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Conference paper

OPTIMIZATION OF ANIMAL WELFARE IN PIG FATTENING OBJECTS DURING SUMMER

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Summary

Providing optimum parameters of the living environment is one of the presuppositions having favourable effects upon the thermoregulatory system in pigs and thus also upon the health state of the animals and the overall results of pig breeding. Temperature as the most important environmental factor in the piggery is influenced by relative humidity and air flow. There is a close correlation between humidity and temperature. Our results show that in 28,25% and 56.4% of time interior temperatures in (14-22°C) and relative humidity (50-75%) oscillated in the optimum range, respectively. Throughout the observation period the total counts of microbes contaminating the air in the piggery ranged between $1.04x10^4$ and $1.38x10^5$ CFU per m^3 of air whereas coliform cts oscillated between $1.57x10^2$ and $1.57x10^3$ CFU per m^3 of air. Based on the measurements carried out in our experiments it can be stated that in pig fattening objects relatively favourable microbiological indices could be achieved under non-standard physical conditions.

Key words: environment, microclimatic factors, microbial contamination

Introduction

Currently in addition to economic factors animal breeders are required to take into account the aspects of animal welfare as well as those of ecology that result from the valid standards of the quality of environment. EU standards will become binding for the Slovak Republic within 1 year. The trend of the

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EU countries is to be followed in Slovakia as well (Botto and Mihina, 2000, Kelly et al., 2000). Suitable housing conditions have to meet the life and production requirements of the animals; besides zootechnical and improvement work as well as nutrition they are a decisive requirement for breeding success (Webster, 1999, Cole and Close, 2000, Skalická et al., 2001). The importance of complex solutions of the housing climate has not always been fully recognized. Interactions of the environment and animals occur that may affect animal health and performance. The microclimate of the housing space may exert highly negative effects upon the health state which is determined not only by the breed, number, category and weight of the animals housed but also by the technology of animal housing, feeding and watering as well as the removal of excreta.

The microclimate of the piggery is one of the factors influencing animal wellness and generated by a complex action of physical, chemical and biological factors. A decisive role is ascribed to the temperature and humidity regime characterized by interior temperature and humidity of the air in the shed as well as by air flow (Buscher and Heidenreich, 1998, Calaghan and Stevenson, 1999).

Microorganisms present an inseparable part of the air. Their numbers in housing objects are much higher than in the nature, their species and number depending on several factors. Similarly to cases of diseases in the shed, microorganism counts in the air increase if housing hygiene is impaired. It is well known that several infections in sheds are airborne ones. Overpopulation of pathogens may decrease the performance and resistance of the animals or it may cause diseases directly (Para and Ondrašovič, 1997). The numbers of microorganisms considerably depend on general hygiene of the environment and fluctuate between 10^3 and 10^6 organisms per m^3 of air. Not only literary data but also the practical experience of our authors revealed pigs to belong to the most demanding animals with respect to the microclimate (Venglovský and Varga, 1991, Bossov, 1995).

This work focused on the observation of some indices of the microclimate in pig fattening premises and took into account the existing state of the microclimate as well as measurements of different factors of the latter.

Material and methods

The basic factors of the microclimate in pig fattening premises have been stated for 2000 hours as follows:

- hourly continuous determination of the heat-humidity regime in the animal zone of a closed piggery by means of TESTOSTOR 175 registration thermohygrographs (Testo, Italy)
- in regular two-week intervals ambulant observation of:
  a) air flow in the shed using a katathermometer according to Hill,
  b) pollutant (NH_3 and CO_2) values in the shed air using detection tubes and a device by DRÄGER (Sicherheitstechnik GmbH, Germany),
  c) microbial contamination of the air in the piggery, viz., total microorganism and coliform ciunts (expressed in CFU per m^3 of air) using sedimentation on solid media (meat pepton agar and Endo agar, respectively, both by Imuna, Šarišské Michaľany, Slovak Republic).

