport by road and railway was established.
It became evident that the influences on transported animals were essential.
The influences have been of different significance and influential connection.The connection in multifactorial analysis has shown the significance of the main impact as standardised beta

regression coefficient in multiple regression calculation, that influences were of different largeness.

The strongest connection had influences as follows:

- scarcity of place or surplus of animals per m^2 surface
- season, year, month
- duration of transport
- weight per m^2

In the statistical evaluation of the value, largness of beta regression coefficient we can see difference in the means of transport as well as species of animals too. This could be seen from table 2, 3.

CONCLUSIONS

From the analysis of transport of 427,000 cattle and horses, transported by road and railway in different environmental conditions i.e. year, season, distance, care, etc. we can conclude that:

- environmental conditions of transported animals can very much influence direct and indirect losses of transported animals.
- rang list of influences shows, that the main influences are:
  overcrowding, exceeding numbers of animals per surface of vehicle, season, distance, care and duration of transport.

This rang list of influences on transport is an indicator of problems and shows us what we have to do, to mitigate the transport problems which are of economic as well as welfare value.

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Table 1.: Number of animals transported to Italy in 1980 - 1995

	CATTLE		**HORSES**		
YEAR	road	railway	road	railway	***SUM***
1980	25	13011	0	30580	43616
1981	0	21211	0	29460	50671
1982	0	10126	0	22671	32797
1983	0	10337	0	20422	30759
1984	0	17302	0	14377	31679
1985	9889	17456	2809	11588	41742
1990	35338	25	5992	0	41355
1991	20446	0	14732	24	35202
1992	20397	0	9003	0	29400
1994	46318	0	0	0	46318
1995	39259	1809	0	0	41068
SUM	171672	91277	32536	129122	424607

Table 2.: Analysis of influences of different variables on loses and multifactorial analysis of variance

	CATTLE		**HORSES**	
VARIABLE	road	railway	road	railway
YEARS	0,1	0,55	0,16	0,28
YEARS 94/95	0,1	0,54	*	*
MONTHS	0,25	0,37	0,33	0,13
QUARTER OF YEAR	0,07	0,26	0,15	0,1
CATEGORY	0,01	0,13	*	0,04
CONDITION	*	*	*	0,14
WEIGHT	0,03	0,54	0,09	0,14
DURATION OF TRANSPORT	0,07	0,19	0,21	0,31
DISTANCE	0,06	0,49	0,16	0,18
SURPLUS OF ANIMALS	0,33	0,63	0,27	0,11
CARE	0,16	0,24	0,18	0,13
SURFACE PER ANIMAL	0,06	0,42	0,1	0,11
EXCESS OF A. %	0,1	0,72	0,07	0,15
WEIGHT PER M^2	0,16	0,32	0	*

Table 3.: Rang list of influences on transport losses by railwayof cattle and horses (beta coeficient)

Table 3.: Rang list of influences on transport losses by railwayof cattle and horses (beta coeficient)

CATTLE, RAILWAY:

• excess of animals %	0,72
• excess of animals	0,63
• body mass	0,54
years	0,55
• all years	0,54
• distance	0,49
• month	0,37
• body mass per m^2	0,32
• quartes of year	0,26
• care	0,24
• duration of transport	0,19
• category	0,13

HORSES, RAILWAY:

• duration of transport	0,31
• year	0,28
• distance	0,15
• surplus of animal %	0,15
• body mass	0,14
• care	0,13
• month	0,13
• surplus of animal	0,11
• surface per animal	0,11

Welfare monitoring of piglets in relation to transport

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Summary

An important variable in transport is vibration, characterized by direction (horizontal, vertical), magnitude, acceleration and frequency, and experiments were started to define comfort zones for pigs in relation to welfare during transport. Piglet welfare was quantified by comparing heart rate characteristics, during a control period before vibration exposure and during vibration. Behaviour before and during vibration was recorded and analysed. During vibration, heart rate increased and the animals were restless, resulting in a longer duration of standing. Differences between accelerations were clear, while responses to vibration at 2 and 8 Hz tended to be higher. Isocomfort contours based on these parameters showed the greatest specific sensitivity of the piglets during vibration at a frequency of 8 Hz, especially in combination with a r.m.s. acceleration change up to 3 m/s^2. Hence, for transport r.m.s. acceleration should be lower then 3 m/s^2 to protect piglets' welfare, being more sensitive to acceleration than to frequencies within the treatments investigated.

Key words : piglets, transport simulation, stress, heart rate measurements, behaviour

Introduction

Consumers are placing increasing emphasis on both meat quality and animal welfare from conception to slaughter. Meat quality may be related to welfare during handling and transport before slaughter. Vibration is one aspect of transport that can influence welfare and is characterized by direction (horizontal, vertical), acceleration magnitude and frequency. The question remains if an aversive zone for pigs in response to vibration may be defined in a similar way to that for discomfort for humans (Oborne and Clarke, 1974). Comparing heart rate characteristics gives an idea of the release of catecholamines both of which have been used to evaluate the autonomic response of animals to stress (Moberg, 1987; Geers *et al.*, 1994). Behaviour during transport can be quantified by the period of time each animal has spent laying down/standing in a defined time interval. Therefore, during handling and simulated transport, heart rate and period of time each animal spent laying down, have been measured at different frequencies and accelerations in order to define comfort zones for pigs in relation to welfare during transport.

Material and methods

Seventy two piglets were housed in thermally neutral conditions (Geers *et al.*,1990). For each treatment a total of 6 piglets were available. For the control treatment, with no vibration, 36 piglets were used. When experiments started, three animals from the same climatic room were transferred to individual pens. The day after at 8 a.m., two animals were placed in the crate of the vibration machine, the third one stayed in the individual pen. The hydraulic pump was switched on at 9 a.m., to allow acclimatization to the noise of the machine. Time spent laying down was observed during 10 min intervals from 10 a.m. to 11 a.m. In the afternoon the animals were anaesthetized and an ambulatory Holter-device (Hewlett Packard Model 43400B Analyzer) was attached, allowing acquisition of maximum and mean heart rate during the next 24 hours (Villé *et al.*, 1993). Recording for the reference period took place during the night (10 p.m. until 6 a.m.). The day after (8 a.m.), the same two animals were moved to the crate of a vibration machine and the third was a control animal (indicated as 0 Hz and 0 m/s^2), which stayed in its pen. Vibration treatment started at 10 a.m. until 11 a.m.

Results

Heart rate measurement

The maximum heart rate (MHR) occurred near the start of the vibration and is therefore likely to indicate the initial fear level of the animals. The highest value for MHR was found at a vibration level of 2 Hz and 3 m/s^2. This value differed significantly ($P<0.0001$) from the MHR found at a vibration level of 18 Hz and 1 m/s^2 (Table 1). The r.m.s. acceleration had a significant effect on MHR (data not shown) by indicating a higher fear response at 3 m/s^2.

Table 1 : Maximum heart rate (MHR) and mean heart rate (XHR) during vibration at different frequencies and accelerations (mean±SEM), means with a different superscript differ significantly in a paired t-test ($P<0.05$)

Frequency (Hz)	Acceleration (m/s^2)	MHR night (beats/min)	MHR vibration (beats/min)	XHR night (beats/min)	XHR vibration (beats/min)
0	0	173±5 ^{a}	184±5 ^{a}	119±4 ^{d}	124±4 ^{d}
2	1	174±2 ^{a}	185±3 ^{b}	127±2 ^{d}	128±2 ^{d}
2	3	178±4 ^{a}	203±5 ^{c}	123±4 ^{d}	139±3 ^{e}
8	1	167±7 ^{a}	182±8 ^{a}	122±7 ^{d}	128±5 ^{d}
8	3	174±5 ^{a}	193±5 $^{b, c}$	126±4 ^{d}	145±3 ^{e}
18	1	172±4 ^{a}	178±5 ^{a}	125±4 ^{d}	128±3 ^{d}
18	3	163±6 ^{a}	190±7 $^{b, c}$	111±6 ^{d}	139±5 ^{e}

Mean heart rate (XHR) is considered to reflect the general response of the piglets to vibration. Mean heart rate during vibration at 8 Hz and 3 m/s^2 differed significantly from mean heart rate during vibration at 2 Hz, 1 m/s^2 ($P<0.0001$) and 18 Hz, 1 m/s^2 ($P<0.0006$) (**Table 1**). XHR of the control group did not differ from measurements during vibration at 2, 8 or 18 Hz in combination with a r.m.s. acceleration of 1 m/s^2.

Behavioural parameters

Our results confirm earlier findings (Lambooy, 1988) that piglets will be more restless when the journey starts, then later on, when they are adapted to the motion of the vehicle. Animals will feel more exhausted after vibration at a frequency-r.m.s. acceleration combination of 8 Hz and 3 m/s^2. Effect of r.m.s. acceleration in each tested frequency is significant ($P<0.0001$) as tested with Wilcoxon non-parametrical test. More than 50% of the animals will spent their time laying after one hour of vibration at a r.m.s. acceleration of 1 m/s^2. More than 50% of the animals exposed to vibration at a r.m.s. acceleration of 3 m/s^2 will be restless for more than 2 h.

Conclusion

Due to the large between-animal variability the results did not differ significantly in an overall analysis for all variables. At the start of transport low vibration frequencies at high accelerations should be excluded to avoid fear in the pigs, induced in part by the greater displacement and the lower predictability of the motion. Weiss (1971) has shown that an unpredictable environment is a major factor inducing stress. Higher frequencies in combination with low r.m.s. accelerations may induce little displacement and a higher predictability, which does not compromise welfare of the transported animals. Vibration at a frequency of 8 Hz looked more stressful, especially in combination with 3 m/s^2 and may discomfort the piglets by resonance of the internal organs (Randall *et al.*, 1996). However, in our experiments the effect of mixing with strange conspecifics and other aspects of a new environment, which also provoke an increase in heart rate, were not taken into account.

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BEHAVIOURAL REACTIONS OF SOWS DURING THE PRE-FARROWING WASHING PROCEDURE

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Summary

The behavioural reactions of 1000 sows from five different genetic lines were observed during the pre-farrowing washing procedure in order to evaluate the response in relation to welfare and possible relations with individual differences in reactions to stress. During the four stages of the washing procedure the occurrence of vocalisations (VOC) and escape attempts (ESC) was recorded. Although VOC and ESC were statistically correlated ($\chi^2 = 122.7$; $P = 0.0001$), the association was only weakly linear (Spearman rank correlation coefficient $r = 0.10 \pm 0.03$, $P < 0.05$). Furthermore, both VOC and ESC were dependent of the genetic line and VOC was dependent of the parity, but ESC wasn't.

Additional behavioural tests and analyses will elucidate if these differences are consistent between and within tests. Further analysis of the data should help recommending optimal temperatures for the environment and the washing water.

Key words: sow, coping behaviour, individual differences, welfare

Introduction

For hygienic reasons and according to E.C.-directive L340/37 all sows must be washed before entering the farrowing pens. Because most sows are only washed just before farrowing, this rather infrequent procedure can induce a stress response. Individual differences in stress coping strategy have been described in various domestic animals and in man. It is still debatable whether such differences also exist in pigs: Spoolder *et al.* (1996) didn't find significant correlations between social and non-social tests in 15 weeks old female piglets, nor a bi- or multimodal distribution of the test scores. Stable individual differences in response to non-social challenges in gilts were found by Lawrence *et al.* (1991), but these differences did not predict responses in social groups. Mendl *et al.* (1992) found that the strategy used to cope with the social environment, measured as the success rate in agonistic interactions had strong consequences for physiological state and reproductive success. The total weight of liveborn piglets was higher for sows of the High Success group than for sows of the Low Success group, with the No Success group being intermediate. Varley and Stedman (1994) investigated the relationships between the personality of 40 crossbred multiparous sows, their endocrine status and reproductive performances. They divided the population in placid, flighty and average temperament sows, based on two open-field tests, two fear response tests to a human and a social interaction test with a “standard” sow. There was a non-significant trend that flighty sows had litters of a lower total weight than sows with an average temperament; and the placid sows had the highest litter weights of all. Moreover, Varley and Stedman calculated that personality of the sow accounts for 18 % of the variance in litter size.

The present study is part of a research project on possible individual differences in stress-coping capacities in pigs and consequent selection schemes. According to Jensen (1995) these individual differences must have a high intra- and intersituation consistency, have a bi- or multimodal distribution and be due to genotypic differences. We have assessed the teat order and the reaction to a backtest and an open-field test in piglets (Mulkens *et al.*, 1996), but haven’t found a bimodal distribution of character traits. The social rank and the fear of humans was evaluated in a part of these animals when they were seven months old (Mulkens *et al.*, 1997). We found a trend for behavioural consistency in gilts between social rank and fear of humans. In the study presented here, behavioural reactions of sows were observed during the pre-farrowing wash in order to determine if individual differences exist and to evaluate the impact on their welfare.

Animals, Materials and Methods

The behavioural reactions of 1000 sows were observed during the pre-farrowing wash from October 1995 to December 1996. 100 of them were washed a second time during this period. The animals, belonging to five genetic lines, were kept on a pig-selection farm. They were washed with a low-pressure spraying pistol. The washing procedure consisted of four stages: (1) soaking, (2) back and flanks, (3) head and thorax, and (4) belly and hind quarters. The environmental temperature was noted before soaking and the temperature of the water was noted after soaking and at the end of the total washing procedure. The behavioural response was evaluated by recording the occurrence of vocalisations (VOC) and the escape attempts (ESC) of the sows. Previous research in pigs suggests that high-frequency vocalisations correlate with increasing levels of epinephrine (Schrader and Todt 1996) and escape behaviour is one of the stress coping strategies (Wechsler 1995). The data were analysed with the SAS-software package (SAS system 6.08 for Windows, SAS Institute Inc., Cary, NC, USA). The dependence of the different parameters was tested by the PROC FREQ-procedure, based on a χ^2-distribution.

Results

Considering the whole population VOC and ESC were statistically correlated (χ^2 = 122.7 ; P = 0.0001), but the association was only weakly linear (Spearman rank correlation coefficient r = 0.10 ± 0.03, P < 0.05). For two genetic lines those two parameters were independent (P > 0.1). Furthermore, a score was given to the different classes of VOC and ESC, i.e. never = 0, sometimes = 1 and always = 2. The same was done for the combination VOC - ESC, to get a global impression of the behavioural reactions. The means of these global scores were dependent of the genetic line (P < 0.05). Finally, the influence of repetition and parity was evaluated. VOC was independent of the parity (P = 0.26), but the VOC during the second wash depended on VOC during the first wash (P = 0.01). ESC was dependent on parity (P = 0.001), but ESC during the second wash was independent of ESC during the first one (P = 0.24).

Conclusions

The data mentioned above indicate that there are differences in stress response between the genetic lines used. Additional behavioural tests and analyses will elucidate if these differences are consistent between and within tests. If these personality traits are consistent and heritable, then it would be possible to select pigs that are better adapted to the needs of modern pig husbandry.

Further analysis of the data should yield recommendations for the optimal temperature of environment and washing water.

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The Gastric pH in Pigs in Non-stress and Stress Situations

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While investigating the intragastric pH-dynamics in different functional conditions of the stomach of pigs, a question arose - how a stress situation affects gastric pH and some physiological and blood biochemical indices of animal organism.

It is well known that any unusual manipulation for untrained animals, when a conditioned reflex to the particular situation is not developed yet, acts as a stress factor. The animal restraint and probing procedure caused the pigs stress in the beginning of the experiment. However, it should be pointed out that pigs belong to that kind of animals which develop conditioned reflex rather quickly. After the fourth or fifth time of the experiment pigs already "knew what they had to do".

The aim of our research was to investigate how the stress affects pH-dynamics in different stomach gland zones of pigs before feeding on an empty stomach and after milk feeding.

Material and Methods

Eight pigs of Latvian White breed aged 2.0-2,5 months with the same body weight were used for the experiment.

Gastric pH-dynamics was determined by making use of multizone pH-probes with two, three and four electrodes widely applied in human medicine.

Multiple factors such as placing pigs into a special cage restraint, keeping the animal head under restraint, inserting a special mouth speculum and probe, as well as the procedure of probing contributed to creating stress situation. Before performing experiments two pigs were injected aminazin 0,006 mg/kg body weight and two pigs- azaperone 8 mg/kg body weight causing only a sedative effect. Four pigs were probed without administration of any sedatives.

The results were compared among themselves and with those of intragastric pH indices obtained after three weeks when a conditioned reflex to the probing procedure was completely developed, and animals responded calmly to the manipulations "knowing what to do".

In order to identify if the sedatives aminazin and azaperon affected the acidity degree of the stomach in non-stress conditions, the same original scheme of experiments was also used after three weeks (**table l**).

The stomach probing was usually performed in the morning 11-12 hours alter the last feeding, then 15-20 minutes and 1,0-1,5 hours after milk feeding.

To examine the general health condition of animals, the morphological and biochemical blood tests were employed. The glucose level, total bilirubin, creatinine, total protein, ALAT, ASAT, calcium, inorganic phosphorus and alkaline phosphatase were determined in the blood.

100 g milk contained 3,9 g protein and 3,5 g fat. Blood samples for the test were obtained in the morning before feeding on the first, seventh and twenty-first day of the experiment.

Results

According to our experience of the investigation of intragastric pHdynamics in pigs, it is important to take into account the changes of the fundal gland zone and cardiac gland zone of the stomach as they differ functionally very much.

The results of pH-dynamics of the stomach fundal gland zone of pigs which did not receive sedatives before the probing procedure, animals which were injected either aminazin or azaperon, and the same animals after 3 weeks of the experiment are shown in table 2.

Table 1

Scheme of experiments

Animal	Number of measurements					
	Before feeding	After 200 ml milk		After 500 ml milk		Total
		15-20 min	1.0-1.5 h	15-20 min	1.0-1,5 h	
Without sedative (n=4)	16	4	4	4	4	32
With Aminazine (n=2)	8	4	4	4	4	24
With Azeperone (n=2)	8	4	4	4	4	24
After three weeks without sedative (n=4)	16	4	4	4	4	32
With Aminazine (n=2)	8	4	4		4	24
With Azeperone (n=2)	8	4	4	4	4	24

Table 2

Average intragastric pH-indices in the fundal gland zone of pigs

Animal	Before feeding	After 200 ml milk		After 500 ml milk	
		15-20 min	1,0-1,5 hours	15-20 min	1,0-1,5 hours
Without sedative	1,2±0.2	1,4±0.5	1,3±0.2	1,5±0.4	1,2±0.2
With aminasine	1,4±0.4	1,7±0.6	1.6±0.2	1.7±0.3	1,5±0.3
With azaperone	1,3±0.3	1,5±0.4	1,4±0.3	1,6±0.4	1,4±0.2
Three weeks after					
Without sedative	1,4±0.3	1,6±0.4	1,4±0.4	1,7±0.5	1,3±0.2
With aminasine	1,3±0.4	1,6±0.5	1,5±0.3	1,6±0.5	1.4±0.1
With azaperone	1,4±0.4	1,5±0.3	1,4±0.3	1,7±0.4	1,4±0.3

Intragastric pH indices of the fundal gland zone of the pigs which were not injected any sedatives were a little lower in comparison with the sedative injected animals, consequently, the stomach media in that gland zone was a little more acid. This phenomenon was prominent in the mornings when the stomach of the animal was empty, and also 1,0-1,5 hours after milk feeding. Then the degree of acidity reached the peak in the fundal gland zone, and pH was 1,2±0.2.

