

## OPTIMIZATION OF HOUSING CONDITIONS ON PIG FARMS

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### Abstract

On specialized farm of pig breeding, indices of the microclimate were observed in pre-fattening object for pigs of 18 - 30 kg l.w. Continuous evaluation was carried out of the temperature and humidity status and in regular two-week intervals the speed of air flow in the piggeries and pollutants, i.e., carbon dioxide and ammonia levels were determined. The obtained values of the microclimate indices were compared with the reference values of microclimate factors as given in the currently valid regulation of the Ministry of Agriculture of the Slovak Republic No. 230/1998 on farm animal breeding and pig killing.

In house (pre-fattening of pigs) the measurements were conducted between March and May 2000. Internal temperatures and relative humidity ranged within the optimum in 66.08% (18 - 24°C) and 51.34% (50 - 70%) of the cases, respectively. These indices of the microclimate can be considered as favourable.

The levels of pollutants in all housing facilities fluctuated within the standard range of values valid for air quality in the animal zones of closed piggeries (carbon dioxide max. 3000 ppm, ammonia max. 20 ppm)

*Key words:* pigs, microclimate, temperature, relative humidity, ammonia, carbon dioxide

### INTRODUCTION

The microclimate of animal housing premises may substantially influence the health of animals and the prosperity of the farm. The bioclimate is a whole complex of physical, chemical and biological factors that influence the organism of farm animals. Housing premises and the respective technologies are the basic element in the optimization of farm animal environment therefore age of the animals, the level of nutrition and the aims of production need to be taken into account.

The microclimate is becoming an increasingly weighty health and prosperity factor and the relation „hygiene = health = efficiency = rentability“ has been generally acknowledged (NOVÁK and ZEMAN, 1996).

According to BOTTO and MIHINA (2000) in addition to economic factors breeders currently have to take into account the aspects of animal welfare and animal protection as well as ecological viewpoints that arise from the increasing requirements on the quality of the environment.

Nowadays animal production is supposed to produce high-quality goods. The quality requirements presuppose the existence of breeds and hybrids bred for this aim on one hand and an optimum environment in which the genetically founded production capacity of the animals can fully develop, on the other one (PARA and ONDRAŠOVIČ, 1997).

## MATERIALS AND METHODS

The temperature and humidity regime in the animal zone of the interior of a closed object was determined in one-hour intervals by means of registration data-logger Testostor 175 (Testo, Germany).

In regular two-week intervals ambulant observations were carried out of

- a) the speed of air flow in the stable by the thermoanemometric method carrying out measurements with a katathermometer according to Hill;
- b) pollutant (carbon dioxide and ammonia) levels using detection tubes and a device by Dräger.

The investigated stable for pre-fattening pigs is situated in a lowland region of Slovakia. It is a one-storey building designed to house 300 pigs in the weight category of 18 – 30 kg. The external walls are plastered from both sides and the ceilings are made of heat-isolated panels. In the northern part of the building there is a feed store and auxiliary rooms. The animals are housed in group pens providing 0.8 m<sup>2</sup> of utilizable space per animal; the pens are situated in three rows. The floor of the pens consists of a solid resting place and a slatted dunging area.

The feeding and watering technology is fully automated on the basis of a stationary feeding line. Ventilation is provided by four manually controlled under pressure ventilators situated in the longitudinal walls of the stable. Radiation heating is used as a supplementary heat source in periods of low outer temperatures. Excreta are removed by a standard shovel-shaped drawing device.

## RESULTS AND DISCUSSION

The data obtained by the above measurements were evaluated according to the Decree of the Ministry of Agriculture of the Slovak Republic No. 230/1998 on the breeding of farm animals and killing of slaughter animals. As to the breeding of weanlings in the weight category of 18 – 30 kg the following values are listed:

1. Temperature: minimum 15°C, optimum 18-24°C
2. Relative humidity: maximum 75%, optimum 50-70%
3. Air flow: max. 0.05 m.s<sup>-1</sup> at minimum temperatures, 0.2 m.s<sup>-1</sup> at optimum and 0.5 m.s<sup>-1</sup> at higher than optimum temperatures.
4. Admitted pollutant values: carbon dioxide 3 000 ppm, ammonia 20 ppm

In the period between March 1, 2000 and May 4, 2000 a total of 1 533 hours were evaluated.