The indices of the microclimate were observed in a shed for fattening pigs with a total capacity of 2000 animals, a closed turnover of the flock and turn operation, situated in the lowland region of Eastern Slovakia. The skeleton of the single-floor rectangular object of 8.6 x 85 m is made of a steel load-bearing structure with wall and ceiling panels that are heat-isolated by a 10 cm layer of mineral wool. The shed is fitted with a saddle roof covered with corrugated iron sheets. It is divided by a transverse corridor in the middle into two housing sections of 40 m length, of which each has two rows of pens divided by a manipulation corridor. The group pens of 3.5 x 2.8 m are made of a solid resting part and a slatted dunging area and are designed for 10 pigs each.

The technology of feeding (Sanifood Tigsa type) and watering (valve-furnished jet drinker) is fully automated and based on a stationary feeding line for dry feeds supplied into storage troughs from a central storage container outside the shed. The shed is gravitation-ventilated through its windows and doors.

Slurry is removed by hydro-mechanic overflow in the gutter under the slats and deposited in a semi-deep pit.

Results and discussion

Most literary data consider a relative humidity of 50-75% and a temperature of 10-22°C to be the optimum for pig breeding. According to the Public Notice of the Ministry of Agriculture of the SR No. 230 of 1998 the maximum permitted air flow value at this temperature is 0.3 $m.s^{-1}$. Of the chemical factors of the microclimate mainly ammonia, carbon dioxide and hydrogen sulphide exert negative effects (Chiumenty et al., 1994, Deglin et al., 1999). Of the aforementioned substances maxima of 0.002, 0.30 and 0.001 vol.% are admitted, respectively.

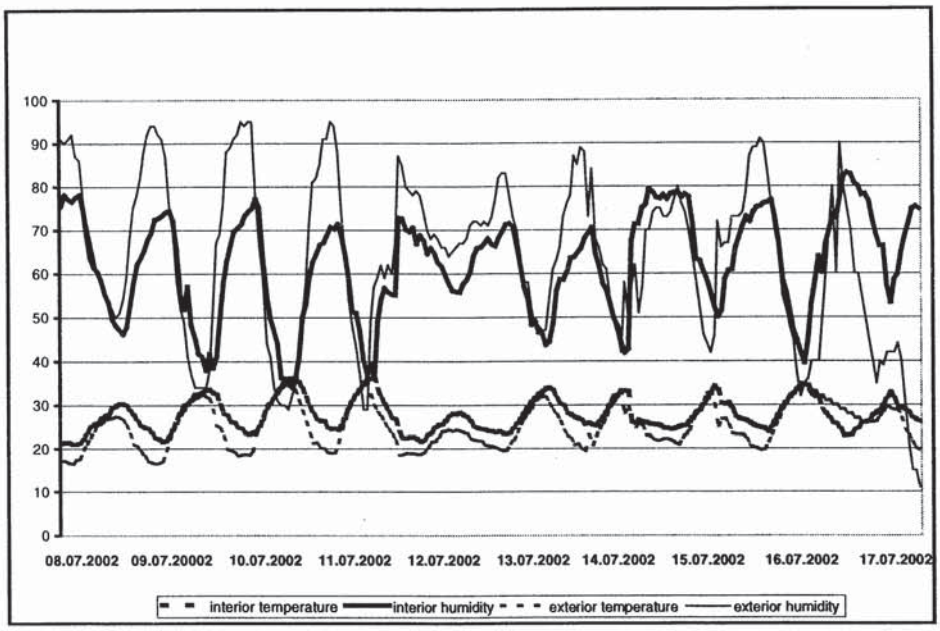
The indices of the microclimate (Tab. 1) were evaluated according to the Public Notice of the *MA SR No. 230 of 1998* Coll. on the breeding of farm animals and killing of slaughter animals. A total of 2000 hours were observed in the period between May 25th and August 16th, 2002. Throughout that period the interior temperatures were found to be optimum (14-22°C) and higher than optimum (more than 22°C) for 28.25% and 71.65% of the evaluation time, respectively. Relative interior humidity was optimal (50-75%), higher than optimal (75-80%), higher than maximum (over 80%) and lower than optimum (under 50%) for 56.4%, 19.25%, 10% and 14.35% of the observation time, respectively. Graph No. 1 shows an observation period of 10 days between July 8th and 17th, 2002. Exterior temperatures reached values between 16.5 and 35.9°C, the interior maxima were recorded between 15:00 and 17:00 on July 7th and at 14:00 and 15:00 on July 11th when they surpassed 36°C; this correlated with the maxima measured in the exterior. Relative humidity in the exterior reached values of 31 – 95% whereas in the houses maximum humidity reached 82.7% at 4:00 on July 17th. The minimum humidity value was observed at 14:00 on July 10th (36.1%).