In the stress situation histamine acted as an extra irritant of the stomach fundal gland zone, and its secretion was increased. It is common knowledge that histamine is a strong irritant of the hydrochloric acid producing glands of the stomach. It has been proved for many times that the biologically active substance histamine always takes part in the stress reactions of the organism.

As to the acidity degree in the stomach fundal gland zone of the pigs fed with milk and which did not receive sedatives, intragastric pH indices were comparatively a little lower 15-20 minutes after feeding. These results are given in table 2. However, it should be pointed out that pH level in the fundal gland zone was a little increased 15-20 minutes after milk feeding in comparison with the pH indices on an empty stomach. This is a natural phenomenon as some amount of hydrochloric acid is bound by milk.

The sedative effect of both aminazin and azaperon on the pig behaviour during the probing manipulations was similar. The intragastric acidity level in the fundal gland zone was decreased a little more by aminazin than by azaperon. After three weeks when animals were already accustomed to the manipulations of the experiment and probing procedure pH changes in the fundal gland zone in all functional conditions of the stomach were mutually similar (**table 2**). There were no essential differences between them and the intragastric pH-dynamics in the beginning of the experiment when animals were probed after they had received sedatives.

Intragastric pH-dynamics in the cardiac gland zone of pigs in the beginning of the experiment without and with administration of sedatives is shown in **table 3.**

Table 3

Average intragastric pH indices in the cardiac gland zone of pigs

Animal	Before feeding	After 200 ml milk		After 500 ml milk	
		15-20 min	1,0-1,5 hours	15-20 min	1,0-1,5 hours
Without sedative	5,9±0.4	6,1±0.4	5.8±0.3	6,2±0.7	5,7±0.6
With aminasine	5,8±0.4	6.2±0.6	5.9±0.5	6,1±0.6	5,8±0.4
With azaperone	6,1±0.5	6,4±0.5	6.1±0.5	6,3±0.4	6,2±0.5
Three weeks after					
Without sedative	5,8±0.5	6,1±0.5	5,9±0.6	6,2±0.6	5,8±0.8
With aminasine	5,9±0.3	6.2±0.4	5,8±0.3	6,1±0.4	5,9±0.6
With azaperone	5,8±0.3	6,1±0.6	5,9±0.5	6,2±0.5	5,8±0.6

According to the table, pH indices of the cardiac gland zone of the pigs in a stress situation and after administration of sedatives in the beginning of the experiment do not differ from those obtained after three weeks. It means that mucus producing cardiac glands of the stomach are less sensitive to a stress situation than the fundal glands. The sedatives aminazin and azaperon do not change the stomach media substantially in the cardiac gland zone.

The general health assessment of pigs led to the conclusion that they were in good health as the haematological and biochemical blood tests answered the physiological standards.

Conclusions

When investigating intragastric pH-dynamics of pigs in a long-term experiment, one should consider that a stress situation can be caused by the probing procedure (inserting the pH-probe per os) in the first weeks of the experiment. The stress, in its turn, affects more or less pH-dynamics in the fundal gland zone of the stomach and increases its acid concentration.

The cardiac glands of the stomach are rather little involved in the stress response of the organism, as the pH-dynamics in this gland zone is comparatively stable in pigs.

The sedatives aminazin and azaperon administered in the doses of sedation in non-stress situation do not affect pH-dynamics of the stomach.

CO_2/O_2-anaesthesia: A relevant method to reduce stress during castration?

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Summary

The aim of this study was to verify a simple and economic method of CO_2/O_2-anaesthesia during castration of piglets under the aspects of animal welfare. Blood samples were collected from animals aged between 2 and 4 weeks following castration with (n=43) and without anaesthesia (n=50) in hourly intervals. ß-endorphin and total plasma cortisol were measured using radioimmunoassay techniques.

One hour after castration, the unanaesthesised animals showed a highly significant increase of total plasma cortisol levels (184.8 vs. 309.0 nmol/l). Subsequently, the values decreased continously and reached basal levels after 24 hours. The piglets under anaesthesia had a significant increase in ß-endorphin concentrations (12.0 vs. 15.7 pmol/l) one hour after castration. Cortisol levels maintained highly significantly increased for up to 4 hours after castration procedure (171.2 vs. 429.9 nmol/l) and reached a highly significant lower level compared with basal values 24 hours after surgery (126.0 nmol/l).

Due to the more severe physiological reaction in response to castration with CO_2-anasthesia, this method cannot be recommended to reduce piglets' stress response to castration.

Key words: pig, stress, castration, CO_2-anaesthesia, cortisol, ß-endorphin

Introduction

Castration of male piglets is a common procedure in many countries for hygienic meat production. Only in Germany about 25 mio piglets are castrated every year. Although the German animal protection law in its newest draft limits the allowed castration without any analgesia and anaesthesia up to 4 weeks post partum, there are increasing public debates about the welfare relevance of this procedure, leading to a search for a practicable method of analgesia. Until now, no feasible way for analgesia during this procedure was found (WALDMANN et al. 1994). In contradiction to the anaesthesia of slaughter animals, common in some countries, with 70% CO_2 and 30% air (WERNBERG 1979), the experiments of LAUER et al. (1994) proved the possibilities of CO_2 anaesthesia with a mixture of 60% CO_2 and 40% O_2 instead of air during the castration of piglets as the best solution. Aim of the present study was to assess the animal welfare relevance of this method of anaesthesia. Therefore ß-endorphin and total plasma cortisol were measured as stress parameters after the castration of male piglets with and without anaesthesia.

Animals, Material and Methods

In 93 piglets, 2-4 weeks old, blood samples were taken at the same day time, before and 1,2,3,4 and 24 hours after castration. The samples were taken through a jugular catheter which was placed 2 days before under anaesthesia with Propofol (8-10mg/kg i.v.). The animals were castrated either with (n=50) or without (n=45) CO_2/O_2-anaesthesia. The piglets were put into a closed box during anaesthesia with a window to look through (LAUER et al. 1994) for 60 sec. with a mixture of 60% CO_2 and 40% O_2. The gas concentrations were measured continuously to keep the mixture constant. For the castration which lasted about 2 minutes, the animal were placed in a “Niedeck castration hook“ while the head remained in the gas mixture. After about 15 minutes wake up phase the animals were fully concious und were placed back to their mother sows. In the animals’ plasma total cortisol and ß-endorphin were assessed. Cortisol samples were evaluated by radio immunoassay (RIA) preceded by extraction with organic solvent (LEBELT et al. 1996) and ß-endorhin after concentration (sep columns C18, Pininsula Labs) with a commercial RIA test kit (Peninsula). For the statistical analysis t-test for dependent and independent probes was used. An error probability of less than 5% ($p<0.05$) was accepted as significant and of less than 1% ($p<0.01$) as highly significant.

Results

The results are presented in the figures 1 and 2. Significant differences compared with basal levels are labelled with * (* $p<0.05$; ** $p<0.01$) and differences between the groups are shown within brackets.

The castration without anaesthesia caused increased ß-endorphin values after one hour which were not significant. The values decreased during daytime and reached basal levels at 24 hours after castration. Cortisol concentrations showed the same tendency. One hour after castration the value was highly significant increased. In opposition, in piglets which were castrated with CO_2 anaesthesia, the ß-endorphin levels increased significantly one hour after castration. Cortisol concentrations were at a highly significant increased level from 1 to 4 hours post castration. 24 hours post castration both parameters were below the basal values. This decrease was highly significant for cortisol. Comparing both groups, cortisol levels of the piglets castrated under anaesthesia were significantly higher in the first two hours post castration than in the conventional castrated piglets. After 24 hours the cortisol concentrations showed the opposite tendency: The values of piglets castrated under anaesthesia were highly significant decreased compared with the other group.

Fig.1: ß-endorphin levels in response to castration (mean ± SD)

Fig.2: cortisol levels in response to castration (mean ± SD)

Discussion

The results presented show that the castration is associated with an increase in stress parameters. Without doubt, this measure is stressful for the piglets which is also supported by the findings of MCGLONE et al. (1993) and LAUER et al. (1994). Therefore, the considerations if castration can be done without analgesia, are quite reasonable under the aspect of animal welfare. As reported by WALDMANN et al. (1994) general anaesthesia using different injectable drugs as well as local anaesthesia were not effective in reducing piglets' stress response to castration. The present study shows that this is to be meant for the CO_2 anaesthesia as well. In opposite, using the described method of anaesthesia, even in comparison with conventionally castrated animals a clearer and longer lasting increase in the assessed stress parameters was found. The decrease of cortisol concentrations below basal values 24 hours after anaesthesia, provide evidence for a negative feedback on the hypothalamic-pituitary-adrenocortical axis.

To summarise the results of the present study, from a welfare point of view CO_2 anaesthesia seems not to be a relevant method to reduce piglets' stress response to castration.

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Fig.1: ß-endorphin levels in response to castration (mean ± SD)

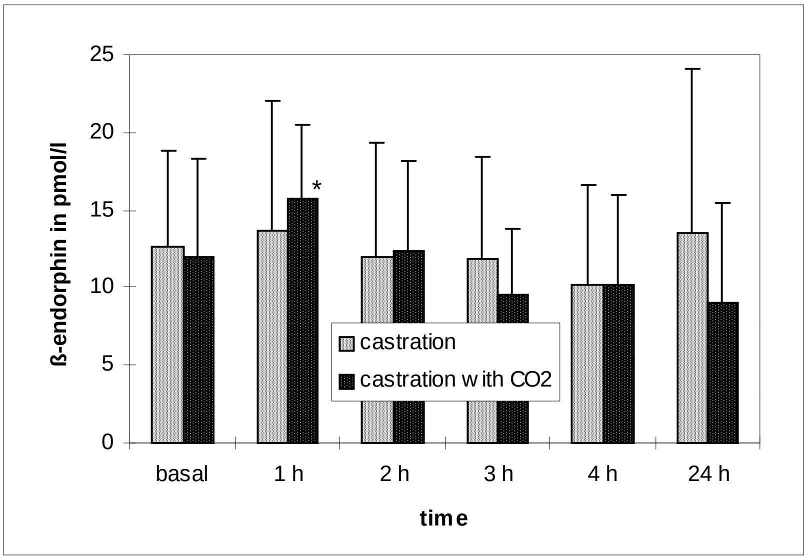
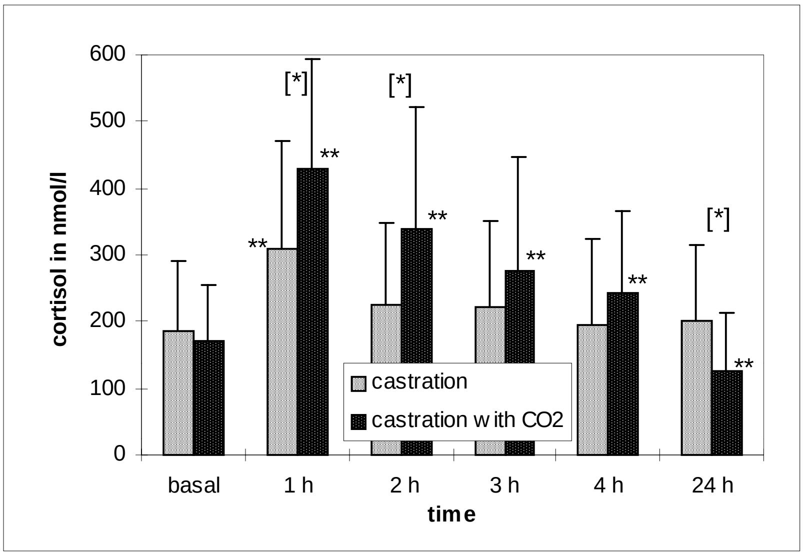


Fig.2: cortisol levels in response to castration (mean ± SD)



Pre-testing of new technique from an animal health and welfare point of view: Alternative systems for laying hens

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Summary

Since 1990 Swedish farmers have been allowed to buy aviary systems for laying hens, provided they allow official investigations of bird health and behaviour to be performed. The investigation involves production records, health studies at clinical examinations and at autopsies, behavioural studies and studies of environmental parameters. So far the pre-testing has involved about 150 000 laying hens in 70 flocks at 21 different farms. Mortality, mainly due to cloacal cannibalism, varied between flocks. Feather pecking damages were common in both systems. Multiple linear regression analysis showed that increase in the prevalence of pecking wounds at the cloaca at 35 weeks (n=32) increased with increasing group size and number of hens per nest box (r^2=0.63).

Key words: poultry health, aviary, behaviour, clinical scoring, cloacal pecking, nest boxes, group size, regression analysis

Introduction

According to the Swedish law on animal protection, hens for egg production shall not be housed in conventional battery cages after January 1, 1999. In compliance with the law, there is an increased interest for new commercial high stocking density (>9 hens/m^2) loose housing systems, which is regarded as a new type of technical system in Sweden. All new technical systems for animal housing should be pre-examined and approved regarding animal health and protection before the new systems are released on the commercial market. In 1990 aviary systems for laying hens were introduced commercially in Sweden. Farmers were allowed to buy the systems, provided investigations of animal health and behaviour were taking place on these farms. The Swedish National Board of Agriculture has commissioned the Section of Animal Hygiene, Department of Animal Environment and Health, Swedish University of Agricultural

Sciences in Skara to pre-test two new types of commercial aviaries for laying hens, the OLI Free and the Vencomatic systems. A special methodology was developed and a data base was created.

The aim of this paper is to describe the practical accomplishment of the pre-testing regarding production, animal health, behaviour and animal environment and to present some preliminary results from the analysis of the data.

Material and methods

The pre-testing of the OLI Free and the Vencomatic systems consists of three phases. The first, experimental, phase involves detailed studies during two production periods at semi-commercial farms. In the second phase all commercial farms allowed to run the systems at high stocking densities were submitted into the field phase A. After being studied in field phase A for at least two production flocks, these farms were transferred into field phase B which involves less intensive recordings. A detailed description of the methodology used in the experimental phase is given in Gunnarsson et al. (1995). The methodology used in field phases A and B are based on the methods from the experimental phase.

From 1990 to 1997, 55 flocks with all together 110 000 laying hens at 21 farms, have been investigated in field phase A and 10 flocks with 30 000 laying hens are in field phase B. Eight different hybrids were represented in the flocks and the median group size was 1100 hens (394-5074; 90% central range) at median stocking density of 15.5 hens/m^2 (10.2-17.9; 90% central range).

Data about the number of eggs collected, the number of mislaid eggs and egg quality, were reported from each flock by the farmer. Animal health was studied at clinical examinations, at autopsies of all dead and culled birds and occasionally at slaughter inspections. Clinical examinations of 100 randomly selected hens were performed three times in each flock; at 35, 55 and 75 weeks of age. Each bird was weighed, scored and results were filed individually. The scoring was done by especially trained researchers. A photo guide of the clinical features recorded are described in Gunnarsson et al. (1995). At autopsies the cause of death and secondary findings of interest were recorded for each individual hen. Behavioural studies were carried out at 35 and 55 weeks of age on hen distribution, dustbathing, nervousness, aggressive behaviour and feather pecking. In association with to the clinical inspections temperature, relative humidity, ammonia concentration and carbon dioxide concentration in the house were recorded.

Descriptive data are presented as median values, with 90% central range in brackets as data were not normally distributed. Multiple linear regression analyses were used for modelling the factors influencing the prevalence of pecking wounds to the vent.

Results and discussion

Total mortality was 13.4% (4.4-23.8) and outbreaks of cloacal cannibalism were the main reason for mortality, which also had a negative impact on the egg production. The percentage of mislaid eggs was 2.3% (0.5-28.7; 90% central range) and was probably influenced by stocking density, hens per nest box and rearing conditions. Feather pecking was common and the variation between the flocks was large. The percentage of hens scored with naked areas > 5 cm on the back at 35 weeks of age was 58% (0-94) and at 55 weeks 85% (0-98). Genetical and nutritional factors as well as rearing factors has been suggested to contribute to feather pecking (Blokhuis 1991; Appleby et al. 1992). Foot condition was generally good, but in 15 flocks the prevalence of bumble foot was more than 5% at 35 weeks. There was also a tendency that the white hybrids were more likely to get bumble foot. Higher than 3% prevalence of broken claws was only seen in the two flocks where a detail in the system design caused trapping of hens‘ feet. Behavioural studies in OLI Free flocks (n=22) showed that the hens were equally distributed in the system during the daytime and about 70% of hens were roosting on perches at night time. Hens were dustbathing less where the litter was wet, than where the litter was dry. There was significantly more aggressive behaviours (pecks and threats) at 55 weeks than at 35 weeks (0.19/min versus 0.12/min, Wilcoxon sign rank test; $p=0.01$), but there was no difference in aggression in white compared to brown hybrids. Brown hybrid hens feather pecked significantly more than white hens (0.32/min versus 0.12/min, Mann Whitney U; $p<0.01$), but no age difference was found. Most aggressive behaviours and feather pecking was seen on the litter areas. Studies of environmental parameters showed that the amount of total dust and ammonia at rare occasions exceeded the limits set by workers‘ protection and animal welfare legislation ($5 mg/m^3$ dust and 25ppm NH_3, respectively).

In 14 flocks the prevalence of pecking wounds at the vent was more than 10% at one or more clinical inspection. A multiple regression model for pecking wounds at the cloaca at 35 weeks of age in OLI Free (n=32) with group size (x_1), hens per nest box(x_2) and stocking density (x_3) was performed. Analysis showed that an increase in the prevalence of pecking wounds at the cloaca at 35 weeks could be explained by increasing group size and number of hens per nest box ($y=-15.38+0.01x_1+2.20x_2$; adjusted $r^2=0.63$). No significant interaction was found.

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WELFARE OF VEAL CALVES IN DIFFERENT HOUSING SYSTEMS, TECHNICAL AND ECONOMICAL EFFECTS.

