RESEARCH OF PHYSICAL AND CHEMICAL ENVIRONMENTAL FACTORS AND THEIR INFLUENCE UPON COWS KEPT AT COLD COW-HOUSES

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INTRODUCTION

It is known that just from animals which are kept in healthy and good conditions it is possible to get qualitative and high-quality production. Lately very important is welfare of dairy cows regarding the export of production joining the European Union. The welfare is connected both with the cow keeping, feeding, care and milking and provision of microclimate in cattle-shed. The cows shall be fed with an appropriate daily portion regarding their physiological condition, shall have access to appropriate clean, drinking water regarding to sanitary rules. The care of the cows shall not raise too high stress, make pain and traumatism. The indicators of microclimate in cattle-shed (air humidity, temperature, gas concentration, ventilation frequency, amount of dust, light etc.) shall promote physiological process of cows (2, 4, 6). There are used different solutions in cow keeping. If 20–30 years ago it was dominant to leash the cow in European countries, then lately more popular is to not to leash the cows in boxes, kombi-boxes, on sloping floor or deep litter. It is possible to keep the cows in so-called cold cattle-sheds, whose construction costs are less than 20–50% (3).

It is necessary for animals to have a lot of fresh and dry air. That is the reason why the premises shall be with the appropriate capacity and good ventilation. The cows are not disturbed because of low weather temperature (around 0^{o}C) or fresh air flow, but humid air and draught is dangerous. It is important to assess the quality of air in appropriate place, where the cows are sleeping or standing. The initiators of illness are bred in warm and humid premises; meanwhile the cows are under the stress (1, 2, 4, and 5). Due to unfavourable changes of microclimate, the productivity of animals can be decreased by 20 = 30% as well as animal protection against diseases can be decreased. (2). It is observed that the cows which are constantly in places with 30 mg/m^3 or higher ammonia concentration in the air of cattle-shed can have even anaemia, decreased reserve of blood alkali and bad usage of nutrients. As a result milk yield is dramatically decreased.

The cattle-shed No 1 of dairy cows shall be planned for 106 cows in unleashed keeping 2.20 m x 1.20 m in boxes with feeding rack, parturition zone and place where to keep calves of different ages. There is milking parlour with fir-tree shaped milking hardware, milk cooling device as well as the staff room situated in the middle of long wall in the cattle-shed. Reinforced concrete construction columns of the moving parts in cattle-shed and folding metal ceiling framework. External walls are made of aerated concrete panels, but the terminal wall of the building are made of ceramsite blocks. The stone-wool shall be used in order to insolate the ceiling. The floor within the zone of feeding and droppings aisle made of concrete, but box sleeping-places as litter is used coarse sand, which is added of necessity around twice a week.

There shall be built a special herringbone type milking parlour for 2 x 5 cows for milking. There the cows are situated next to each other obliquely against the trench. For milking places on the one side of trench there are common entrances and exit gates, therefore the cows in milking places are let in and out by groups.

Drinking bunks (one per 15 cows) shall be situated at the end of box rows in order to water cows.

Dung shall be brought out with tractor machinery once a day. Draining canals and slurry well shall be installed for collecting slurry. Ventilation system of tubes with pipes of exhaust fumes shall be functioning within the farm. However, fresh outdoor air shall enter through windows and specially installed opening in the cornice part. The artificial light luminescent electric bulbs – 2 x 36 W situated in 3 groups; 11 bulbs in each. During the night – pilot light (blue light 40 W bulbs).

Stall No 2 of milking cows with the way of tied keeping is constructed in 1975 as a complex of milking cows with finished production cycle for 400 cows. There are 200 milking cows situated in isolated block in stall. The construction of cattle-shed shall be columns of reinforced concrete with folding ceiling framework of reinforced concrete metal. External walls shall be built of bricks in which there are designed main doors. There is automatic water bunk in the stall – one bunk where to drink per two cows. Each cow row has its own vacuum-tube and milk tube. Withers bar for cow fixation shall be in height of 1.05 m from the ground. Corrugated ceramic tiles shall cover the floor in stall. Saw dust and straw are used as litter. Tractor and food-distributor are used for mechanization of labour.