Table 1. - RESULTS OF THE TEMPERATURE AND HUMIDITY REGIME IN THE 2ND STAGE OF PIG FATTENING (50-90 kg l.w.)

Evaluation period	25.05.2002-30.06.2002		01.07.2002-31.07.2002		01.08.2002-16.08.2002		Σ 25.05.2002-16.08.2002	
Number of hours evaluated	879		744		377		2000	
Interior temperature Ti	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%
Lower than minimum below 11°C	0	0	0	0	0	0	0	0
Lower than optimum 11-14°C	2	0.23	0	0	0	0	2	0.1
Optimum 14-22°C	349	39.70	105	14.11	111	29.44	565	28.25
Higher than optimum over 22°C	528	60.07	639	85.89	266	70.56	1433	1.65
Relative humidity RH	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%
Lower than optimum below 50%	136	15.47	138	18.55	13	3.45	287	14.35
Optimum 50-75%	557	63.37	479	64.38	92	24.40	1128	56.4
Higher than optimum 75-80%	153	17.41	92	12.37	140	37.14	385	9.25
Higher than Maximum over 80%	33	3.75	35	4.70	132	35.01	200	10

In the reported period air flow varied between 0.15 and 0.3 $m.s^{-1}$. The following pollutants were determined: NH_3 and CO_2 were present at 0.001-0.002 and 0.15%, respectively, thus ranging within the limits given in the Public Notice No. 230 of 1998 Coll. Dustiness as measured on July 8th was in the interval of 0.96 – 1.92 mg/m^3.

Graph 1 - TEMPERATURE AND HUMIDITY VALUES OF THE HOUSING SPACE



Duchaine et al. (2000) observed the effects of building maintenance, environmental factors and season on air contamination in eight piggeries, 2 times in the winter and once in the summer in each of them, focusing on the correlation between biological and chemical contamination. During winter the following levels were stated: CO_2 – 0.304% (0.254 – 0.349%), NH_3 – 0.00196%, dust – 3.54 mg/m^3 (2.15 – 5.60), total microorganism counts – $4.25x10^5$ CFU/m^3 ($1.67 – 9.30x10^5$). A certain decrease during summer was evident.

If we strive to optimize the microclimate it is important to take into account the principle according to which quality is primarily determined by the building itself. In reconstructed piggeries, insufficient air flow and thus insufficient ventilation presents the most frequent problem.

The continental climate that is typical for the Slovak Republic is characterized by a considerable fluctuation of temperatures between as low as –25°C in the winter and +35°C in the summer.

Temperature as the main bioclimatic factor of farm animal performance should be understood as a factor influencing the physiology, performance and health state of the animals and thus the profitability of the business. As a component of the microclimate temperature participates in providing an optimum environment for animals, thus it is an important factor and parameter of animal welfare. Temperature fluctuation may cause hyper- or hypothermy. Optimum temperature is a requirement that differs in relation to farm animal species, age and production group. Mikuláš and Mikulášová (1996) pointed at the importance of the quality of the microclimate from the viewpoint of morbidity and mainly loss of performance. According to these authors performance decreases by 20-30% if temperature in the interior of piggeries drops below the optimum.