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Summary

Trials have been conducted at the experimental farm of the Institut de l'Elevage (Livestock Farming Institute) to determine the effects of different housing systems on the welfare of veal calves and technical or economical consequences.

Technical results (growth rate, feed conversion and carcass characteristics) did not differ as a function of the pens model. Only the meat color was enhanced for calves raised in group pens. Mortality and morbidity rates were generally higher in group pens. Welfare of the calf was evaluated with two scores, one involving the ability of the animal to relax muscularly (postures of members) and the other its level of activities (grooming, licking, scraping...). Working time, specific to the distribution of milk replacer and health supervision was lower when the rearing building is arranged as individual pens. Economically, there are lower profit margins as the size of individual pens is increased or if group pens are chosen.

Key words : welfare, veal calves, housing systems.

Introduction

Individual pens are the most widely used housing system for veal calves in France. Group pens on slatted floors or straw bedding have nevertheless been increasing since 1994. Technical performances, health problems, calf welfare, working time and economic aspects have been compared with different housing systems.

Health

In experimental farm, with limited number of calves, frequencies of digestive and respiratory disorders are not significantly different between calves in a group pen or an individual pen (Bertrand et al 1995). Nevertheless, prior results (Webster 1985 ; Smits and de Wilt 1991) tend to show increasing respiratory problems for calves in group pens and ter Wee et al (1991) observed an increase in diarrhea in collective pens.

If we should refer to prior studies, in particular Smits et Ham (1988), their survey involved almost 7000 calves in individual pens and 9000 in collective pens and showed that mortality was higher in group pens (3.95 % vs 3.01 %).

Technical performances

Technical performances were similar between calves reared in group or individual pens concerning most of the parameters. Only the final hematocrit of calves in group pens was higher (Bertrand et al 1995) and the meat color was correlatively enhanced. This observation was not generally confirmed by others, except for Smits and Ham (1988) who detected a slight advantage (meat of lighter color) in calves in individual pens.

In conclusion, technical parameters differ little or not at all as a function of the housing system. It is nevertheless probable that the know-how is all the more important when calves are reared in group pens.

Welfare

Welfare (comfort or discomfort) was characterized by direct observation of calves in group (5 calves per pen, 1.5 m^2 per calf) or individual pens (81 cm wide), all postures and activities were noted at 10, 14 and 18 weeks of rearing (Pasquet et al 1994).

The results of these three successive observation periods are processed in two steps : description of different profiles of frequency of postures and activities for group, then comparison of group using the method of scores (Gesmier et al 1992). The quantification of the welfare level by a score leads to a single estimation of animal comfort.

Postures: The degree of the standing position is higher in group pens resulted from the presence of other animals acting as disturbing elements. The group pen would be less comfortable than the individual pen for this criterion. Posture with 4 legs tucked under the body is the predominant posture specially in group pens. Its higher frequency in group pens would result from the numerous standing/lying down alternations and poor synchronization among animals in group pens would favor this posture by preventing them from lying down for fear of being stepped on by other animals. Posture with one hind leg stretched is an indicator of useful space for muscular relaxation and is considered as a posture that reflects a certain degree of comfort. From this point of view individual pens (81 cm wide) confer higher comfort (10 weeks) or one equal to that provided by the group housing.

Activities: Licking and scraping, considered as stereotypies, are the expression of conflict or frustration indicating a certain lack of well being. Appearing more frequently in group pens, these behavior patterns would reflect for some a latent boredom (Wiepkema 1987) for others the possibility of eliminating a certain degree of anxiety (Dantzer and Mormède 1979). Tongue rolling was more frequent in individual pens. The use of an automatic milk distributor clearly reduced their frequency as did the presence of straw (Bertrand et al 1994). Mastication is the main activity of calves when lying down. This activity is more frequent in individual pens. It is probable that it requires a relative calm to be expressed. Calves disturbed by their neighbours in group pens cannot carry out this activity as much as animals in individual pens. Grooming is an important index for the determination of comfort even if its interpretation is sometimes delicate. There was little or no difference in this criterion between the two types of pens.

Comfort scale: Individual pens had a comfort for posture of legs higher than that of group pens at 10 weeks. Beyond this age neither pen model differed on this score. Group pens presented a higher comfort as judged by activities (Bertrand et al 1995).

Working time

Concerning the duration required for health care and feeding, the mean time per calf differed by 0.08 minute per day according to the housing system, this small difference becomes important for a building containing 200 calves fattened in 140 days : about 40 hours more with group pens.

Economy

Economic comparisons as a function of the type of pen were done on the basis of data obtained in practical conditions, when the farmer arranges their building of a given surface with pens of variable sizes (individual pen : 70, 80 or 100 cm wide ; group pen 1.5, 2 or 2.5 m^2/calf). The margin is proportional to animals produced every year and to the remuneration per calf. In these conditions, there are lower margins as the size of individual pens is increased or if group pens are chosen (Bertrand et al 1995).

Conclusion

The choice of a group or individual housing system for arranging a new or existing building is an important subject. The mortality and morbidity rates are generally higher in group pens. The technical results of animals are pratically identical if we do not take into account animals that are eliminated during the fattening period. The evaluation of comfort shows that individual pens are better for the capacity to relax muscularly and group pens are favorable for the activity level. Economically there are lower margins as the pen size per calf is increased.

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Influence of dry feed supplements on different parameters of welfare in veal calves

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Summary

The aim of the study was to evaluate the interest of supplying veal calves fed an all-liquid milk replacer (G0) with 10 and 25 kg of straw and starch pellets (G10 and G25). Each of the 3 feeding programs involved 21 males Friesian calves kept in individual crates from 1 to 21 weeks of age. Oral activities, haematological parameters, rumen characteristics, health and performance were investigated. In calves supplied with dry feed, ruminating behaviour was not evidenced and chewing, considered as a non nutritive oral activity, was clearly reduced. Tongue playing and manipulating objects were not influenced by additional pellets.

Haemoglobin concentration was higher in G25 than in other groups in consequence of extra iron brought by pellets. Other blood parameters were unchanged. In G10 and G25 a ruminal activity was clearly demonstrated from 3 observations: weight of reticulo rumens increased by 11 and 35%, presence of small size villi (non-existent in all-liquid fed calves) with a darkening of mucosa, and marked reduction of hair balls, resulting from a continuous elimination of ingested hair by ruminal motricity.

In G25, carcass weight was significantly increased by 6.5% and no detrimental effects such as bloat or abomasal ulceration were evidenced when dry feed was added. Finally, supplying calves with pellets was considered positive for welfare of veal calves, and although not calculated, likely profitable for producers.

Key words: veal calves, animal welfare, solid feed.

Introduction

Feeding veal calves exclusively on milk replacer allows a strict control of iron intake and a production of pale meat. However with all-liquid diets, calves cannot perform normal behaviour of rumination and chewing (Wiepkema, 1987; Broom, 1991) and as a consequence, they develop non nutritive oral activities characterised by sucking, licking or biting inanimate objects, and by tongue playing (Sambraus, 1985; de Wilt, 1985; van Putten, 1982). Another abnormality related to exclusively liquid feeding and to the lack of fibre in the diet is the non development of villi in the rumen, impairing normal fermentation (van de Braak et al., 1991). In fact, roughage and concentrate should be properly balanced to stimulate microbial population and rumen development (EU Scientific Veterinary Committee, 1995).

The aim of the present study was to investigate the interest of adding pelleted dry feed into the calves diet on oral activities, rumen characteristics, health and performance.

Material and methods

Sixty three males Friesian calves were assigned to 3 groups of 21 animals housed in individual crates from 1 to 21 weeks of age.

Calves were bucket fed, twice daily, a milk replacer with an iron concentration of 40-50 mg/kg during the first 5-6 weeks of rearing and 10 mg/kg there after. First group was only fed an all liquid milk replacer (G0); second and third groups were given increasing amounts of solid feed in pellets in addition of liquid feed, respectively 10 kg (G10) and 25 kg (G25). Pellets included 48% of starch and 11.6% of crude fibre.

Each calf was individually observed by scanning method (de Wilt, 1985) every 15 min during 4 hours sessions (17 scans) every two weeks from 4 to 20 weeks of age (9 sessions) so as 153 scans were performed for each calf. Each session started 30 min after distribution of pellets. Total activities, grooming (self licking), activities related to feeding (chewing or rumination), and non nutritive oral activities were recorded.

Individual blood samples were collected for haematological controls. Mortality and morbidity were recorded. At slaughter, reticulo rumens were individually weighed after their contents were eliminated. Presence of hair balls was checked. A fragment of ruminal wall (10 cm x 10 cm) was removed from each rumen and pigmentation of mucosa samples was measured by means of a photometer (CR Minolta 300) as described by Morisse et al. (1992). Development of villi was evaluated by scoring their length and density as follows: 0 = absence, 1 = weak, 2 = medium, 3 = high. Frequency of abomasal lesions was recorded.

Average daily gain was estimated; carcasses were electronically weighed on the processing line and their pigmentation was measured by means of a photometer at the *Rectus abdominis* muscle.

Results

Neither total activities nor grooming (respectively 25% and 3% of total observations) were influenced by treatment. At 6, 8, and 10 weeks, there was strong evidence for a decrease of chewing activities in lying position when calves disposed of pellets ($P<0.01$), so that these activities cannot be considered as rumination. Manipulating objects, observed in standing position, tended to increase up to 14 weeks of age in calves eating dry feed; in the same way, tongue playing tended to become more frequent in G10-25, without clear statistical evidence.

Haemoglobin concentration was higher in calves fed 25 kg of dry feed than in other groups (7.3 vs. 6.8 and 6.5 g/100 ml, $P<0.05$) in consequence of the additional iron brought by pellets (180 mg/kg). Other blood parameters were independent of intake of pellets.

When amounts of pellets increased, there was strong evidence ($P<0.001$) for a linear increase of reticulo rumen weights and for a reduction of hair ball presence (**Table 1**, $P<0.001$). That latter characteristic cannot be explained by a reduction of grooming activities which were similar in all treatments, but more likely by a continuous elimination of ingested hair induced by ruminal motricity.

In addition, ruminal mucosa was significantly darker as pellets supplies increased ($P<0.001$). Villi were observed only in G10-25 and their size was higher in G25 than in G10.

Supplying 10 kg of dry feed was not sufficient to increase daily gain and weight of carcass, whereas 25 kg improved daily gain by 9 per cent and carcass weight by 6.5 per cent.

Health was excellent throughout the fattening period (two calves dead or eliminated for pneumonia). In contrast with results of van de Braak and Mol (1991), and Welchman and Baust (1987), no symptoms of bloat were observed when dry feed was added; furthermore, only slight abomasal erosions were noticed in G10-G25.

Conclusion

Although rumination was not evidenced in the study, providing calves consistent amounts of pellets induced the development of villi in the rumen and increased the growth rate without detrimental effects on health. Consequently, providing dry feed supplement can be considered as positive for welfare of veal calves and likely profitable for producers.

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Table 1: Fore stomach characteristics in 20 week old calves fed an all-liquid diet (G0) supplemented with 10 kg (G10) and 25 kg (G25) of calves feed (mean ± SEM)

	G0 n=20	G10 n=21	G25 n=20
Weight of reticulo rumen (g)	$2\,313 \pm 237^{a}$	$2\,579 \pm 369^{a}$	$3\,120 \pm 480^{b}$
Hair ball presence (nb of calves)	17^{a}	4^{b}	2^{b}
Pigmentation of rumen mucosa			
L*	51.4 ± 7.6^{a}	47.4 ± 9.6^{ab}	44.1 ± 7.4^{b}
Villi length (nb scores 2 + 3)	0^{a}	6^{b}	14^{c}
Villi density (nb scores 2 + 3)	4^{a}	18^{b}	19^{b}

Data in a row with no common superscript differ significantly (Mann-Whitney test; P<0.001 except L*: P<0.05)

Behavioral and physiological responses of calves to castration when performed at weaning or 3 weeks prior to weaning

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Summary

The removal of a calf from its social and physical environment along with transportation and processing (branding, castration, and vaccination) are production stressors that may affect calf well-being. Therefore, it is important to understand which management practices can be combined or should be performed independently to reduce stress. Often pre-weaning vaccination programs may be employed. By integrating castration at this pre-weaning event, stress levels may be lowered at weaning, thereby improving well-being. A study was conducted to compare surgical castration 3 weeks prior to weaning with surgical castration at weaning. Calf behavior was observed and physiological measures (cortisol concentrations, total white blood cell counts, neutrophil to lymphocyte ratios and acute phase protein concentrations) were collected following castration at the two ages. Calves surgically castrated at weaning were more active ($P<.05$) on the first two days following castration than calves castrated three weeks before weaning. Haptoglobin responses indicated an additive effect of weaning stress and castration ($P<.0001$). Our results suggest that performing surgical castration 3 weeks prior to weaning may be less stressful than performing castration at weaning.

Key words: cattle, stress, weaning, castration, behavior

Introduction

Weaning is a production stressor that may affect well-being. High levels of stress at weaning are not likely to be based on the lack of nutrient uptake from milk sources alone. Vessier and Le Neindre (1989) have shown that the offspring-maternal bond is still present, even at 8 months of age. VonTungeln (1985) suggested an additive effect of weaning, transporting, exposure to new environments, restructuring of social order, and possible exposure to pathogens as factors influencing post-weaning stress in cattle. The removal from a static social structure and new environmental surroundings, transportation, and processing (branding, castrating, vaccinating, pest and disease management) and the possible change in diet all effect the level of stress. Therefore, it is important to understand which management practices can be combined or should be performed independently to reduce stress. Often pre-weaning vaccination programs may be employed with a booster given at weaning to establish a secondary immune response or higher titer. By integrating castration at this pre-weaning event, stress levels may be lowered at weaning, thereby improving well-being.

Materials and Methods

Twenty Angus, Simmental, and Angus x Simmental crossbred bull calves (180.0 ± 18.6 days of age and 241.5 ± 28.0 kg) and their dams were transported to a brome grass pasture. The following morning calves were separated from their dam and surgically castrated (n = 10) or restrained in the processing chute only (controls, n = 10). Vaccination also occurred at this time. Three weeks later, an additional twenty calves of similar breed (208.0 ± 7.9 days of age and 245.2 ± 22.7 kg) were transported to the same pasture and held overnight. The next morning, calves were weaned and processed in a similar manner. Calves also received a 5 ml booster of vaccine.

At both ages, blood samples were collected by jugular venipuncture prior to castration, following castration and at 4, 8, 24, 48, and 72 hrs post-castration. Samples were analyzed for total white blood cell counts and differential white blood cell counts and Neutrophil-to-lymphocyte ratios (N:L). Plasma and serum were separated for cortisol, haptoglobin (HP), alpha-1 acid glycoprotein and immunoglobulin G (IgG) concentrations. Active behavior (grazing, drinking, standing, walking, nursing) was recorded during 10 min focal samples from an observation platform (3.7 m) in the pasture.

Results

Calves castrated 3 weeks prior to weaning were less active the first day after castration than controls ($P<.05$). Activity was similar between control and castrated calves on all other days. Performing surgical castration on calves before or at weaning induced changes in HP concentrations, N:L ratios and cortisol concentrations. Surgically castrated calves had a greater HP concentration (133.5 ± 8.0 mg/ml) compared to controls (47.8 ± 8.0 mg/ml; $P = .001$). Neutrophil-to-lymphocyte ratios were also greater in surgically castrated calves (.67 ± .03 Vs .48 ± .03 for surgical Vs control, respectively; $P = .001$). Control calves had a lower serum cortisol concentration than castrated calves (22.2 ± 2.6 Vs 31.7 ± 2.7 ng/ml; $P = .01$). No differences were identified for alpha-1 acid glycoprotein, Ig G or total white cell counts.

Only HP was different when comparing surgically castrated calves castrated three weeks prior to weaning or at weaning. When castrated at weaning, calves had a higher HP concentration than calves castrated prior to weaning (159.6 ± 11.3 Vs 107.5 ± 11.3 mg/ml respectively, P < .01). Haptoglobin concentrations were not different from zero until 8 hours following castration and peaked at 48 hours post-castration. Neutrophil-to-lymphocyte ratios began increasing in both surgical and control calves between the post-castration sampling and the 4 hour sample with a peak in N:L occurring for both groups at the 8 hour sample.

Discussion

The effect of castration on active behavior was minimal, with the exception of suppression of active behavior in pre-weaning castrated calves the first day following castration. This reduced activity may be reflective of the pain of castration as Robertson et al. (1994) concluded that younger calves suffer pain when castrated. This difference was not seen on day one for weaned calves. Calves at weaning may have been more active due to maternal separation and thus the higher activity level in these calves should not be assumed to be reflective of reduced stress or pain following castration.

Haptoglobin levels in this study were different between surgically castrated and control calves. Connors et al. (1988) concluded HP levels are positively correlated with the degree of tissue damage present in an animal. If HP production is also an indicator of stress then our results would indicated a greater level of stress when calves are castrated at weaning than three weeks prior to weaning. Faulkner et al. (1992) suggested using HP as an indicator of inflammation in cattle and cortisol as an indicator of “whole body stress.” Our study indicates that HP may also be a sensitive measure of handling stress and the combined effect of castration and handling in the calf even after cortisol concentrations have returned to control values.

Conclusions

Behavioral data (activity) did not indicate whether castration prior to weaning was less stressful than at weaning but suggested a different behavioral response in the two groups. Maternal separation appears to be a factor in the expression of behavior in weaned calves. Physiological data, such as cortisol suggests that castration is stressful both pre-weaning and at weaning but that there is no difference between the two ages. The one indicator suggestive of reduced stress when castrating calves and returning them to their dam was HP. This measure may reflect the additive nature of weaning and castration stressors.

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Behaviour pattern of lying out and animal welfare of suckler cows and calves at the pasture

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Summary

Observations of large herds of suckler cows in Mecklenburg-Western Pomerania have shown that losses of calves, aggressiveness of cows and increased working time expenditure for handling may occur if disturbances with regard to the realization of the behaviour pattern of „Lying out" arise. Where the fenced-in pasture does not provide the cover facilities required for this a lot of calves leave the pasture in order to find an appropriate lying-out place outside. If the return of the calves to their mother has become more difficult the breaking-off of mother-child contacts may cause dramatic developments. By establishing „calves oases" an undisturbed and harmless realization of lying-out inside the pasture is offered with low expenditures.

Keywords: behaviour, suckling cows, lying out, losses, well-being, management

Introduction

Pomerania losses of calves and abnormal types of behaviour of cows and calves were noticed the reasons for which can probably be explained by disturbances of the behaviour pattern „Lying out" of the calves. The task of the present study was to find out whether and to which extent calves of different cattle breeds show behaviour types of „Lying out", how the animals realize this behaviour pattern with the usual pasture organization and what effects do disturbances of the natural behaviour have. Establishment of a „calves oasis" shall be conducive to well-being.