Internal temperatures ranged within the optimum limits (18-24°C) in 66.08% of the time whereas temperatures below the optimum (15-18°C) and higher than the optimum (over 24°C) were recorded for 1.96% and 31.96% of the observation period, respectively. Temperatures below the minimum (less than 15°C) were not recorded.

Relative humidity values reached optimum (50-70%), higher-than-optimum (70-75%) and higher-than-maximum (over 75%) levels for 51.34%, 11.87% and 5.74% of the time, respectively, whereas lower-than-optimum humidity (less than 50%) was observed during 31.05% of the measurement period.

The results of the temperature and humidity measurements are given in Table I both in absolute and in relative values (number of hours vs. percentage of the total measurement time).

**Table 1.** Results of temperature and humidity measurements in a stable for pre-fattening pigs

Period evaluated	Internal temperature	T <sub>i</sub>
Ist March – 4th May 2000	Hrs.	%
Lower than minimum, below 15°C	0	0
Lower than optimum, 15 - 18°C	30	1.96
Optimum, 18 - 24°C	1013	66.08
Higher than optimum, over 24°C	490	31.96
Period evaluated	Relative humidity	RH <sub>i</sub>
Ist March – 4th May 2000	Hrs.	%
Lower than optimum, below 50%	476	31.05
Optimum, 50 - 70%	787	51.34
Higher than optimum, 70 - 75%	182	11.87
Higher than maximum, over 75%	88	5.74

Total number of registration hours: 1 533

Ammonia and carbon dioxide levels in the piggeries reached 5 – 10 ppm and 2000 – 2500 ppm, respectively, i.e., they did not surpass the limits given for piggeries in the abovementioned Decree.

Air flow values ranged in the interval 0.1 – 0.2 m.s<sup>-1</sup>.

The recorded values of the individual factors of the bioclimate can be considered as favourable since optimum temperatures were obtained in 66.08% of the measurement time and no decrease below the recommended minimum of 15°C could be stated. The occurrence of higher-than-optimum temperatures in 31.96% and lower-than-optimum humidity in 31.05% of the time points at a considerable heat reserve in ventilation.

Our evaluations were based on the requirements of the Decree of the Ministry of Agriculture of the Slovak Republic Nr. 230/1998. Data similar to those presented in the Decree for internal temperature combined with relative humidity and air flow were also reported by PARA and ONDRAŠOVIČ (1997) and BOTTO et al. (2000).

The importance of continuous observations of the microclimate was also confirmed by HARICHOVÁ et al. (2002) who observed the microclimate in a reconstructed pre-fattening stable not to reach optimum values in spite of controlled ventilation. They reported optimum internal temperature (18-24°C) and air humidity (50-70%) to be present only during 18.9% and 38.1% of the registration period, respectively.

Under the current conditions of agriculture optimization of the factors of bioclimate in farm animal housing premises displays specific features. A great part of the housing premises in our country are out-of-date and technologically worn down. Investment means present the basic instrument of the reconstruction and modernization of old buildings or the construction of new ones. Optimization of the bioclimate is mainly influenced by the thermic and isolating properties of the basic elements of the external walls and the roof construction as well as by the housing technology.

For this reason it is important to pay increased attention to the basic factors of the bioclimate in housing premises. When modernizing piggeries, in addition to internal temperature and relative humidity attention should be paid to the construction of the ventilation system as well as the species and category of animals; air flow should be limited accordingly.

The levels of common pollutants (carbon dioxide, ammonia, hydrosulphide and methane) should be observed and evaluated in the context of overall requirements on the optimization of the bioclimate.

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