Microbial contamination of the air is given in Table 2. Total micro-organism counts revealed $1.04x10^4$ – $1.38x10^5$ CFU per m^3 of air whereas coliform counts reached $1.57x10^2$ – $1.57x10^3$ CFU per m^3 of air. Para and Ondrašovič (1997) reported the total microorganism counts following stocking of the piggeries to be between 10^4 and 10^6 CFU per m^3 of air.

Table 2. - RESULTS OF MICROBIOLOGICAL EXAMINATION OF AIR BY THE SEDIMENTATION METHOD

Evaluated period	Sampling	Sampling site No.1 (centre of shed)	Sampling site No.2 (periphery of shed)
25.05.2002	MPA	$7.50x10^4$ - $1.26x10^5$	$5.56x10^4$ - $9.40x10^4$
	Mean values	$1.01x10^5$	$7.48x10^4$
	EA	$3.10x10^2$ - $9.40x10^2$	$1.60x10^2$ – $3.10x10^2$
	Mean values	$6.25x10^2$	$2.35x10^2$
01.07.2002	MPA	$8.48x10^4$ - $1.13x10^5$	$8.20x10^4$ - $1.38x10^5$
	Mean values	$9.89x10^4$	$1.10x10^5$
	EA	$1.10x10^3$ - $1.57x10^3$	$1.57x10^2$ - $4.71x10^2$
	Mean values	$1.34x10^3$	$3.14x10^2$
16.08.2002	MPA	$2.70x10^4$ - $6.80x10^4$	$1.04x10^4$ - $3.80x10^4$
	Mean values	$4.75x10^4$	$2.42x10^4$
	EA	$3.14x10^2$ – $4.10x10^2$	$1.57x10^2$ - $3.14x10^2$
	Mean values	$3.62x10^2$	$2.36x10^2$

MPA – meat pepton agar
EA - Endo agar

Microorganism counts depend on the exchange of air, usage of the ventilation equipment as well as on temperature and relative humidity. Massive gradation of airborne microorganisms has a negative effect upon the animal organism and indirectly also on air quality. It can be stated that the microbiological indices observed in this investigation ranged within the standard levels, however, due to impaired temperature and humidity values the physical indices of the microclimate have to be qualified as unfavourable.

Conclusion

The good level of breeding depends not only on maintaining an optimum microclimate in the piggeries but also on abiding to measures that focus on preventing infectious agents from colonization of the premises where persons and free living animals as well as technological systems and equipment act as vectors. The development of technologies in pig breeding undergoes rapid progressive changes that lead to an improved microclimate and thus considerably improve profitability. Although several properties pertaining to the required performance of pigs have been improved by breeding work, the housing requirements remain unchanged from the physiological viewpoint.

The results of our measurements revealed that with respect to animal health and production pig housing was inadequate since insufficient ventilation of the premises (passive ventilation without an active ventilation system) caused overheating of the houses where interior temperature increased to more than 36°C at critical time periods, thus surpassing the upper limit permitted by the standard. This fact had an unambiguously negative effect upon animal health and performance.

REFERENCES

1. Bossow, H.: Stallwetterkontrolle - Bedeutung fur Praxis, Tier- und menschliche Gesundheit, Der praktische Tierarzt 9, 1995: 780 - 786
2. Botto, Ľ., Mihina, Š.: Welfare and protection of animals in pig breeding. Proceedings of the conference „Animal protection and welfare 2000" part A, ISBN 80-7305-386-1, VFU Brno 2000: 5-9
3. Buscher, W. - Heidenreich, T.: Ventilation methods for large scale compartments in pig fattening: a process engineering evaluation, Landtechnik, 53, 6, 1998: 366 - 367
4. Calaghan, J., Stevenson, P.: The Factory Farming of Pigs - Briefing, Proceedings of the conference „Animal protection and welfare 1999" part A, ISBN 80-85114-71-2, VFU Brno 1999: 261-266
5. Cole, D. J. A., Close, W. Nutrition of Sows and Boars, Nottingham University Press, ISBN 1-897676-53-0, 2000