State of knowledge

The typical behaviour of many new-born ungulates during their first days of life is called „lying out" (hiding). „The new-born ungulates leave their mother after suckling and lie themselves down flat on the bottom at protected places until the next feeding time..." (GATTERMANN, 1993). Thus **lying-out** is described as an active action of the young animal without direct exertion of influence by the mother animal. In the case of laying-down (following) first the new-born animal follows its mother until she requests the new-born animal to leave and lay down (follower). Lying out and laying down are understood as protective behaviour (WALTHER, 1966; ESPMARK, 1969; LEUTHOLD, 1971). The young animals prefer a high vegetation from where they are convered from sight. The terms of lying-out and laying down are often used as synonyms. The older hunting literature is as a rule based on the assumption that red deer and roe deer are hiders. DATHE (1966), however, describes experience from the Berlin Zoo according to which new-born calves of the cervides (deer) are not laid down by their mothers but leave their mother **independently** and so are lying-out. For this purpose the calves are said to overcome considerable obstacles.

STUBBE and PASSARGE (1979) point out that hiding fawns remain lying in squat down position even in the case of human approach and can be marked during this time. Twin fawns lie down at a distance far away from each other. In the case of fallow-deer living in the wild, such as white-tailed deer and blackbuck also hiding has been described (ELISABETH MUNGALL, 1991).

ELKE SCHEURMANN (1974) observed lying-out with calves of black-coloured lowland cattle which calved at the pasture. Between the 2nd and the 5th day of life the calves at the lying-out place were particularly passive towards external influences (e.g. touching by man). The calves left the lying place only for suckling and subsequent playing. She arrives at the conclusion that „the calf of the European cattle at least during the first 4 days of life belongs to the hiders or at least takes a transitional position between the strict hiders, such as the cervides, and the followers...“

Own results

First observations were performed when clearing up the reasons for losses in suckler cow herds of different size of the breeds Charolais, Highland Cattle and cross-breeds, which were kept extensively at the pasture. Case examples were documented by photographs.

1st observation: At a standing pasture for suckler cows (cross-breed herd black-coloured x spotted cattle) the cows showed restlessness and formed up a directed motion towards a certain spot of the fence. There was a new-born calf outside the fence in a ditch with high stand of plants and tried desperately to get into the paddock. Although the fencing of the paddock consisted of an intact stationary fence with 4 wires and an electrical fence fitted in front of it the calf had slipped through this well protected fence.

2nd observation: In a smaller Charolais breeding herd which was grazing at a barren and stripped bare paddock the absence of a calf, which was born the day before, was noticed. After intensive searching the calf could be saved from a fenced out ditch filled with water shortly before drowning. Despite the electrical fence the calf had gone to the higher vegetation of the ditch edge, was then unable to keep balance on the slope and had slipped off into the water.

3rd observation: In a Highland Cattle herd of 45 cows, which is used at an extensive area for landscape care both an undisturbed and a severely disturbed process of the observed behaviour pattern could be documented. With constant regularity cows separate themselves from the herd before calving (LIDFORS et al., 1994). In the case observed a cow had calved at the edge of the pasture in front of the fencing and kept staying there. On the third day after birth it was noticed that the calf passed the fence from outside the pasture and went to its mother. Immediately after that the cow and calf returned to the herd which was staying at a distance of about 300 m. Here obviously the behaviour pattern of „Lying out“ could be performed in an undisturbed way.

In the morning another cow was observed when calving in an isolated place at the edge of the pasture. In the afternoon the animal had joined again the herd grazing at a distance of 150-200 m, but the calf could not be seen. When searching in the vicinity of the birth place the terribly lowing calf was found in a high strongly wetted vegetation of weeds and grasses about 15 m outside the pasture fence. The calf itself was fully wetted, shiffering and showed itself in a state of no orientation after it had been startled. The calf was rubbed dry and taken to the herd. The mother immediately got into nasoanal contact (PORZIG, 1969) and reacted extremely aggressively. The udder was fully swollen and strongly reddened. Cow and calf had to be separated again. Obviously the calf had removed too far from the fence when searching for a lying-out place, had become wet, had lost power and orientation and had not found the way back to its mother. The interrupted mother-child communication caused ceasing of sucking which caused weakening of the calf as well as pressure and pains in the udder of the mother. In the case reported the natural „lying out“ of the calf had caused a strong endangering of the calf and its mother.

Conclusions

New-born calves of cattle show the behaviour pattern of „Lying out“. For satisfying this need they require a cover, high grass, weed, reed, bushes, even unevenness of the pasture is accepted as cover. If a new-born calf does not find these preconditions at a pasture which is kept short by the cows then it will search for its lying-out place also outside the pasture. With the absence from the mother and leaving the pasture a series of risks are connected. The need of the calves of cattle for realization of the typical behaviour pattern of „Lying-out“ has to be taken into consideration by the animal keeper in the pasture management. The time and space structures of this behaviour are often not known or not known any longer to the cattle owners. They must be recognized and taken into consideration in the pasture management, otherwise impairments of the well-being of animals, performance diminishing, losses and an increased labour expenditure cannot be excluded.

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Activity and aggressive contacts of pigs transported at night or in the day time

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Summary

The aim of the study was to compare the activity and aggressive contacts of pigs transported during the night to those transported during the day. Ten night transports and ten day transports were studied. Ten pigs from each transport were videofilmed during the time they were in the lorry. The number of pigs lying, sitting or standing was recorded every two minutes from the tapes. Aggressive contacts were recorded continuously. After arrival to the lairage the activity of the pigs was recorded every two minutes for two hours by direct observation. Aggressive contacts were recorded from the video tapes continuously. In the preliminary results there was a significant difference in the frequency of aggressive contacts between night and day pigs. During loading day pigs were standing more and lying less than night pigs. During night transports the proportion of lying observations of all observations was two times higher than during the day transports. In the lairage pigs were lying and sitting less during the day than during the night. Differences in the activity and aggressive behaviour of night pigs and day pigs in lairage can be affected by the time of day but also by differences in the mixing grade, the humidity and the sex ratio in the night and day groups.

Key words: pig behaviour, aggression, activity, transport, lairage

Introduction

In Finland pigs are usually transported to the slaughterhouse at daytime. One Finnish abattoir company has now started to transport pigs at night as well. These pigs are the first to be slaughtered in the morning. The aim of the study was to compare the activity and aggressive contacts of pigs transported at night or daytime.

Material and methods

Ten transports at night and ten transports at day time were studied. "Night pigs" arrived at the slaughterhouse between 2 and 4 o clock in the morning and "day pigs" between 7 in the morning and 12 o clock in the day. The lorry and the two persons loading and driving were always the same.

The time pigs spent in the lorry during loading varied from 14 to 63 minutes. Driving time varied from 56 to 155 minutes. The behaviour of the animals was observed in three phases: loading (lorry not moving), during transport and during the time in lairage.

Ten pigs out of about 50-100 pigs transported each time were focal animals. The day before transport these animals were marked individually. Their sex and the pen the pig originated from were registered. The amount of pens the focal animals originated from is called mixing grade. The higher the grade the higher is also the amount of pens. For practical reasons the mixing grade and sex ratio could not be standardized.

Marked pigs were loaded into the pen in the front of the lorry. No other pigs were put in this pen. The space allowance was $0.43m^2$ per pig. The ten pigs were video filmed all the time they were in the lorry. From the tapes the amount of pigs lying, sitting and standing was recorded every two minutes. Aggressive contacts were recorded continously.

The following behaviour patterns were considered as aggressive behaviour (Jensen 1980, 1982): biting, head-to-head and head-to-body knocks (fast hits with the head towards another pigs head and body respectively), levering (or lifting of another pigs head or body with head) and parallell/inverse parallell pressing.

In lairage the ten pigs were put in a pen with aspace allowance of 0.53 m^2 per animal. The pigs were video taped during two hours after arrival at the lairage. Aggressive contacts were recorded from the video continuously troughout the two hours in the same manner as during the transport. The activity of the pigs was recorded every two minutes by direct observation during two hours after arrival.

Temperature and relative humidity were measured in the slaughterhouse.

Results

At the moment there are only preliminary results on activity and aggressive behaviour. There was differences in the activity of pigs at night and day. During loading day pigs were standing more and lying less ($p<0.05$) than night pigs. If the difference in mixing grade and the amount of castrated males in the night groups and in the day groups were taken into consideration there was no significant difference between the activity of "night pigs" and "day pigs".

During transport there was significant difference only in lying behaviour of "night pigs" and "day pigs". During the night the proportion of lying observations of all observations was two times higher than during the day ($p<0.05$). Difference was significant also when the difference in the mixing grade and the amount of castrated males in the night and day groups were taken into consideration. The lying and sitting behaviour was increasing when the amount of castrated males increased. The effect of castrated males on standing behaviour was the opposite.

In the lairage the difference between the activity of "night pigs" and "day pigs" was highest. During the day pigs were lying and sitting less ($p<0.05$) and stood more than during the night. When the difference in the mixing grade and the amount of castrated males in the night and day groups were taken into cosideration difference in the activity between night and day decreased and became slightly nonsignificant. Also in lairage lying behaviour increased and standing behaviour decreased when the amount of castrated males in the group increased.

In the lairage pigs were lying less when humidity was higher and the temperature lower.

In the lorry there was no difference in the amount of aggressive contacts between night- and day transports, neither during the loading nor during the transport. During loading the frequency of aggressive behaviour was highest, on an average of 65 aggressive contacts per hour. During the transport the frequency of aggressive contacts decreased to an average of 11 contacts per hour. The frequency of aggressive contacts in the lorry was not influenced by the difference in the mixing grade and the amount of castrated males in night and day groups.

In the lairage there was a significant difference ($p<0.05$) in the amount of aggresssive contacts between pigs transported during the night (an average of 12.5 aggressive contacts per hour) and pigs transported during the day (an average of 28.2 contacts per hour). In the lairage the frequency of aggressive contacts was significantly higher) when the mixing grade increased ($p<0.05$). The pigs in the night groups came from on an average of 4.1 crates and the pigs in the daygroups from on an average of 4.8 crates per group. The temperature and the relative humidity in the lairage influenced the frequency of aggressive contacts significantly ($p<0.05$).

During the night the relative humidity in the lairage was lower than during the day, while the temperature was about the same. During the day high humidity together with low temperature seemed to increase aggressive contacts. During the night there was no significant effect.

Conclusions

Differences in the activity of pigs during night and day pigs in lairage can possibly be explained by the time of the day but also by differences in the humidity and by the lower amount of castrated males in the night groups.

Higher amount of aggressive contacts in the lairage might be affected by the time of day but also by differences in the humidity and the mixing grade of night and day groups. During the day pigs are showered in the lairage when the temperature raises. This is not common during the night. Showering increases the relative humidity. Aggerssive contacts increased when humidity increased. It might be that pigs may react to the showering itself and not only to changes in the humidity.

Human activity in the lairage can also affect the activity and aggressive contacts of the pigs. During the day time there is more human activity, unloading and moving of animals than during the night.

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Evaluation of welfare in Holstain Frisian Cattle

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Summary

Clinical immunological and haematological parameters, along with clinical conditions and growth rate, were studied in 413 male Holstein Frisian calves introduced into a large centre for genetic selection in different seasons of the year. Abnormalities were revealed by the laboratory tests in the great majority of calves after the transportation stress, a general tendency to the restoration of physiological values being evident thereafter. Laboratory parameters were correlated with disease conditions: with 3 exceptions only, animals showed altered laboratory parameters some days before the occurrence of clinical symptoms. 18% of animals showed altered parameters with no obvious clinical signs of disease; yet, they experienced a reduced weight gain. Results suggest that clinical immunological and haematological parameters could be the foundation of a new, large-scale, robust approach to the control of welfare in cattle, which should be integrated preferably by a further range of records and measures.

Key words: immunological and haematological parameters, cattle, welfare.

Introduction

The rise of consumer concern over animal welfare during the past two decades has been dramatic. The issue is perceived most vividly with regard to farm animals; the latter are commonly kept in intensive herds under practices which challenge the animals' coping ability and affect animal welfare. Consumer pressure has thus resulted in the Agri-Food industry being forced to provide "welfare friendly" meat products. These demands occur in advance of a clear scientific definition or understanding of animal welfare and its relationship to stress, or the availability of reliable test procedures for assessment of animal welfare. In recent years, it has become evident that an intimate relationship exists between behaviour, stress, the neuroendocrine and the immune systems (Blalock, 1994). Thus we decided to investigate fundamental parameters of non-specific immunity and haematology in conjunction with clinical conditions and thriftiness in cattle; the aim of this study was to develop an integrated scheme for an objective evaluation of welfare on an immunological basis.

Materials and Methods

Animals.The study took place in a large Holstein Genetic Centre in northern Italy. Calves from all over Italy enter the Genetic Centre at the age of 6-7 months; they are introduced into a large quarantine holding and submitted to clinical surveillance and sanitary tests. *Sampling*. Blood samples in tubes with and without anticoagulant were collected from 413 calves during the quarantine period, 5-7 days after the arrival and 2-3 weeks later, respectively. *Laboratory tests*.The following parameters of non-specific immunity were investigated according to established procedures (Bonizzi et al., 1989; Ponti, 1989; Berneri et al., 1991): concentration and distribution of major serum proteins, total haemolytic complement, serum lysozyme, serum bactericidal activity, mitogen-driven lymphocyte stimulation. 10 haematological parameters (RBC, WBC, Hgb, Hct, MCV, MCH, MCHC; Plt, MPV, Pct) were assessed by a semi-automatic, electric impedance analyser. Data were checked for significant shifts from a range of physiological values, derived from both published results (Kaneco, 1991; Nemi, 1993; Rosemberger, 1993) and the authors' studies. *Evaluation of animals*. Animals were divided into the following groups: animals with (CS+) or without (CS-) clinical abnormalities during the quarantine period, animals showing laboratory parameters within the normal range in the second sampling (CIP-N), or with two or more laboratory parameters altered in both samplings (CIP-A), animals with weight gain within or beyond the expected range of 750-900 grams/day (WG-N) in the quarantine period and animals with weight gain below the expected range (WG-A).

Results

Results can be properly divided into three phases in order to highlight fundamental seasonal influences. The correlation among clinical conditions, weight gain and laboratory results in the three phases of the study is shown in **table 1**. The overwhelming majority of calves showed altered laboratory parameters at the first sampling, following the transportation stress; a tendency to the restoration of normal parameters was evident thereafter, the process being complete (CIP-N condition) in 40% of the animals at the second sampling. There was evidence that altered parameters preceded the disease events by some days. With the exception of three calves, all animals with clinical abnormalities also showed altered laboratory parameters within the above period of time. 18% of animals showed altered laboratory parameters with no obvious clinical signs of disease; yet, they experienced a reduced weight. Conversely, 22.7% of calves with reduced weight gain had normal laboratory parameters. There was strong evidence of seasonal influences on the disease events, which affected 30% (July-August, 2nd phase), 20-25%

(winter months of phases one and three) and 8.5 - 14% (mid seasons) of the calves. The obvious correlation between CIP-A and WG-A conditions (30% of calves in the three phases) was increased in the hot and cold seasons (54% of calves in these periods).

TABLE 1. Distribution of calves according to the experimental results

Phases	Season	CIP	CS+		CS-		Total
			WG-N	WG-A	WG-N	WG-A	
1th	Winter	A	7	13	35	42	97
		N	0	0	0	23	23
2nd	Spring-Summer	A	17	18	12	12	59
		N	1	1	31	46	79
3rd	Autumn	A	25(+2)*	19	30(+2)*	21	99
		N	1	0	23(+7)*	25	56

Every result is expressed in terms of number of calves.CS+: animals with clinical abnormalities during the quarantine period. CS-: animals without clinical abnormalities during the quarantine period. CIP-N: animals showing laboratory parameters within the normal range in the second sampling. CIP-A: animals showing two or more laboratory parameters altered in both samplings. WG-N: animals with weight gain within or beyond the expected range. WG-A: animals with weight gain below the expected range..()*: weight gain not determinated.

Discussion

The activity of the Genetic Centre of Holstein cattle is characterized by a fundamental concern for animal welfare, which is evidenced by the common husbandry practices. This reflected upon the rapid amelioration of haematological and clinical immunological parameters after the transportation stress. The transportation stress proved to be more or less detrimental in different seasons of the year; seasonal influences on the health status were also evident among the different groups under study. Most important, clinical immunological and haematological abnormalities were highly predictive of poor health conditions.The CS+ animals of this study should be viewed as subjects which did not cope successfully with the transportation stress and could not restore efficiently fundamental homeostatic functions thereafter. Even though the most dramatic cases of growth check occurred in our study among CIP-A animals, other cases were also recorded among CIP-N animals; this confirms that welfare should be assessed by a range of measures, since individuals vary in the consequences they suffer due to difficulty or failure to cope (Broom, 1986). In our opinion, such immunological tests can be substantially more robust and reliable for a satisfactory approach to animal welfare than hormone investigation or behaviour studies.

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Approval of housing systems for cattle and swine according to Norwegian regulations

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Summary

This paper describes Norwegian Governmental regulations for housing of cattle and swine. They include among others an approval systems to provide a basis for good health and well-being, and to ensure that animal needs are taken into consideration. To get approval of a product (pen fittings, cow trainer etc.), the product has to be evaluated by experts at the Norwegian Agricultural University and the Norwegian College of Veterinary Medicine to ensure that the product meets the requirements in the regulations. The evaluation is based on practical experience and reported results in the literature. If needed, supplementary practical tests have to be performed. The approval of new buildings or rebuilding on the farm implies that the plans have to be evaluated by the District Veterinary Officer (DVO) before the construction works can start. Furthermore, the DVO shall approve the project before the new housing can be taken into use.

Key words: regulations, approval systems, housing, cattle, swine

Animal Welfare Act and Animal Disease Control Act

The Norwegian Animal Welfare Act and the Norwegian Animal Disease Control Act are regulations which relate to animal welfare. The Animal Welfare Act, which cover all animal species, is of particular importance in this respect. One of the paragraphs (§ 4) states that all animals shall have appropriate housing according to the needs of the animals, but does not state any specific requirements. In another paragraph (§ 30), the Ministry is given power to make supplementary regulations regarding animal housing.

Regulations for housing of cattle and swine

Regulations for housing of cattle and swine under the Animal Welfare Act and the Animal Disease Control Act entered into force in 1992, and was revised in 1996. The aim of the regulations is to provide a basis for good health and well-being for cattle and swine and to ensure that animal natural needs are taken into consideration.