16 airshafts shall be installed for output of cattle-shed air. However, fresh air shall enter through windows and specially installed opening in the cornice part. Condensate on windows and metal constructions shows that air exchange (ventilation) is insufficient. Artificial light is installed in three rows and 10 incandescent bulbs in each of row, but incandescent bulbs often blow out and are not replaced in time, therefore does not assure artificial light 4.5–5 W by m^2 regarding the appropriate standards.

Dung removal and stall cleaning shall be made twice a day with rake-conveyer attached to articulated tractor; afterwards it shall be transported to midden. Slurry shall be drained to slurry storage, where it is pumped out of necessity.

The mode of animal feeding, amount of daily food and composition in both of farms are similar. Increasing relative air humidity over 80%, daily milk yield of highly productive cows on every of 5% humidity increase, decreases by 1.2–1.4 kg (4). The major works in maintaining microclimate are bringing out the dung, stall strewing, ventilation of premises, cleaning and preventive disinfection.

In order to maintain optimal indicators of microclimate and to make appropriate milk yield, the air quality of cattle-shed shall be regularly assessed and air composition shall be tested.

The objective of the research is to identify some indicators of microclimate regarding milk yield in cow stalls with different ways of keeping – leashed or unleashed.

CONTENT AND METHODOLOGY

The research in both farms is made between 1st of November 2003 – 1st of May 2004. Cows were fed and milked similarly in both farms twice a day at 5.00 AM and 15.30 PM. Agricultural consultations and software “LEDA” from education centre were used in order to make daily food dose. The indicators of microclimate (air temperature of premises, air motion speed, air humidity and gas structure) were defined during the research in farms No 1 and No 2 36 times in each one

taking into consideration existing methodology. However, the equipment was used from the laboratory of Food and Environment Hygiene Institute. Milk yield was counted every day. Statistical functions, data analysis tools, correlation and regression functions of MS Excel were used for the analysis of gained results.

RESULTS AND DISCUSSION

Results of the research verified that daily milk yield are different in accordance with similar feeding conditions and food doses where there are different ways of keeping cows (leashed and unleashed). Daily milk yield keeping cows unleashed was 14.0–17.3 litres in the farm No 1. However, in the farm No 2 where the cows were kept leashed daily milk yield changed to 9.2–14.9 litres. It is known that the milk yield is affected also such factors as breed, lactation, parturition etc., therefore the connection between the milk yield and the indicators of microclimate was determined together in both cattle-sheds.

The average indicators of microclimate of cow premises in comparison with the norm are seen in the Table 1.

Table 1. Indices of microclimate in the cow sheds of Farm No1 and Farm No 2 in winter 2003/2004

Indicators	Farm Nr 1	Farm Nr 2	Norm
Relative air humidity %	74–88	73–94	75–85
Conc. of ammonia mg/m^3	4–17	10 – 25	<20
Air motion m/s	0,2–0,35	0,02–0,25	0,3–0,4
Air temperature, ^{0}C	1,0–11,5	6,0–19,5	8–12

Evidently the relative air humidity in the farm No 1 ranged between 74–88% which complies with the advised standards overall. The relative air humidity in the farm No 2 increased over the standards by 94% in December, January and February that could be connected to insufficient air motion speed due to the deficient ventilation. Relative fluctuations of humidity in the air of cattle-shed did not affect a lot daily milk yield in research (Figure 1).

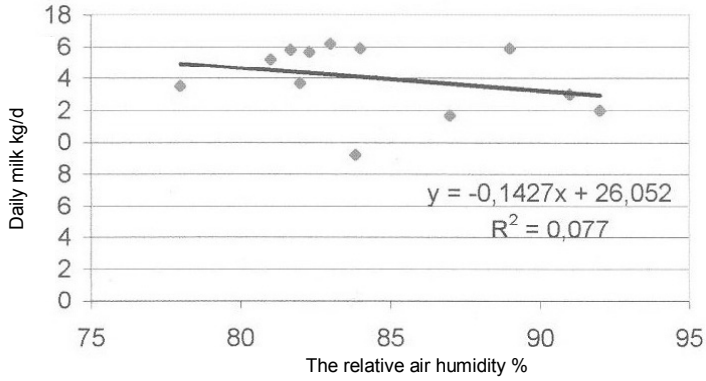

Figure 1. The relative air humidity % in the cowshed air on the daily milk yield in farm 1 and farm 2

Ammonia concentration in the cow farm No 1 was between 4 and 17 mg/m^3, i.e. according to the norm (< 20). Also in the farm No 2 in the majority of research it was within the norms with fluctuations from 10–25 mg/m^3. The highest ammonia concentration in the farm 20–25 mg/m^3 was registered in April that is above the norm. As the ammonia concentration in the air of cattle-shed was increased, decrease of milk yield has been registered (Figure 2).