6. Deglin, D., Caenegem, L. Van - Dehon, P., Van Caenegem, L.: Subsoil heat exchangers for the air conditioning of livestock buildings. Journal of Agricultural Engineering Reasearch. 73, 2, 1999: 179-188
7. Duchaine, C., Grimard, Y., Cormier, XY.: Influence of building maintenance, environmental factors, and season on airborne contaminants of swine confinement buildings. American Industrial Hygiene Association Journal.61, 1, 2000: 56-63
8. Chiumenty, R., Da Borso, F., Donantoni, L.. Dust and ammonia reduction in exhaust air from piggeries using a mechanical wet separation system. In: Proceedings of the Seventh Technical Consultation on the ESCORENA Network on Animal Waste Management, Bad Zwischenahn, Germany, 1994: 301-307
9. Kelly, H. R. C., Bruce, J. M., English, P.R., Fowler, V. R., Edwards, S. A.: Behavior of 3-week weaned pigs in Straw-Flow R, deep straw and flatdeck housing systems. Applied Animal Behavior Science. 68, 4, 2000: 269-280
10. Mikuláš, M., Mikulášová, D. The microclimate in large housing objects and its effects upon the construction of the latter. Proceedings of the Working Days of Bioclimatology 1996:197-203
11. Para, Ľ., Ondrašovič, M.: The bioclimate and its regulation in pig fattening premises. Slovak Veterinary Journal, 22, 1, 1997: 51-54
12. Skalická, M., Koréneková, B., Naď, P.: Lead in edible tissues of livestock from polluted area. Proceedings of the 3rd International symposium on trace element in human. New perspectives, S. Ermidou-Pollet, S. Pollet eds. Athens, Greece, 2001: 54-58.
13. Venglovský, J., Varga, J.: Evaluation of the microclimate in stables for fattening pigs from the viewpoint of heat protection. Compendium of scientific works of the ÚEVM, VII., 1991: 9 - 30
14. Regulation of the Ministry of Agriculture of the SR No. 230/1998 of the Collection of laws on the breeding and killing of slaughter animals.
15. Webster, J.: Animal Welfare: Limping towards Eden? Proceedings of the conference „Animal protection and welfare 1999" part A, ISBN 80-85114-71-2, VFU Brno 1999: 241-244

OPTIMALNI UVJETI DOBROBITI ŽIVOTINJA U OBJEKTIMA ZA TOV SVINJA U LJETNOM RAZDOBLJU

Sažetak

Osigurati optimalne uvjete okoliša jedna je od pretpostavki koja će imati pozitivan utjecaj na termoregulaciju svinja, zdravstveni status životinja te poboljšane rezultate u rasplodu svinja. Na temperaturu kao najvažniji okolišni čimbenik u svinjcu utječe relativna vlaga i protok zraka. Bliska je veza između vlage i temperature. Naši rezultati pokazuju da u 28,25 % i u 56,4 % vremena, unutarnja temperatura (14-22°C) i relativna vlaga (50-75%) bile u optimalnim rasponima. U promatranom vremenu, ukupni broj mikroba koji su kontaminirali zrak u svinjcu, kretao se od $1,04x10^4$ i $1,38x10^5$ CFU/m^3 zraka, dok se ukupni broj koliformnih mikroorganizama kretao od $1,57x10^2$ i $1,57x10^3$ CFU/m^3 zraka. Na osnovu mjerenja provedenih u ovom istraživanju može se zaključiti da u objektu za tov svinja relativno povoljna mikrobiološka slika može biti ostvarena pod ne standardnim fizikalnim uvjetima.

Ključne riječi: okoliš, mikroklimatski uvjeti, mikrobiološka kontaminacija

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