In these regulations specific requirements regarding housing and management are stated. Emphasis is put on functional traits with respect to the animals. Priority is given to systems which allow the animals free movements. For example, calves cannot be tied up before they are 6 months old, and dairy cows housed in stanchion barns shall be given possibility for exercise (preferably pasture) for a period of at least 8 weeks durng the summer season. In pig production, dry sows cannot be confined in stalls (all tethering is prohibited), and lactating sows can only be confined in crates for a period of 10 days at the time around farrowing.

In addition to these regulations, there is worked out a set of more detailed recommendations where stall dimensions, minimum floor area per animal etc. are given. These recommendations will be currently updated when needed.

Furthermore, the regulations include a system of approval of a) series-produced housing systems and installations and b) of new buildings or rebuilding on the farm.

Approval of series-produced housing systems and installations

Equipment made by the farmer for his own operation does not need to have a central authorisation, but still needs approval of the DVO (see later). Manufacturers or importers of series-produced housing systems and installations for sale will have to obtain an authorisation for each product. Authorisation is only required for systems and installations for cattle and swine, and not so far for hens, sheep, goat etc. All installations which will affect the well-being of the animals will actually be included in the authorisation system. Examples of products are stalls, tethering systems for cattle, boxes, farrowing pens, feed and watering devices, slatted floors, feeding barriers and cow trainers.

To get approval of a product, the manufacturer has to send an application to the Norwegian Agricultural Inspection Service. The application is evaluated by experts at the Norwegian Agricultural University and the Norwegian College of Veterinary Medicine to ensure that the product meets the requirements in the regulations. For each group of products, a set of specific requirements are listed based on the regulations and recommendations. The evaluation is grounded on practical experience and reported results in the literature. If needed, supplementary practical tests have to be performed.

Some products will be approved with specified conditions and requirements for the use and installation of the product. All approved products should be marked with the approval number.

A similar approval system has been running in Switzerland for several years (Steiger, 1988), with good results. The regulations in Sweden also mentions an approval system, but this is only required for «new» systems.

There are relatively few manufacturers of housing systems that supplies the Norwegian farms. Two main companies dominate the market for these products. The manufacturers welcome the authorisation system.

Getting approval of a product and the examination of the product has to be paid by the manufacturer or importer. The costs for authorisation for a product is stipulated to NOK 5000. However, if more basic research is needed to evaluate a new group of products/installations, the whole costs of this is not charged the applicants.

Since the capacity of examinations of products are limited, it has been necessary to make strict priorities for which group of products to be approved first. The use of cow trainers have been of special concern, and it is stated specifically in the regulations that all cow trainers should be approved. That is why cow trainers was the first group of products in the authorisation system. The next will be farrowing pens and then individual boxes for calves. Because of the limited capacity, it has also been necessary to give a transitional approval so that products could continued to be marketed pending on a permanent authorisation. Still, such products has to be approved by the DVO.

A consultative board will be established with representatives from the manufacturers, farmers, DVOs and the Ministry.

Approval of buildings or rebuilding on the farm

This system of approval implies that all new building projects, and also rebuildings, shall be approved by an official veterinary officer. The aim is to secure that factors related to animal welfare and disease control is taken into consideration in individual building projects. The veterinary officer shall control that the new housing meets the requirements in the regulations for housing of cattle and swine.

The DVO has been devoted this control function. There are 209 DVOs in Norway, and they work in close contact with the farmers. This is a condition which encourages a communication between the farmer and the veterinary officer before the project starts, and also during the project period. Training programs have been established to provide the DVOs a better professional background within the field of animal housing and management in relation to animal health and welfare.

The approval takes place in two steps. On the one hand, the DVO shall approve the new housing before it can be taken into use. But even as important, it is required that plans shall be approved before the construction work can start. This provision secures a dialogue between the farmer and the veterinary officer in beforehand, so that factors related to animal health and welfare can be evaluated in an early stage of the project.

Concluding remarks

The new regulations and approval systems represent an important step forward in securing the welfare of the animals in livestock production. Requirements regarding specific components of animal housing and management are specified, and systems are establihed to secure that these requirements are met.

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Motion sickness in pigs during transport: effects on meat quality

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Summary

This experiment examined whether concentrations of plasma LVP at exsanguination could be used as an indicator of which pigs were the most travel sick during transport and whether those pigs which exhibited behavioural symptoms of travel sickness had particularly poor meat quality. Fifty 90 kg slaughter pigs were transported on a lorry for 5h. RHB travelled in the main body of the vehicle scanning the individually marked pigs every 8 min for incidences of standing, lying and symptoms of travel sickness (sniffing, foaming at the mouth, chomping, retching and vomiting). Upon arrival at the slaughter house, pigs were unloaded, slaughtered immediately (with no time in lairage) and a blood sample was taken at exsanguination for analysis of plasma LVP. 24h after slaughter measures of meat quality were made (pHu, FOP and PQM) to allow assessment for PSE (pale, soft, exudative) or DFD (dark, firm, dry) meat. 13 pigs vomited or retched during the journeys. Correlations revealed no significant relationship between concentration of LVP and meat quality measures. The number of carcasses showing PSE or DFD in one or more muscle was 24 (of which 3 showed both). Travel sick pigs did not have poor meat quality.

Key words: motion sickness, welfare, transport, pigs, lysine vasopressin, meat quality

Introduction

Forsling *et al.* (1984) have shown that exposure to vibration and noise leads to raised concentrations of plasma lysine vasopressin (LVP) in pigs. In addition, it is known that nausea is associated with enhanced vasopressin secretion in man (Rowe, *et al.* 1979). It has also been shown that vasopressin release is stimulated in monkeys (Verbalis, *et al.* 1987) and pigs (Parrott, *et al.* 1991) following iv injection of cholecystokinin, a gut/brain peptide that induces emesis (Verbalis, *et al.* 1987; Parrott, *et al.* 1991). Recently it has been shown that pigs, even when not fed before transport, can exhibit symptoms of travel sickness and that these symptoms appear to be associated with elevated concentrations of plasma LVP (Bradshaw *et al.* 1996a).

We wished to establish whether concentrations of plasma LVP at exsanguination may reveal which pigs had been travel sick during the journey to slaughter and whether those pigs which display behavioural symptoms of travel sickness exhibited subsequent poor meat quality.

Materials and methods

Fifty 90 kg slaughter pigs were transported on a lorry (25 each day for two days, food withdrawn the previous evening at 1700) for five hours (0.49 m^2 per pig). On each of the two days pigs were loaded at 08.00 and transported in two groups of 13 (rear pen) and 12 (front pen) at a stocking density of 0.49m^2 per pig. This stocking density is lower than normal commercial practice due to constraints imposed by vehicle design.

RHB travelled in the main body of the vehicle throughout the journey (between the front and rear pen) scanning the individually marked pigs every 8 mins for incidences of standing, lying and symptoms of travel sickness (sniffing, foaming at the mouth, chomping, retching and vomiting). The physical vibration characteristics of the journey were measured using accelerometer equipment.

On each day, upon arrival at the slaughter house, pigs were unloaded, slaughtered immediately (with no time in lairage) and a blood sample taken at exsanguination, collected in 10 ml heparinised sample tubes ('Monovette', Sarstedt Ltd, Beaumont Leys, Leics.), for analysis of plasma LVP. Blood was centrifuged and the resultant plasma frozen in dry ice and subsequently stored at -30 °C pending analysis for LVP (conducted as described in Thornton *et al.* 1987).

24h after slaughter pHu, FOP and PQM were measured in one or more of three muscles (LD, SM, AD) to allow meat quality assessment for PSE (pale, soft, exudative) or DFD (dark, firm, dry) calculated according to Barton-Gade *et al.* (1996).

Behavioural records of travel sickness were related to concentration of LVP at exsanguination and subsequent meat quality.

Results

13 pigs vomited or retched during the journeys (26%) distributed approximately equally over the two days. If foaming and chomping is also included as a symptom of travel sickness the total number was 26 pigs (52%).

The journey was not a particularly rough one based on acceleration shock events compared with previous studies; 16 acceleration events compared with 52 during an 8h journey in Bradshaw *et al.* (1996b).

Correlations revealed no significant relationships between concentration of plasma LVP and meat quality measures.

The number of individual carcasses showing PSE or DFD in one or more muscle was 24 (of which 3 showed both). Travel sick pigs (individuals who vomited or retched) did not have poor meat quality (DFD or PSE; chi-squared test; $p > 0.05$ - see **Table 1** for DFD).

If foaming and chomping is also included as an unambiguous symptom of travel sickness (along with vomiting and retching) there was still no significant relationship between travel sickness and incidence of DFD or PSE (chi-squared test; $p > 0.05$ - see **Table 2** for DFD).

Table 1. Pigs which vomited/retched or did not vomit/retch vs. those showing subsequent DFD or no DFD meat quality.

Behaviour:	vomit/retch	no vomit/retch	Total
DFD	2	10	12
no DFD	11	27	38
Total	13	37	n = 50

Table 2. Pigs which [vomited/retched + foamed/chomped] or did not display these symptoms vs. those showing DFD or no DFD meat quality.

Behaviour:	[vom/retch+foam/chomp]	[no vom/retch+foam/chomp]	Total
DFD	5	6	11
no DFD	27	12	39
Total	32	18	n = 50

Conclusions

Concentrations of plasma LVP at exsanguination cannot be used to establish which pigs were the most travel sick during transport. Travel sick pigs did not have particularly poor meat quality.

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Measurement of sound-stress limit in swine depending on intensity and frequency of sound stimulus

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Summary

Investigation on the sound-stress limit in swine-function of sound stimuli frequence-were carried out on 10 adult females (batch A) and **16 females aged 3 months** (batch B) in separate shelters with on intensity of 50.5 dB(A) and 49.5 dB(B) respectively during repose; to these the animals displeyed normal behaviour.

In order to reveal the reactions to noise of higher intensity there were administred sound signals as freqvences significant with pigs: 40 Hz; 8,000 Hz; 16,000 Hz; 20,000 Hz with growing intensities, three minutes each and the animals' reaction was videorecorded. As significant response to a certain sound signal, on highly altered behavoiur (TRM) with at least half of the animal number in the batch was taken accountable.

At 40 Hz, TRM shows up at 85 dB, with both batches; at 8,000 Hz at 75 dB, 80 dB respectively; at 16,000 Hz at 85 dB, with both batches and, at 20,000 Hz (ultrasound band) at 90 dB, 95 dB respectively. Stress reactions are accompanied by increase in cortisol by 34%, and 19% respectively. The ponderal average of noise inducing the alarm reaction is at 83 dB(A), encountered only accidentally in pig houses.

Key words: swine; noise stress; behaviour; cortisol.

Introduction

Noise is a major polluting factor in animal houses (Plaff, 1974) by its affecting all phisiological structures and mechanisms of the organisms (Heinemann, 1992). In common shelters one may encounter an average level corresponding to ceaseless noise, i.e., 61.3 dB(A) for 24 hrs., with au utmost of 93 dB on a frequency of 62 Hz (Drăghici 1994) and the swine have the auditory perception stimuli of 34 Hz up to 34,000 Hz with a maximum of sensitivity at 8,000 Hz (Heffner, 1982).

On exposing swine to increasing noise levels. their behaviour alters significantly (Talling, J.C., 1996) along with increase in catecholamine and glucocorticosteroids (Kemper, 1976). On passing begond the normal adrenalin and cortisol level by 15% (Kanenko, 1980), swine will find themselves in the first stage of stress, the alarm reaction (Stephens, 1980). In order to identify the threshold of inducing stress, in the pressent report the behaviour alterations have been correlated with the biochemical ones on various sound intensities generated in frequencies significant to swine.

Material and Methods

The investigations were carried out on ten adult females (batch A) and 16 females aged 3 months (batch B), in separate shelteres. At first, a sonometer was used to determine the level of extant noise in the sheltering spaces. The noise here was of 50.5 dB (Batch A), and 49.5 dB(B) respectively. The behaviour of animals was videorecorded; it was absolutely normal. In order to reveal reactions to stronger noise, there were produced sound signals at desired frequency, generated by a transmitter coupled with an intensity amplifier and four loudspeakers, oriented towards the animals. Frequencies significant to swine were chosen: 40 Hz (lower limit of auditory perception in swine); 8,000 Hz (highest frequency of auditory perception); 16,000 Hz (the top of sound field); 20,000 Hz (first octave in ultrasound field).

Starting from the level of 50 dB extant in sheltes, for each freqvency of transmission, the sound intensity was increased with 5 dB spread for 3 minutes. During the last 10 seconds of each signal, the behaviour of animals was videorecorded. The behavioural reaction of animals as measured against nomal, was considered as: slightly modified (+); medium modified (++); highly modified (+++). We took for significant response to a sound signal the highly modified behaviour (TRM) with at least 50% of animal per batch. In order to reveal the biochemical stress there were collected 5 blood samples at repose-noise level and after 15 minutes from introducing TRM in the batch, and out of these, cortisol was determined by fluorimetric method.

Results and Discussions

The ponderal average level of repose noise within the limits of human auditory perception has close values (50±0,5 dB) in the two shelters. The assessment of swine behaviour after the administration of sound signals, based on video recordings, one can discern TRM function of frequency and intensity of the signals adrninistred (**Table 1**). On frequency of 40 Hz, TRM is induced in both batches at 85 dB; at 8,000 Hz, at 75 dB (batch A) and 80 dB (batch B); at l6,000. TRM shows up at 85 dB in both batchs, and with 20,000 in the ultrasound field it makes its presence perceptible at 90 dB (batch A) and 95 dB (batch B). TRM comes up with the same intensity or with minor differences in pigs in the two batchs with higher receptivity in young pigs. Noise within the range of audible frequencies alter the behaviour of animal at lower intensities, comparably with those in the ultrasound field. Cortisol values in repose at 50 dB(A) was of 2.5 µg/dl in batch A, 8.7 µ/dl in batch B. so that at 8,000 Hz and 75 dB it be of 4.4 µg/dl, 11.2 µg/dl respectively, representing au increase by 34% and 19% respectively. By accepting that an increase beyond 15% in cortisol we can assert that we are facing a biochemical stress and there results that the sound level inducing TRM coincides with the moment of alarm reaction in the batch.

The ponderal average of noise intensiveness inducing TRM at frequencies with significant influence to swine is at 83 dB(A). From the measurements on noise levels in shelters of all swine categories in intensive raising there results that the level of 83 dB(A) is reached only in boar shelters for short duration, so that the risk of triggering auditory stress in swine in current exploitation is fairly low.

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Table 1. Behavioural reaction to addaed noise in swine.

Behaviouralreaction to added noise in swine

Table 1

Hearing signal: Generated frequency (HZ)	Hearing signal: Hearing sound level (dB)	Modified behavioural reactions intensity	Animals that react (%) Lot A	Animals that react (%) Lot B
40				
	55	+	0	0
		++	0	0
		+++	0	0
	60	+	0	0
		++	0	0
		+++	0	0
	65	+	60	0
		++	0	0
		+++	0	0
	70	+	30	0
		++	10	0
		+++	20	0
	75	+	10	50
		++	30	0
		+++	10	0
	80	+	30	12,5
		++	10	12,5
		+++	40	37,5
	85	+	0	0
		++	30	25
		+++	**70**	**75**
	90	+	10	0
		++	30	25
		+++	60	62,5
	95	+	20	0
		++	10	25
		+++	70	75
	100	+	10	0
		++	10	25
		+++	90	75

Hearing signal: Generated frequency (HZ)	Hearing signal: Hearing sound level (dB)	Modified behavioural reactions intensity	Animals that react (%) Lot A	Animals that react (%) Lot B
8 000				
	55	+	30	37,5
		++	30	12,5
		+++	0	0
	60	+	40	25
		++	20	12,5
		+++	0	12,5
	65	+	70	0
		++	10	37,5
		+++	20	37,5
	70	+	20	75
		++	30	12,5
		+++	20	12,5
	75	+	20	0
		++	10	25
		+++	40	**75**
	80	+	0	0
		++	30	12,5
		+++	**70**	75
	85	+	10	0
		++	20	0
		+++	70	100
	90	+	10	12,5
		++	0	0
		+++	90	87,5
	95	+	10	12,5
		++	10	12,5
		+++	80	50
	100	+	20	25
		++	0	0
		+++	80	75

Hearing signal: Generated frequency (HZ)	Hearing signal: Hearing sound level (dB)	Modified behavioural reactions intensity	Animals that react (%) Lot A	Animals that react (%) Lot B
16 000				
	55	+	20	0
		++	0	0
		+++	0	0
	60	+	30	0
		++	20	25
		+++	10	0
	65	+	60	0
		++	10	0
		+++	0	12,5
	70	+	30	0
		++	10	37,5
		+++	40	0
	75	+	30	25
		++	20	50
		+++	20	0
	80	+	30	25
		++	30	12,5
		+++	40	37,5
	85	+	10	12,5
		++	40	37,5
		+++	**60**	**50**
	90	+	0	12,5
		++	30	25
		+++	60	62,5
	95	+	0	0
		++	20	0
		+++	80	100
	100	+	30	25
		++	0	0
		+++	70	75

Hearing signal: Generated frequency (HZ)	Hearing signal: Hearing sound level (dB)	Modified behavioural reactions intensity	Animals that react (%) Lot A	Animals that react (%) Lot B
20 000				
	55	+	0	0
		++	0	0
		+++	0	0
	60	+	0	0
		++	0	0
		+++	0	0
	65	+	50	0
		++	0	0
		+++	0	0
	70	+	30	0
		++	0	0
		+++	0	12,5
	75	+	40	12,5
		++	0	25
		+++	10	25
	80	+	20	12,5
		++	20	37,5
		+++	0	0
	85	+	10	0
		++	30	25
		+++	30	37,5
	90	+	20	37,5
		++	40	12,5
		+++	30	**50**
	95	+	0	37,5
		++	40	0
		+++	**60**	62,5
	100	+	0	37,5
		++	20	12,5
		+++	80	50

SEMNIFICATION: + = low modification of the behavioral reaction; ++ = medium modification of the behavioral reaction; +++ = intense modification of the behavioral reaction.

Acoustic phenomena stressful to animals

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Summary

Animal reactions to sounds emitted as a sign of warning, sygnalling or in order to paralyse the possible victim of a predator are commonly known. The study of the frequency, length and intensity of those sounds could be useful for noninvasive frightening away rodents and other pests. With the help of measuring equipment presently used it is possible to measure the acoustic wave propagation in the atmosphere of the frequency from 1 Hz to about 100 kHz and the use of digital computer techniques allows the recording and analysing of impulses which last within the ms range. The investigation of the effect of short lasting impulse stimuli present additional difficulties and request the introduction of equipment recording the peception of reaction to those stimuli in the equivalent time intervals. The method used in the present investigation consists in the recording of reflexes with video technique with the simultaneous marking of the time of acoustic stimulus emission and the merit of this method is the possibility of a precise association of stimulus and reaction.