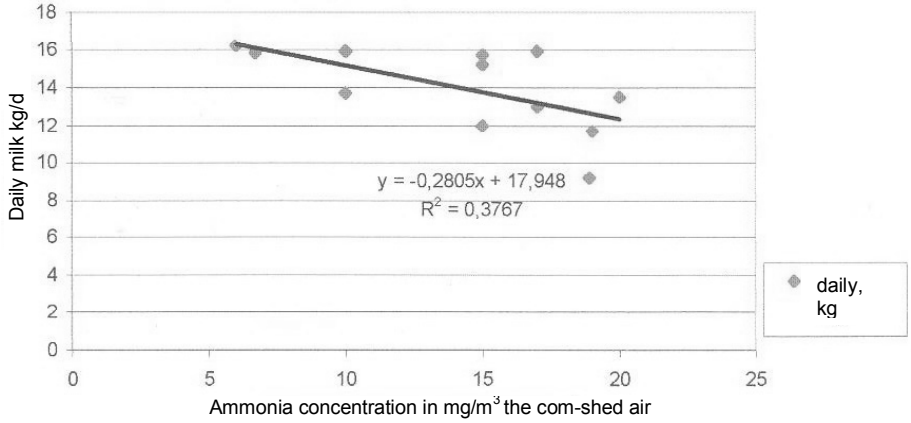

Figure 2. The ammonia concentration mg/m^3 the cowshed air on the daily milk yield in farm 1 and farm 2

Air motion speed in the farm No 1 was corresponding to the norm (0.3…0.4m/sec) and ranged from 0.2–0.35 m/sec.

However, in the farm No 2 it was considerably insufficient especially in January and February (0.02ficient. It has been noticed that on the moment when there is low air motion speed daily milk yield of cow is a little bit lower (Figure 3).

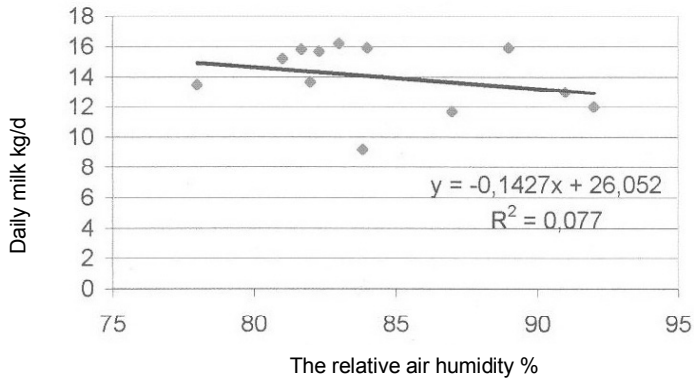

Figure 3. The relative air humidity % in the cow shed air on the daily milk yield in farm 1 and farm 2

Temperature of the cattle-shed in the stall No 1 in several measurements in December and especially in February was above the advised norm (8–12^{o}C) and ranged from 1.0–11.5^{o}C, but I the stall No 2 from 6.0–19.5^{o}C, which exceeded the optimal at the end of March and April. These fluctuations match to the fluctuations of the outdoor air temperature. Taking into consideration observations the cattle-shed indicators of the air temperature did not affect milk yield a lot.
The presence of hydrogen sulphide in both places was not found.

CONCLUSIONS

1. The Indicators of microclimate (relative air humidity, ammonia concentration, air motion speed, cattle-shed air temperature) in the farm No 1 with unleashed cows was corresponded more to the norms in force as in the farm No 2 where the cows were leashed.
2. Daily cow milk yield in the farm No 1 was higher than in the farm No 2. There has been observed a link between the indicators of cattle-shed microclimate – ammonia concentration, air motion speed and daily cow milk yield. Increased ammonia concentration and decreased air motion speed demonstrate negative influence to the cow milk yield.
3. Correlation between relative air humidity and yield in cattle-shed as well as air temperature and yield was not found in research.

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