Key words: stress, acoustics, animal environment.

Introduction

Many technical, biological and natural objects generate sound and vibration signals which affect living organisms in a way which has not been fully defined yet. A negative effect of certain ranges of acoustic waves of a high magnetic intensity on living organisms has already been noted. One can also observe animal reactions to sounds emitted as in order to warn, sygnal something or paralyse the possible victim of a predator. The knowledge of the frequency, length and intensity of those sounds could be useful for noninvasive frightening away rodents and other pests.. The majority of the hitherto obtained results refer to the effect of sounds on human organism and they are almost automatically transferred to animals using the same comparative scale. The resulting error may refer to both the range and the intensity level of receiving acoustic stimuli, the animals can receive acoustic stimuli within a much wider frequency range and may react to much lower acoustic intensity and to impulses of a very short duration. With the help of currently used measuring equipment one can measure the acoustic waves propagating in the air of the frequency from 1 Hz to about 100 kHz and the use of digital computer techniques allows the recording and analysing of impulses which last within the ms (microsecond) range. The present investigation is an attempt at chosing the newest measuring techniques including computer recording and analysis of signals in the investigation of acoustic phenomena in the animal environment and at determining the stresful ranges of acoustic phenomena.
The investigations aimed at:

- selecting phrases-impulses out of natural animal sounds which can be used to frighten away, warn or paralyse other animals;
- testing new methods of measuring the recordings and analysing the acoustic phenomena on the basis of digital computer analyses,
- determining of the significance of stressful acoustic stimuli and their parameters,
- working out a set of stimuli for frightening the rodents away,

Material and methods

The scope of investigation The study of the spectrum of animal voices for the presence of acoustic parameters necessary for warning, frightening away or paralysing other animals. The investigations will include the folowing stages:

- building a collection of voice fragments (sound phrases) recording with the equipment allowing their precise processing and spectrum analysis,
- analysis of the spectrum of sonic phrases chosen from the voises emitted by animals for a defined purpose,
- an attempt at selecting sonic phrases or chosen impulses in order to study the effect of those stimuli on the livestock or their use for frightening the rodents away.

The investigation of animal reactions to the chosen sonic stimuli. Here the following stages are intended:

- working out of a method of recording the externally perceived reactions to the chosen parameters of acoustic stimuli,
- choosing the methods of eliminating other factors adulterating the effect of the investigated parametres on animals,
- study of reactions to the combined stimuli, reducing and intensifying the effect of the basic parameters,
- an attempt at choosing other (other than external) reactions confirming the effect of stimuli on the animal organism in a reliable way.

The applied method and equipment used In order to investigate the spectrum of animal voices for the presence af acoustic parameters used for warning, frightening away or paralysing other animals, a set of equipment was used which included:

- a sound intensity meter equipped with a microphone for the ultrasound range,
- an analogue-digital processor,
- a notebook with the PCMCIA card.

The investigations of animal reactions to the sonic stimuli of a stressful character are controversial because of the differences in the methods which have been used so far. The studies of the impulse stimuli of a very short duration cause additional difficulties and require the use of equipment recording the perception of reaction to those stimuli in the equivalent time intervals. The method used in the present investigation consists in the recording of reflexes with video technique with the simultaneous marking of the time of acoustic stimulus emission. That method allows a quite limited evaluation it does not allow the assessment of the degree of a biological and physiological result of the organism reaction to that stimulus and its merit is the possibility of a precise association of the reaction and stimulus.

The set of equipment used in the investigations includes:

- a set for a precise emission of acoustic stimuli,
- a video camera with remote control which marks the time of emission of the successive sonic stimuli,
- a laboratory computer ser for processing the recorded material.

Introductory results

Acoustic signals within the full measuring range of the sound intensity meter (0-130 dB) and frequency from 20 Hz to 50 kHz are measured with the help of the above mentioned equipment. The connection with a computer allowes the recording of interesting signal fragments for the laboratory spectrum analysis. The analyses of the spectrum of animal voices recorded in the situations indicating the states of stess excitation could be compared with other voices recorded in similar situations.The main aim of these analyses is the selection of sonic phrases emitted by animals in the states of excitation. A precise recording and analysis of fragments of those voices and their repeated emission in the surroundings of animals may confirm the significance of the selected fragments as the stressful agent. The research was performed on fragments of spectra of animal voices of a very short emission time or comprising a phrase of a different, i.g. very high key. These sonic phrases are emitted within the frequency range inaudible for man and thus they are difficult to perceive.

Conclusions

The present investigations which have been performed for the last 3 years allowed the elimination of some problems and the confirmation of others, e.g.:

- there are significant individual differences in the animal population and it is very difficult to select typical groups of sounds which are stressful for a certain population,
- most animals show reactions to stimuli of high sound intensity most animals react more intensively to sounds of a high key,
- a particular sensitivity to certain frequency ranges can be defined for a given population, however, the intervals are wide because of individual sensitivity and it is very difficult to define the, so called, threshold pressures for animals and the, so far, applied methods of investigations are not precise,
- most of breeding animals and pests show some adaptative traits and after some time they do not react even to high levels of continued acoustic emissions, the mechanism of that is not known, it may be connected with the TTS syndrome (temporary threshold shift), PTS (permanent threshold shift) or auditory fatigue phenomenon; the phenomenon of "delaying" the reaction to stimuli may be observed in some animals and not in others,
- the reaction to the "impuls" stimuli isolated from the sonic phrase is observed in most animals,
- so far, only the effectiveness of using some chosen phrases of guinea fowl voices to frighten the rodents away have been proved (T.Kolbuszewski et al. 1996).

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EVALUATION OF STRESS, SKIN DAMAGE AND MEAT QUALITY OF PIGS TRANSPORTED IN THE NIGHT AND THE MORNING

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Summary

No significant difference was found in blood creatine kinase (CK) activity between pigs transported in the night and the morning (1172 and 1904 units/litre, respectively). Carcasses of pigs transported in the night were more often clean (no damage) than those transported later in the morning. However, the difference was not significant. The frequency of damage was highest in the back and shoulder. As a result, extreme skin damage was common in the shoulder. Futhermore, the frequency of damage increased with prolonged lairage time. Therefore, the recommended lairage time should be one to two hours. The occurrence of PSE carcasses was 5.7 %. Moreover, pigs transported in the morning had higher PSE frequency than those transported in the night (6.2 and 5.3 %, respectively). In conclusion, the results showed that night transport was less stressful for pigs than morning transport.

Key words: pig transport, porcine stress, skin damage, meat quality

Introduction

It is well known that loading, transport, unloading and lairage can be stressful for pigs unless properly handled. Especially high temperatures, the use of electric prods and mixing of unfamiliar animals will result in decreased animal welfare and meat quality (Lambooij and van Putten 1993). There are no studies that compare pig transport in the night with transport in the daytime. The purpose of this study was to compare the effect of night transport and morning transport on porcine stress, pig skin damage and meat quality.

Material and methods

The material consisted of 873 pigs of which 367 were transported in the night (loading at midnight and unloading at about 4 a.m.), 412 in the morning (loading at about 6 a.m. and unloading at 8 - 9 a.m.), 35 in the daytime and 59 were held overnight in lairage. All pigs were transported in the same vehicle in 20 deliveries, 10 in the night and 10 in the morning. At each farm 60 - 100 pigs were loaded first at midnight and then in the morning of the same day. A group of 10 animals from the same farm was loaded, transported and then unloaded in the same pen. After two hours lairage time all pigs were slaughtered.

Porcine stress was evaluated by the blood CK activity of 100 pigs at slaughter (Honkavaara 1988). Skin damage of the shoulder, middle (=back) and ham of 873 carcasses was assessed 30 min p.m. (Barton Gade *et al.* 1996). PSE status ($pH_1 \leq 5.80$) was measured in the M.longissimus dorsi (LD) 45 min p.m.

Results

Pigs transported in the night had a lower stress level than those transported in the morning. This was shown by the CK values of the former and latter group, 1172 ± 973 and 1904 ± 2724 units/litre, respectively. However, due to the wide variation, this difference was not significant.

Table 1 shows that the occurrence of clean carcasses was higher in pigs transported in the night than in those transported in the morning, 4.7 and 3.0 %, respectively. The frequency of damage was highest in the back, both in the back and shoulder and only in the shoulder independent of the time of transport. Extreme skin damage occurred especially in the shoulder of pigs transported in the morning (7.4 %) whereas ham sustained very little damage. However, the difference in the amount of damage suffered by the transport groups was not significant.

In general, an increase in shoulder damage resulted in more back damage ($P<0.05$). This suggests that pigs bite first on the shoulder, then on the back and last on the ham. The frequency of damage was also found to increase with prolonged lairage time. Therefore, the recommended lairage time should be one to two hours, which improves animal welfare and carcass quality.

The 10 pigs transported and held in a separate pen in lairage had a higher frequency of clean carcasses than those held in pens of 60 - 100 animals (8.2 and 4.2 %, respectively). In general, the former pigs showed less damage if they were transported in the night compared to morning transport.

There was no significant relation between blood CK activity and pH_1 value of LD.

The occurrence of PSE carcasses was 5.7 %. PSE frequency was higher in pigs transported in the morning than in those transported in the night (6.2 and 5.3 %, respectively).

Conclusions

The results of this study show that night transport was less stressful for pigs than morning transport. In the former case pigs showed lower CK activity at slaughter, less skin damage and lower PSE occurrence than in the latter case.

Table 1. Evaluation of skin damage in pigs transported in the night and morning on a four point scale: no damage (1), slight damage (2), considerable damage affecting quality (3) and extreme damage with possible rejection of tissue (4). Ten deliveries in both groups.

Skin damage	Skin damage of transport group, %		
	In the night	In the morning	Average
No damage	4.7	3.0	4.2
Back:			
slight	26.6	23.7	25.8
considerable	14.5	18.2	15.3
extreme	5.7	3.5	4.3
Back and shoulder:			
slight	4.8	4.9	4.6
considerable	9.9	10.2	11.0
extreme	5.7	5.1	6.3
Shoulder:			
slight	3.9	3.8	4.0
considerable	2.4	3.2	2.9
extreme	4.6	7.4	6.2
Shoulder and flank:			
slight	0.9	1.1	1.0
considerable	2.9	2.6	2.4
extreme	7.6	5.0	5.6
Back and flank:			
slight	0.7	0	0.5
considerable	1.7	1.5	1.6
extreme	0.8	2.0	1.2
Back and ham:			
serious	0.2	0.6	0.3
Flank:			
slight	0.4	1.2	0.7
considerable	1.2	1.7	1.3
extreme	0.8	1.2	0.8
Total	100	100	100

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Housing of veal calves: assessment of welfare in two-calf pens compared with individual crates and four-calf pens

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Summary

The aim of the study was to compare the different components of welfare in 2-calf pens and in individual crates or 4-calf pens. A total of 118 calves was assigned in the three housing systems from one week until 22 weeks of age. Animals were bucket fed a milk replacer iron deprived. Behaviour, cortisol responses to transport, haematological and biochemical parameters, performances and health were investigated. In pens, calves were observed more often standing than in individual crates and their major activity consisted in licking material; they spent more time with their four legs bent than in crates. In 2-calf pens, the stretching of forelegs was more frequent than in other systems. After handling, transport and waiting at slaughter, cortisol responses were lower both in 2 and 4-pens than in individual crates ($P < 0.01$). Blood parameters, daily gains and pigmentation of carcasses were independent of the housing systems. In the conditions of the study, the low number of dead or eliminated animals did not allow to demonstrate any difference between treatments; other health parameters did not show conclusive differences. From the results, it is suggested that 2-calf pens could be an acceptable compromise between individual crates considered as impairing social interactions and inducing higher levels of stress and collective pens leading to increased health troubles in consequence of less easy individual observations.

Key words: veal calves, animal welfare, two-calf pens.

Introduction

In France, largest European producer of veal with 250,000 tons in 1994 (IFFA, 1995), calves are mainly raised in individual crates. From the minimum standards for the protection of calves kept for farming purposes laid down by the 91/629 European Directive, group housing should be preferred to avoid the isolation of individually housed animals. In order to alleviate undesirable aspects of individual crates (Webster et al. 1985; de Wilt 1985), as well as those of collective pens (health problems: Smits and Ham 1988; Broom 1991, Hochard and Kleinhout 1991), two calf-pens obtained by removing the partition between two adjacent crates were studied. The aim of the study was to evaluate the incidence of that new housing system on the different aspects of welfare and its potential interest to improve the well being of animals in comparison with individual crates and four-calf pens.

Material and methods

A total of 118 males Friesian veal calves, 1 week old, was housed the same day in two experimental units (A and B), respectively 68 animals in A and 50 in B. Animals were assigned in both units to one of the three following systems:

- individual crates (i.c),	81 cm x 170 cm,	n = 40 (40 x i.c);
- two calf pens (2.p),	145 cm x 207 cm,	n = 34 (17 x 2.p);
- four calf pens (4.p),	290 cm x 207 cm,	n = 44 (11 x 4.p).

Calves were not tethered and they were bucket-fed a milk replacer twice daily, with an iron concentration of 40-50 mg/kg during the first 5-6 weeks of rearing and of 10 mg/kg thereafter.

Direct individual observations were performed every 15 min between 10 a.m and 2 a.m. (with a blank of 4 hours between 4 p.m. and 8 p.m.) at 18 and 22 weeks of age. Every 15 min, an instantaneous observation of each calf was performed, according to a scanning method describing different activities and postures (de Wilt, 1985).

Plasma was collected by venipuncture at 7 a.m the day before the removal of calves and at the slaughterhouse before stunning as calves had undergone various stressful situations. Plasma cortisol was assayed by enzyme immuno assay (EIA) as described by Morisse *et al.*(1995). On blood collected before removal (22 weeks), haemoglobin concentration (Hb), and iron concentration were assayed by spectrophotometry.

Average daily gain and weight of carcasses were determined. Pigmentation of carcasses was measured by means of a photometer (CR 300 Minolta) at the *Rectus abdominis* muscle.

Plasma concentrations of aspartate amino transferase (ASAT), gamma glutamyl transferase (GGT) and bilirubin were investigated by enzymatic reactions using spectrophotometry (Ciba Corning Express 550).

Mortality was recorded and morbidity was estimated from frequency of animals individually treated with antibiotics. At slaughter, abomasal lesions and ruminal hair balls were investigated.

Data which fit a gaussian distribution were analysed through analysis of variance. Skewed data were converted into dichotomous variables and then analysed by logistic regression.

Results

Calves kept in pens by 2 or 4 were more often standing than calves individually housed. The main activity was the licking of material which was observed more frequently in 2 or 4.p. Self grooming, tongue playing and chewing were not significantly related to housing systems. The observation of lying postures gave evidence that in 2.p and 4.p, calves spent more time with four legs bent and less with hind legs stretched than did calves in individual crates. In 2.p, calves stretched their forelegs more often than did calves in other systems. In crates, the 4 legs stretched posture was observed less frequently than in 2 and 4 calf pens. After handling, transport and waiting at slaughter, cortisol responses were higher in individually than in group housed calves (26.6 *vs.*18.1 and 16.7 ng/ml, $P < 0.01$).

Blood parameters related to plasma iron as well as ASAT, GGT and Bilirubin were independent of housing systems.

Daily gains, carcass weights and characteristics of pigmentation were not influenced by housing treatments.

Frequency of individual medications and abomasal lesions were not different between treatments but the percentage of calves with ruminal hair balls was significantly lower in 4.p. Only 3 calves died or were eliminated in the course of the study: 2 in individual crates and 1 in 4-calf pens.

Conclusions

From the results of the present study, it is obvious that the incidence of the housing system on the welfare of veal calves depends on the studied parameters and it appears that none of the studied systems can offer animals the best level for each of the different components of welfare.

Within the range of space allowance studied (1,5 m² per animal in pens), it is clear that "2" or "4" pens did not change decisively the behaviour of animals except a best stretching of forelegs observed in 2 calves pens. Undoubtedly the cortisol responses to stress was lower in 2 and 4.p. than in individual crates, suggesting a less aversive environment in collective pens.

Haematological values and performances were independent of housing systems. Health controls were not conclusive in our study; however, other studies and field observations attest a higher level of mortality when animals are not individually housed.

From the results of the present study, it is suggested that 2 calf pen could be an acceptable compromise in terms of housing. In such cases, calves are in an environment more adequate for exercise, exploration and free social interaction than when individually housed.

Activity of animals and stretching of their four legs when lying are equivalent in 2 and 4 calf pens, but higher than in individual crates. In 2 calf pens, the better stretching of their forelegs seems to indicate that fear to be stepped on is reduced. In 2 calf pens, cortisol response to handling and transport was similar to 4 calf pens and lower than in individual crates.

The individual sanitary monitoring being easier in 2 animals than in a group of 4, it is suggested that the possibility of early detection of disease could be improved in comparison with collective pens; nevertheless, further investigations would be necessary to assure it and to determine the optimal size and surface of such pens.

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STUDY ON THE NUTRITION-RELATED BEHAVIOUR OF SHEEP UNDER VARIOUS MANAGEMENT CONDITIONS

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Summary

A study was conducted on the behavioural responses of sheep, Tsigai breed, subjected to various management conditions (kept in covered enclosures or under grazing system of penning).

The grazing system type was found to affect strongly the taste preferences to grass. Taste was highly exacting in abundant pasture; in restricted and regulated pasture taste selectiveness was very weakly manifested.

High environmental temperatures changed the behavioural pattern of sheep, too.

The physical state of fodder and the ration composition exercised a considerable effect on the nature of nutrition-related behaviour. In sheep fed on granulated fodder the number of rumination spells was low, the duration of each rumination spell decreased as well as the total duration of rumination, which entailed decreased number of chewing movements compared to sheep fed on hay and non-granulated concentrate ration.

Key words: behaviour, technologies, nutrition.

Introduction

Nutritional motivation has an impact on all animal activities and is dependent on the management system, the feeding rhythm (Mihaltsov and Stepanova 1982) and the physical form of fodder (Sivkova 1979, 1995).

The problems of animal behaviour are particularly important in dealing with the global issues of preservation, rege4neration and sensible utilisation of the fauna under conditions of intensive human activity.

According to Tinbergen (1978) and Conlon (1987), behaviour includes the various modes of motion or change plus complete immobility. Behaviour is a complex of the reactions of an organism related to the structure and function of the nervous system.

A number of researchers (Shoven 1972, Tasev 1982, Krysl et al. 1993) have found that the amazing capability of organisms to perceive external influence is basically regulated by external factors, that is an animal is similar to a machine automatically responding to the outer world.

Animal behaviour is related to both external and internal (hormones, receptors) factors which, in turn, are affected by a number of conditions, such as the seasons with their macro and micro parameters.

In relevant literature there is scarce evidence of the existence of clearly manifested limits among the specific behavioural patterns. Therefore the need of studying some aspects of the nutrition-related behaviour of sheep as an element of their general behaviour under different management systems. The objective of the study was to compare the results and chose between the management systems tested with regard to the better satisfaction of the biological motivation of the specific aspects of the nutritional behaviour of sheep.

Materials and Methods

The study utilised Tsigai breed of sheep equalised in age and weight. The animals were allocated in three groups and subjected to different management systems.

Group 1 consisted of ewes and their offsprings until weaning including young lambs for breeding purposes. The average productivity per sheep and the total production of a flock depended on the productivity of each ewe and the management conditions employed. The grazing period lasted 210 days, followed by 155 days of winter feeding hay and silage on the central plots. Concentrated fodder was fed only to hoggets after weaning and during winter. During the transitory period up to the complete regeneration of pastures, the ewes received 32-52 kg of concentrate.

The trial group 2 was reared on a farm with 1000 ewes, 30 rams, 250 female lambs for breeding purposes and 750 lambs for fattening. The commercial task of the farm consisted in producing meat and wool on the basis of more efficient utilisation of rouphage, green mass and pastures. Mixed grazing and penning system of management was employed with ewes kept together with their young until weaning. Lambs for breeding and fattening were weaned at the age of 3.5 months. Feeding in winter was inside pens or in the yard, in mangers, and in the summer - on the pasture field. Generally, food consisted of hay, silage, concentrated fodder and grazing.

The basic purpose of the trial group 3 was to fully utilise slopes and on-productive land excluded from the cultivated land resources. In winter, ewes were reared in pens and driven to graze on non-snowing days; in the mornings and evenings they were fed concentrated fodder and hay depending on the availability of winter grazing. During the penned rearing period, ewes were kept in semi-open pens with small walking yards provided.

The effect of three ration types was examined. The rations contained different amounts of concentrated fodder (in granulated and powder form) and hay:

- Trial group 1- 90% of meadow hay (grazing) + 10% of concentrated fodder (powdered);
- Trial group 2- 10% of meadow hay (grazing) + 90% of concentrated fodder (powder and granulated);
- Trial group 3 - 50% of meadow hay + 50% of concentrated fodder (granulated).

Animal behaviour was recorded individually for each flock through timing of behavioural elements during three periods each lasting per 3 days. The elements of nutritional behaviour subject to observation were as follows: time for feeding and rumination, number of ruminating spells, time from beginning of feeding to beginning of ruminating, dry matter consumed. Also, the times for lying and standing of sheep were recorded.

The ethograms obtained were processed according to the method of Petit (1969).

Results and Discussion

Through visual observation it was found that all three groups of animals, regardless of the management techniques, showed preference to plants with good palatability. When grass was abundant and pastures were large enough, thick and low-stem grass types were preferred. The grazing system definitely had an impact on the taste preference of sheep. When grazing was restricted and controlled, taste preferences were less strongly manifested.

High temperature periods resulted in definite slowing down and interruption of pasture grazing of sheep.

Evidence from observation of sheep behaviour in group 1 showed that food intake lasted 391 min (27.15% from the 24-hour day) (Table2). Animals in trial group 2 were considerably faster in taking in the concentrated fodder - 164 min (11.59%). The greatest appetite and fastest ration intake was observed in group 3 - 128 min (8.89%).

The key factor in the duration of food intake is the amount of dry matter, according to Conlon (1987). In our study the these amounts were544 g, 781 g and 808 g for groups 1, 2, 3 respectively. The difference in consumption of groups 2 and 3 was probably due to the presence of equal amounts of hay and concentrated fodder in the rations of group3.

The animals in group 1 commenced rumination 107 min after the beginning of fodder intake; in group 2 commencement was considerably belated - 160 min. In group 3 rumination started after 172 min and often did not occur at all in the morning hours.

Evidence shows that the shorter the feed intake period, the shorter the rumination. Group 1 completed rumination in 581 min (40.35%), group 2 - 300 min (20.83%) and group 3 in 220 min (15.28%).

On analysing the daily dynamics of rumination the following rumination cycles were observed: morning, pre-lunch, afternoon, evening and nightly, with almost the same numbers of ruminations spells for groups 1 and 2- 23 and 20, respectively. In group 3 the number of rumination spells was smaller - 18. Each rumination spell lasted from 1 to 81 min with no significant differences observed among groups.

The longest nutritional activity, 972 min for feed intake and rumination, was manifested by sheep with rations of 90% meadow hay; it was shorter lasting for sheep on concentrate rations and shortest , 462 min, for group 3.

Longer nutritional activity is associated with high values for the index of rumination (the time, in minutes, necessary for ruminating of 100 g of dry matter) - 106.8 min/100 g of DM (group 1), 38.4 min/100 g of DM (group 2) and 27.2 min/100 g of DM (group 3).

The physical characteristics of fodder and the composition of the ration exercise an impact on the nature of nutritional behaviour. Studies point to lower number of rumination spells for sheep fed granulated fodder (trial group 3), decrease of both the duration of each rumination spell and the number of chewing movements in comparison with sheep fed hay and powder concentrate (groups 1 and 2). Therefore, the more easily digestible the fodder and the higher its energy efficiency, the longer the rumination spell (trial group 2 featured longer standing and lying periods).

Conclusions

Rations with higher percentage of meadow hay were taken in the course of 391 min (27.15%) and ruminated for 581 min (40.35%). Shorter nutritional activity (feed intake and rumination) was observed after feeding concentrate - 164 min (11.39%). Longer nutritional activity was associated with higher values of the rumination index.

The DM consumption was less for rations containing higher percentage of hay - 544 g, greater for concentrate rations - 718 g, and greatest for rations with average contents of concentrate.

The relative percentage of the basic behavioural elements such as standing, rest, rumination and walking featured longer duration in sheep fed concentrate type of ration.

The physical form of fodder in rations exercised an impact on the nutritional behaviour of sheep.

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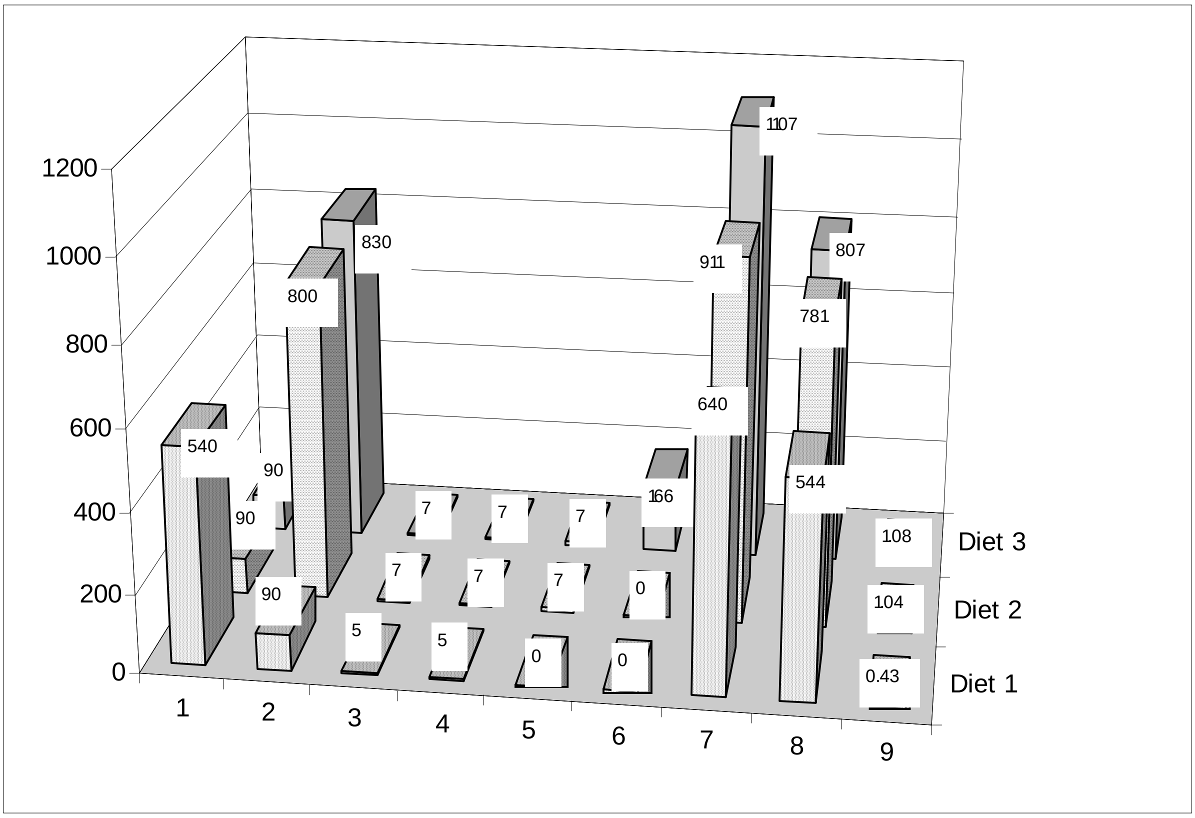
Table 1.

EATING BEHAVIOUR OF SHEEP

Item	Period	DIET 1 90 % meadow hay		DIET 2 90 % concentrate mixture		DIET 3 Diet 2 + PVC	
		min	&	min	&	min	&
Eatind	day	250	17.36	108	7.50	93	6.46
	night	141	9.76	58	3.89	35	2.43
	total	391	27.15	164^{c}	11.39	128^{c}	8.89
Ruminating	day	259	11.99	124	7.64	73	5.07
	night	322	22.36	176	12.22	147	10.21
	total	581	40.35	300^{c}	19.86	220^{c}	15.28
Standing	day	71	4.93	180	12.64	208	14.44
	night	69	4.79	168	12.22	184	12.78
	total	140	9.72	349^{a}	24.86	392^{b}	27.22
Resting	day	139	9.65	308	21.68	346	24.03
	night	189	13.13	319	22.08	354	24.58
	total	328	22.78	627^{c}	43.76	700^{c}	48.61

a<0.05, b<0.01, c<0.001 - levels of significance for 2nd and 3rd group compared to the 1st

Fig. 1 Actual forage intake



1-Meadow hay	2-Concentrate mixture	3-Salt	4-Urea	5-Limestone
6-PVC	7-total	8-Dry Matter	9-FU	

The dependence of the dairy cows' heart rate upon their behaviour

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Summary

Stationary rhythmograms (RG - a temporary sequence the elements of which are the duration of sequential heart cycles) of 71 cows containing up to 1200 heart cycles were registered during the following behavioural patterns: standing, eating hay, eating vegetables, eating concentrates, lying, moving, milking, stripping, standing after milking, standing and waiting in the automated station of concentrate feeder. RG were previously processed and analysed by special program packages. The following parame-ters characterizing RG were calculated: pulse rate and the average value of heart cycle, standard deviation, dispersion, the number and frequency of periodical variables and each variable's part in general dispersion, the heart rhythm disturbances and their quantitative analysis.

The heart beat frequency and the rhythm reflected the variation in the functional needs of the organism and psychological state of the animal at different behavioural categories. Depending upon the behaviour and emotional state, the dairy cows' heart beat frequency may change 26% (usually 65-85 beats/minute). There were also reliable differences among standard deviations of RG and periodic oscillations in the structure of various RG. The variation of the heart rate influenced by the behaviour can be used for the assessment of the cows' adaptation and welfare.

Key words: cow, heart rate, behaviour

Introduction

Heart rate is influenced by different regulation mechanisms (sinoatrial node, autonomic nervous system, higher nervous system, hormonal effects) and the frequency of heart contractions reflects the activity of functioning of the organism. As a result of the activity of regulation mechanisms, fluctuations and waves of different period have been observed in the heart rate. The multiplicity of the wave structure reflects the complicated character of mechanisms regulating the functioning of the organism (Bajevskij 1979, Bajevskij et al. 1984). Consequently, heart rate as a complicated physiological parameter contains in itself the information about the physical and emotional load of the organism and its state of health. This is why different mathematical methods have been used in analysing heart rate (Antila 1979,Bajevskij et al. 1984, Clabough et al. 1989). The results of the mathematical analysis of the heart rhythm characterize the state of regulatory systems and demonstrate the necessary efforts for adaptation.

The task of the present study was to reveal the normative indicators of heart rate depending upon the animal's behaviour and to establish the heart rhythm's dependence upon behaviour.

Material and methods

Experiments were carried out in 4 groups, using cows (all in all 71 animals) of different production level and kept in different technological systems (free stall technology with automated concentrate feeding systems, tied housing technology) in midday and at 3-6 p.m. The cow's electrocardiograms (ECG) were registered and RG formed by bioradiotelemetrical system connected with a personal computer. RG were previously processed and analysed by special program packages. The following parame-ters characterizing RG were calculated: the average pulse rate, the average value of heart cycle, standard deviation, dispersion, the number and frequency of periodical variables and each variable's part in general dispersion, the heart rhythm disturbances and their quantitative analysis (Praks et al. 1988, Praks et al. 1994). The length of RG varied between 250--1200 heart cycles. Shorter RGs (beginning from 70 cycles) were registered only during stripping and in case of movement.

The investigated animals were characterized by the following behavioural patterns :

standing, standing and waiting in the automatic concentrate dispenser, eating concentrates, eating hay, laying, milking, stripping, standing after milking, moving voluntarily (>0.5m/s). Examples of the heart rate's dependence upon the behaviour of 2 experimental groups have been given in **Table 1**.

The variation of the functional needs of the dairy cow's organism in case of different behavioural categories is reflected in the heart beat frequency and the rhythm. When standing calmly the dairy cows' heart beat frequency is on the average 71–75 beats/minute (the duration of the heart cycle is 0.844–0.801 s). Depending upon the behaviour and physiological state, the dairy cows' heart beat frequency may change 26% (usually 65–85 beats/minute, the duration of the heart cycle 0.930–0.704 s respectively). In assessing the heart rate we must take into consideration the animal's individuality. The variation of the duration of heart cycles in the rhythmogram is characterized by standard deviation (s), the normal value of which is 0.028–0.038 s (variation coefficient v=3.5 – 4.5%) when standing. Among periodical changes there are more over 40 s period oscillations in the heart rhythm, especially when eating concentrates and vegetables. The importance of the oscillations with the period lower than 6 s has considerably increased when lying, sometimes during milking. Clinically healthy animals may have occasional rhythm disturbances (blocks, extrasystols).

Table 1 The relation between heart function and behaviour

Free stall technology (~ 5700 kg milk per cow a year)

Status	R_R1	R_R2	s1	s2	P1%	P2%	P3%	P4%
Standing	0.801	100	0.028	100	79.7	9.6	6.6	4.1
Stand. cd.	0.760	94.9	0.036	128.3	96.1	0	0	3.9
Eating c.	0.756	94.3	0.022	79.4	47.9	45.3	0	6.8
Laying	0.908	113.3	0.021	74.9	49.9	24.6	2.4	23.1
Milking	0.816	101.9	0.022	79.4	80.4	2.5	9	8.1
Stripping	0.843	105.2	0.017	61.0	41.2	26.3	16.3	16.2
Moving	0.704	87.6	0.033	119.2				
Stand. am.	0.789	98.5	0.026	93.3	83.5	0	11.4	5.1

Tied housing technology (~9000 kg milk per cow a year)

Standing	0.815	100	0.031	100	56.4	22.9	15.2	5.5
Eating h.	0.808	99.1	0.032	103.2	85.1	0	12.30	2.6
Eating c.	0.715	87.7	0.038	122.6	87.2	0	10.8	2
Laying	0.855	104.9	0.029	93.5	31.4	35.1	4.6	28.9
Milking	0.804	98.6	0.023	74.2	48.2	6.4	31.8	13.7
Stripping	0.809	99.3	0.024	77.4				
Stand. am.	0.838	102.8	0.023	74.2	66.1	7.4	15.4	11.1

Status: Stand. cd. - standing in the automatic concentrate dispenser

Eating c. - eating concentrates

Eating h. - eating hay

Stand. am - standing after milking

R_R1 - average cardiac interval (s) of RG

R_R2 - cardiac interval, % from R_R1 at standing

s1 - standard deviation of RG

s2 - standard deviation, % from s1 at standing

P1% - oscillations with period >40 s, their part in the general dispersion of RG (%)

P2% - oscillations with period 20-40 s, their part in the general dispersion of RG (%)

P3% - oscillations with period 6-20 s, their part in the general dispersion of RG (%)

P4% - oscillations with period <6 s, their part in the general dispersion of RG (%)

Conclusion

The variation and rhythm of the heart rate of the dairy cows in connection with their behaviour must be considered during the animal's investigation and the assessment of its adaptability and welfare.

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The effect of algorithms in automatic concentrate feeding on the behaviour of dairy cows

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Summary

Computerized systems for feeding concentrates to dairy cattle in loose housing technology differ mainly in the algorithms of the programs which guide the logic for the distribution of the food. Two automatic feeding systems with different programs were tested in the groups of dairy cows, experienced with the feeding routine. The studies were focused on behavioral pattern in relation to concentrate feeding station and diurnal rhythms in behaviour. In two experiments the distribution of concentrates was controlled by cyclic program (fixed-time algorithm) and in two experiments by interval program (this program limits the amount of concentrates in the time interval). 3-day observations were carried out. The analysis demonstrated, that circadian patterns of feeding and ruminating, lying and motion activity were affected by concentrate feeding algorithms. The role of feeding programs was highly significant in formation of concentrate consumption pattern.

Key words: automated feeding of concentrates, feeding routine, behavioural patterns

Introduction

Dairy cows are typical herd animals, being active during the day and resting at night, while synchrony of behaviour is pronounced. The usage of automated concentrate feeding systems creates a situation, where the traditional feeding at fixed times can be replaced by a flexible concentrate feeding routine based on the round-a-clock availability of the system, where the cows have to report individually (Winter et al. 1995).

Dairy cows have an ability to learn quickly while adjusting to new equipment and environmental changes. According to Livshin et al. (1994) cows easily adapt to a proposed feeding regimen. Wierenga and Hopster (1991) found that different feeding systems evoked a typical pattern of visits to a feeding station.

The aim of the present investigation was to determine the influence of the concentrate feeding algorithm on the behavioural patterns of dairy cows.

Materials and methods

Data were obtained at the experimental station of Piistaoja, where a group of Estonian Black-and-White dairy cows (17-19 cows) were fed concentrates with automatic feeding system (CFS). It was the intention to use experienced with feeding routine animals. Four 3-day observation experiments were carried out. In two first experiments the distribution of concentrates was controlled by fixed-time algorithm (CP - cyclic program, allocation of concentrates from 6.00 a.m. to 10.00 p.m., cycles began at 6 a.m., 10 a.m., 2 p.m. and 6 p.m.) and in two last experiments by interval program (IP). In this algorithm (Praks et al. 1988) the principles of feed back and information treating are used. In parallel with allocated and obtained amounts of concentrates per day, the amounts of concentrates, obtained during last 3 hours, are saved as well. The amount of allowed concentrates is calculated for the cow at the moment of using dispenser by algorithm: $y = X - [x_k \times f(t_k) +....+ x_n \times f(t_n)]$

y - allowed amount of concentrates, kg,

X - for the time interval (e g 3 hours) determined amount of concentrates, kg. It depends on the feeding conditions and the individuality of an animal,

$x_k...x_n$ - amounts of concentrates, the animal has obtained during last 3 hours, kg,

$t_k...t_n$ - the time till the end of 3 hours. If an animal gets the amount of concentrates x_n, then t_k =180 (minutes) and the value of t_k decreases a unit per minute. Consequently, after 3 hours t_k=0. Two values are assigned to $f(t_k)$: if t=1...180, $f(t_k) = 1$; if t=0, $f(t_k) = 0$. Consequently, if t>0 $x_k \times f(t_k)=x_k \times 1=x_k$, if t=0, $x_k \times f(t_k)=x_k \times 0=0$ and in determining y x_k is not taken into account. By this algorithm cows get concentrates till the allocated amount of concentrates is equal to obtained amount of concentrates per day.

Concentrates were available from 4,30 a.m. to 00 p.m., some “problem” animals got concentrates in the mean time as well. The method of total observation, i e continuous recording of behaviour of the cows was used. Average behavioural patterns per one cow were calculated. The possibilities of correlation analysis (Pearson correlation matrix, matrix of Bonferroni probabilities) were used to determine correlation between behavioural patterns.

Results

Six correlations between average behavioural patterns in four experiments were calculated. Results are presented in **Table 1.**

Table 1. Pearson correlations and *Bonferroni probabilities* between behavioural patterns

Behaviour	**1-2 exp**., CP-CP	**3-4 exp**., IP-IP	**1-3 exp**., CP-IP	**1-4 exp**., CP-IP	**2-3 exp**., CP-IP	**2-4 exp**., CP-IP
Lying	0.858 *0.000*	0.719 *0.000*	0.791 *0.000*	0.670 *0.002*	0.577 *0.019*	0.481 *0.103*
Eating	0.755 *0.000*	0.822 *0.000*	0.642 *0.004*	0.551 *0.032*	0.470 *0.124*	0.343 *0.603*
Ruminating	0.852 *0.000*	0.755 *0.000*	0.628 *0.006*	0.475 *0.114*	0.621 *0.007*	0.370 *0.449*
Locomotion activity	0.631 *0.006*	0.538 *0.040*	0.876 *0.000*	0.575 *0.020*	0.535 *0.043*	0.329 *0.696*
Time at the CFS	0.739 *0.000*	0.641 *0.004*	0.715 *0.001*	0.343 *0.604*	0.511 *0.064*	0.234 *1.000*
Concentrate consumption	0.605 *0.010*	0.702 *0.001*	0.401 *0.313*	0.155 *1.000*	0.221 *1.000*	0.336 *0.654*

There were five significant high value correlations between lying patterns. The allocation of concentrates by IP from 10 p.m. to 6 a.m. did not reduce total lying time in this period (312, 283, 290 and 283 minutes per cow, respectively).

Roughage feeding patterns were determined by traditional 2 feedings per day at fixed times. However, high significant positive correlation (P<0.001) occurred only between 1-2 and 3-4 experiments. From four correlations between experiments, in which concentrate allocation was led by different algorithms, only two were significant (P<0.005). The same tendency characterizes ruminating activity patterns.

Reduced correlation values characterized correlations between locomotion activity patterns. From six correlations were significant (P<0.05) five.

From six correlations between time spent at the concentrate feeding station (CFS) were significant (P<0.005) correlations between experiments, in which concentrate allocation was led by the same algorithm and one correlation between experiments, in which concentrate allocation was led by different algorithms (CP-IP, r=0.715).

From correlations between concentrate eating patterns significant (P<0.01) were only correlations between experiments, in which concentrate feeding was leaded by the same algorithm. This indicates a good adaptability of dairy cows to concentrate feeding routine and signifies the role of feeding algorithm in the feeding management.

Conclusion

The concentrate feeding algorithm affects the cows' behaviour patterns. The most stable is lying pattern. Cows fitted their visits to the concentrate feeding station without "losses" in the lying time. Circadian patterns of feeding and ruminating were more affected by concentrate feeding algorithms. Locomotion activity pattern seems to be relatively "independent". The role of concentrate feeding algorithm is significant in the formation of concentrate consumption patterns.

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The behaviour of Turkeys under the influence of different systems of floor management

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Summary

The behaviour of the birds were observed with the aim of determining the influence of grate, a combination of grate and bedding (1/2 of the surface grate and 1/2 with bedding) and bedding floors on: production, activity of birds during feed intake drinking of water, movement and resting.

It was observed that WAMA-1 turkeys behaved differently on the floors that were used. At twelve weeks of rearing on the combined floor, the least amount of turkeys ate feed and they spent the least amount of time on this. While they tended to spend most of their time resting. After 20 weeks, turkeys reared on grate had the lowest body weight, rested for the longest period of time, and the least amount of birds participated in feeding, but they spent twice as much time at the feeders than from the two other groups. The birds showed a distinct difficulty in moving on the grate floor. While those reared on the combined floor were found to be mainly on the bedding part of the floor.

Based on observation of the behaviour of WAMA-1 turkeys and also production results, it can confirmed that the rearing of averaged sized turkeys for longer than 20 weeks, should not be carried out on grate.

Key words: turkeys, type of floor, grate, bedding, behaviour, feed intake, water intake, movement, body weight

Introduction

Knowledge of behaviour patterns can only lead to improvement of rearing methods. Provision of optimal environmental conditions allows for manifestation of productive capabilities and other possibilities that domestic animals may genitically possess. Bedding floors can bring certain behavioural patterns to light in poultry, which might be essential for their general comfort. A lack of such possibilities in pens or on grate could lead to frustration and may have a negative influence on fattening results. There are not a lot of studies that describe the behaviour of turkeys using alternative rearing systems, instead of bedding. Especially where production performance and health are concerned.

These observations were aimed at determining the influence of usage of different floors on production and activity of birds during: feed intake, drinking of water, movement and resting.

Material and methods

Observation of rearing of medium-sized turkeys of WAMA-1 crossed breed, reared on three different types of floor:

- grate (group I), the entire surface made from a metal mesh of 3 mm thick wire and 20 x 20 mm holes;
- combined (group II), 1/2 of the surface of metal mesh and 1/2 of bedding;
- bedding (group III), the whole surface covered with straw bedding.

Three video cameras used for observation. The cameras were mounted over the pens and 180 minutes of recording was done. Recordings were done twice: in the 12th week, when both sexes were together and in the 20th week, when only males were observed. Nobody entered the enclosers during the recording time, whitch allowed for registration of natural behaviour. Analysis of behaviour involved: feed intake, drinking of water and movement of turkeys. After recording, the activies were analysed per one minute periods, with attention paid to the number of birds involoved in: feeding, drinking and walking. After that, the time duration of the analysed activities was summed up.

Results and discussion

In the 12th week the average body size of the turkeys was similar in all groups (**table 1**). Group II turkeys had a slightly lower body weight (4.99 kg). In the group with a combination of both floors, it was observed that the turkeys ate the least, and the shortest period of time was spent on eating (4.8% of turkeys for 119 secs.) and drinking (1.4% for 34 secs.); and they moved around the pen the least (7.2% for 32 secs.). They moved around mainly to find a place for resting, or to go to the feeders or drinkers.The birds tended to be mainly on the bedding part of the floor, as there were few on the grate. During the time of observation, the turkeys did not feed from the feeders hanging over the grate part of the pen. Some of the birds rested while in a standing position. There were no difficulties in moving nor was there any pecking of each other.

In the group whit the bedding floor, there were the most birds, with an average weight of 5,33 kg, feeding at the same time (7.9% for 139 secs.). They moved around willingly (11.1% for an average of 50 secs.) and showed interest in each other, walking around flopping their wings. They were evenly spreaded out in the entire pen and there were cases of head pecking.

Turkeys reared on grate spent the longest period of time feeding. They spent 6.7 seconds feeding together. Birds in this group moved mainly to get to the feeders and drinkers, or to change their resting places. They spent the shortest period of time on this activity (average of 29 secs.). It was observed that some of them moved about with difficulty (deformation of the hock joint), while the others moved with distinct caution. Ther were also cases of head pecking.

In the 20th week male turkeys were observed. The average body weight of males in group I (10.39 kg) and group III (10.98 kg) was different ($P<0.05$).

In the group with the bedding floor, there were the most turkeys feeding at the same time (6.2 birds on average, for 86 secs.) the lowest number of birds moving around the pen and it was for the longest period of time (26.6% for 71 secs.). The males moved around willingly, showed interest in one another, ruffled their feathers but there were no fights. There was a lot of pecking just like in the 12th week.

In the group reared on grate there was the lowest number of male turkeys that were feeding at the same time, but this was for the longest time (2.6% of birds for 155 secs.). The time spent on drinking was also the lowest (1.8% for 60 secs.). There was hardly any movement of birds in this group, only (6.7% for 33 secs.). The birds did not search for resting places, and most of them just sat in the vicinity of the feeders and drinkers. In group I there were the most birds with damaged legs (sprained hock joints, swollen toes), whitch is the reason for the following difficulties: supporting themselves on wings, loss of balance and staggering. They hardly showed and interest in each other and quite a small number of turkeys ruffled their feathers. Similary, in a study done by Bessei (1992), it was observed that broilers reared on grate spent more time reasting and feeding. However, this study did not reveal whether the type of floor influenced movement and drinking activity.

Turkey cocks reared on a combination of grate and bedding spent most of the time on the bedding part of the floor and obviously fed from feeders hanging over this part of the pen. The birds walked around for an average of 36 seconds, hardly showed any mutual interest and was the lowest number of birds ruffling their feathers. Hughes (Duncan 1992) made it possibile for chicken hens to choose between bedding and mesh floors, and observed that there was no strong preference of floor type. Inspite of this, 88% of eggs layed on the bedding part of the pen.

Conclusions

1. The group with the grate and the combination of grate and bedding floors were the least favourable for production.
2. The least movement was among the turkeys reared on grate, which indicates that this type of floor was not really acceptable.
3. Birds reared on a combination of grate and bedding preferred bedding.

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Table 1. Influence of floor type on behavioural activity of WAMA-1 turkeys in the 12th and 20th week of rearing

Details	12th week of rearing			20th week of rearing		
	Floor type			Floor type		
	grate (I)	combined (II)	bedding (III)	grate (I)	combined (II)	bedding (III)
Feed intake %	6.7	4.8	7.9	2.6	3.6	6.2
Water intake %	1.5	1.5	1.8	1.8	2.3	2.3
Movement %	8.8	7.2	11.1	6.7	19.1	26.6
Feed intake sec.	162	119	139	155	82	86
Water intake sec.	34	39	44	60	51	58
Movement sec.	29	32	50	33	36	71
Body weight kg	5.24	4.99	5.33	10.23[a]	10.29	10.98[b]
Feed consumption kg/kg	2.58	2.16	2.44	3.38	2.94	3.01

a,b - $P<0.05$

AIRBORNE ENDOTOXIN IN ANIMAL STABLES: LEVELS AND SOURCES

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Summary

Levels of airborne endotoxin and numbers of viable airborne gram negative bacteria were measured in several cattle and one poultry farm. Concentrations of airborne endo-toxin did not exceed a suggested threshold level for men, when estimated during normal work periods. However, considerable high concentration could be expected during special activities in stables, like removal of manure. Main sources of airborne endotoxin should be manure and dust on stable surfaces. No correlation was found between con-centration of airborne endotoxin and numbers of viable airborne gram negative bacteria.

Key words: airborne endotoxin, airborne gram negative bacteria, animal stables

Introduction

Gram negative bacteria and their cell envelope lipopolysaccharides (endotoxin) are present in a wide range of organic dusts. Endotoxin concentrations up to 2µg/m³ have been demonstrated in the air of cotton cardrooms (Haglind et al. 1981) and up to 1,42µg/m³ during poultry handling (Thelin et al. 1984). Inhalation of organic dusts contaminated by endotoxins has been associated with the development of subjective symptoms and transient or chronic lung function impairment in workers as well as with the development of several occupational chronic obstructive bronchial diseases (Rylander et al. 1985). The present study was performed to obtain information on the airborne endotoxin concentrations in cattle and poultry farms. Further, total numbers of viable airborne gram negative bacteria were estimated.

Material and Methods

Stables studied: Five cattle stables and one poultry house were studied. A description of the stables is given in **table 1**.

Determination of endotoxin levels and numbers of airborne gram negative bacteria: Airborne endotoxin was collected by using AGI-30 impingers (All Glas Impingers, Brachmann 1964, used in the cattle farms) and the dust sampling system PGP (Ströhlein GmbH; Germany, used in the poultry house). Furthermore the amount of endotoxin in potential sources for airborne endotoxin

- feed, manure and dust on stable surfaces - was estimated. Samples were analyzed for endotoxins by using a Limulus amebocyte lysate test (QLC-1000, BioWhittaker, Walkersville, Md). The number of gram negative bacteria was measured by using AGI- 30 impingers as well as 6-stage Andersen samplers (Andersen 1958). Samples were cultivated on McConkey agar for 48 h at 37°C under aerobic conditions. Grown colonies were screened for Gram reaction using „KOH assay" described by Burkhardt et al. (1992). Samples were collected during normal work periods in all stables. Furthermore concentrations of airborne endotoxin in the poultry house were measured during manure removal.

RESULTS and DISCUSSION

The present experiments were designed to obtain data on airborne endotoxin levels in animal stables. Furthermore the relationship between concentrations of endotoxin and number of viable airborne gram negative bacteria was evaluated.

Both methods, impingement and dust sampling, are suitable to estimate airborne endotoxin levels in animal stables. Determination of airborne endotoxin levels by using AGI-30 impingers offers the possibility to estimate the number of airborne bacteria simultaneously whereas by dust sampling relationships between dust and endotoxin levels could be investigated.

The total amount of airborne endotoxin in the cow stables ranged from 36 to 761 EU/m³, in the calf stables from 44 to 262 EU/m³ and in the poultry house from 96 to 520 EU/m³, when estimated during normal work periods (**Table 2**). That is equivalent to a concentration of 3,6 to 76,1 ng/m³, 4,4 to 26,2 ng/m³ and 9,6 to 52,0 ng/m³ (One endotoxin unit is defined as the biological activity by LAL-assay of 0,1 ng of U.S. Reference Standard Endotoxin; *E. coli* O 113: H10:K - negative, lot number EC-5). These levels did not exceed a suggested threshold level for men of 200 ng/m³ (Lacey and Dutkiewicz 1994). However, endotoxin concentrations could increase considerably during special activities in the stables. We found up to 358,5 ng/m³ airborne endotoxin during removal of manure in the poultry house. Main sources of airborne endotoxin should be manure followed by dust on stable surfaces and feed (**Table 3**).

Although endotoxin was detected in all samples, viable airborne gram negative bacteria were not always present. In general only a small number of viable airborne gram negative bacteria were isolated in each stables. This could be the consequence of a short survival period for many airborne gram negative bacteria (e.g. Müller et al. 1980). An cumulation of endotoxin should occur in the dust, both on stable surfaces and in stable air, as the endotoxic activity persists even after death of bacteria. Therefore the determination of viable airborne gram negative bacteria is unreliable as an indicator of airborne endotoxin concentration and the relationship between dust and airborne endotoxin needs to be investigated. However, it has to take into consideration, that different sources of airborne dust could have different amounts of endotoxin.

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Table 1: Description of studied stables

stable	animals	layout of stall	animal places	litter	ventilation system
1	sucking calves	tying stall	72	-	fan forced
2	weaned calves	loose housing	50	-	window ventilation
3	dairy cows	tying stall	120	-	shaft ventilation
4	breeding cows	tying stall	240	-	shaft ventilation
5	sucking cows	loose housing	2000	straw	shaft ventilation
6	layers	battery (4 flours)	44000	-	fan forced

Table 2: Concentration of airborne endotoxin...

Table 3: Mean concentration of endotoxin...

Table 2: Concentration of airborne endotoxin and numbers of gram negative bacteria in the studied stables estimated during normal work periods (EU = endotoxin units, cfu = colony forming units, N = number of samples)

stable	N	endotoxin in EU/m³ mean	endotoxin in EU/m³ range	gram negative bacteria in cfu/m³ mean	gram negative bacteria in cfu/m³ range
1	5	91	44-156	1040	0-3200
2	5	238	202-262	618	0-1625
3	5	237	36-761	2220	0-8500
4	5	180	70-281	400	0-2000
5	5	199	98-283	800	0-2000
6	5	230	96-520	8	0-28

Table 3: Mean concentration of endotoxin and gram negative bacteria in manure, dust on stable surfaces and feed (EU = endotoxin units, cfu = colony forming units, N = number of samples)

source	N	endotoxin in EU/g			gram negative bacteria in cfu/g		
		manure	dust	feed	manure	dust	feed
stable 4	2	$1{,}1 \cdot 10^{6}$	$4{,}5 \cdot 10^{5}$	$4{,}7 \cdot 10^{5}$	$6{,}1 \cdot 10^{7}$	$1{,}4 \cdot 10^{5}$	$2{,}0 \cdot 10^{4}$
stable 5	2	$1{,}0 \cdot 10^{6}$	$3{,}9 \cdot 10^{5}$	$2{,}9 \cdot 10^{5}$	$9{,}0 \cdot 10^{4}$	$2{,}3 \cdot 10^{5}$	$1{,}0 \cdot 10^{3}$
stable 6	4	$2{,}1 \cdot 10^{6}$	$5{,}8 \cdot 10^{5}$	$2{,}8 \cdot 10^{4}$	$9{,}0 \cdot 10^{6}$	$4{,}9 \cdot 10^{6}$	$1{,}6 \cdot 10^{5}$