

PRELIMINARY INVESTIGATION ON THE INFLUENCE OF AIR QUALITY ON THE INCREASE OF PIGLET LOSSES IN THE FARROWING UNIT

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SUMMARY

The study investigated air quality in the farrowing unit with increased piglet losses (farrowing unit A) by comparison of the obtained results of primary microclimatic values and total airborne microbe numbers to the results acquired from another farrowing unit (farrowing unit B) that operated in strictly controlled conditions with current technology and had optimal air quality. In each facility the investigation extended through two production cycles with full capacity of sows per turn. Farrowing unit A used outdated technology and was 270 m² in size equipped with 40 pens, while farrowing unit B used current technology and was 370 m² in size equipped with 60 farrowing pens. Seven air samplings were performed in every 28-day turn with the SAS 100TM (PBI International, Italy) air collector, and primary microclimatic conditions were monitored with Testo and Dräger (Germany) portable digital instruments. Air was sampled onto corresponding growth medium and the obtained results of microbe numbers were subject to statistical analysis. According to the acquired results a significantly larger number of individual microbe species was recorded in farrowing unit A in both production cycles in relation to farrowing unit B. Besides, inadequate exchange of air with increased ammonia concentration and relative humidity was observed in farrowing unit A. Outdated technology along with insufficient maintenance of ventilation equipment induces unsuitable microclimatic conditions and increased microbe numbers in the air of farrowing unit, which perhaps is in correlation with an increase in piglet losses. Unlike this, in farrowing units with current housing technology and optimal production results the total microbe numbers are expected to be below 10⁴ CFU/m³ and 10³ CFU/m³ of air for bacteria and fungi, respectively.

Key words: nursery, piglet losses, microbiological air quality, ammonium

INTRODUCTION

Air microflora reflects the microbiological condition of the stable and mostly originates from animals and their manure (Methling et al., 1981). It is influenced by airflow and various activities in the facility such as, feed distribution or manure management and dependant on the ventilation system, primary microclimatic conditions, season, and population density (Seedorf, 1998). Therefore, total number of airborne microbes can vary significantly and favor the spreading of disease so the control of animal health status should include the verification of air quality (Bækbo, 1990). In this respect the fattening and farrowing units received most attention in pig production to this date accompanied by comparison of total microbe numbers in the air of these technological phases (Pavičić et al., 2006). However, the aim of this investigation was to compare the microbiological air quality between two farrowing units with different technologies in order to establish possible relationship of airborne microbe concentrations and production results.

MATERIALS AND METHODS

The investigation was conducted on two different farrowing units during two 28-day production turns. Farrowing unit A with older technology was 270 m² in size equipped with 40 pens, while farrowing unit B with contemporary technology was 370 m² in size equipped with 60 farrowing pens. Seven air samplings were performed in identical time periods in every production turn with the SAS 100TM (PBI International, Italy) air collector on multiple points in the level of animal biozone. Sampling was performed on growth medium for the isolation of mesophylic, hemolytic and coliform bacteria and fungi, which were counted after incubation and expressed per m³ (CFU/m³) of air. Isolated bacteria and fungi were identified by microscope and API tests (Bio Mérieux, France). Control of primary microclimatic conditions: temperature, relative humidity, airflow speed and ammonia concentration was performed alongside every air sampling with the portable digital devices (Testo and Dräger, Germany). The obtained data was subjected to basic statistical analysis with Statistica 7.1 (StatSoft Inc., 2005) software, and eventual significant differences in average bacteria and fungi numbers between two farrowing units were recorded. Microclimatic parameters were calculated as mean values.

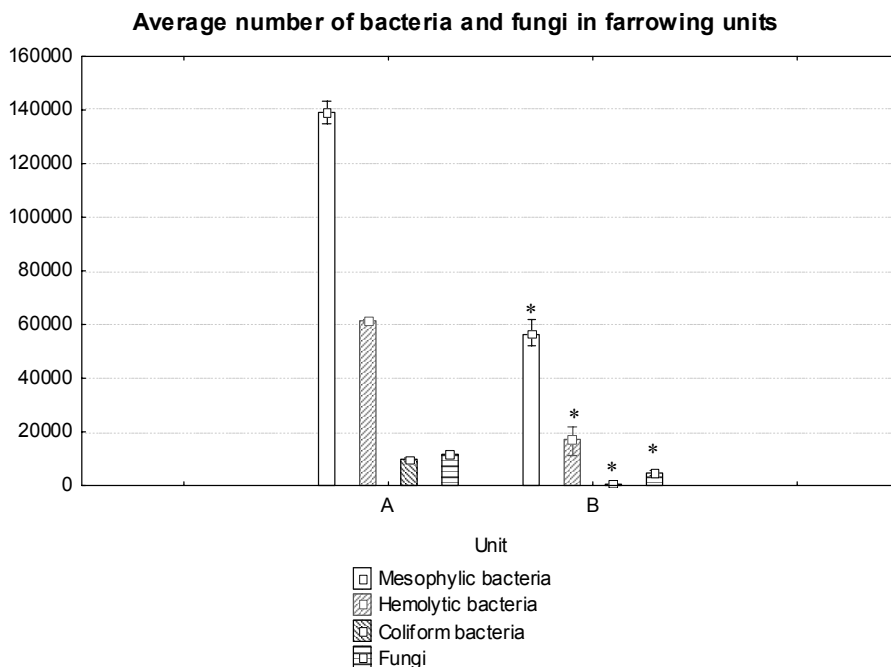
RESULTS

Average numbers of bacteria and fungi in two different farrowing units during the entire trial period is presented in Table 1 and Graph 1.

Table 1. Average number of microbes in the farrowing units during both turns.

Microbes	Farrowing unit with outdated technology (n = 14)		Farrowing unit with modern technology (n = 14)	
	Mean	SD	Mean	SD
Mesophylic bacteria	139678,6	± 2194,110	56357,14*	± 2841,374
Hemolytic bacteria	61228,6	± 1084,456	16992,86*	± 3297,427
Coliform bacteria	9871,4	± 634,191	469,29*	± 45,143
Fungi	11600,0	± 736,938	4650,00*	± 453,618

* Statistically significant lower value (significance level $p < 0,01$) relative to value recorded in the other facility



Graph 1. Average number of bacterial and fungi in the farrowing units during the entire investigation.

* Statistically significant lower value (significance level $p < 0, 01$) relative to value recorded in the other facility

Gram positive bacteria were predominant in both facilities with 22 bacteria species identified in farrowing unit A and 18 bacteria species identified in farrowing unit B. The proportion of gram negative bacteria was generally lower, but significantly higher in farrowing unit A. Besides, 12 and 8 species of fungi were identified in farrowing units A and B, respectively, whereat *Aspergillus spp.*, and *Trichopyton spp.* were predominant in both facilities. Average microclimatic conditions in farrowing unit A were: temperature $24^{\circ}\text{C} \pm 1^{\circ}\text{C}$, relative humidity 82%, airflow speed 0,02 m/s and ammonia concentration 36 ppm. At the same time ammonia values in certain locations in the level of animal biozone were as high as 50 ppm. Average microclimatic conditions in farrowing unit B were: temperature $26^{\circ}\text{C} \pm 1^{\circ}\text{C}$, relative humidity 65%, airflow speed 0,2 m/s and ammonia concentration 4 ppm.

DISCUSSION

Unsuitable zoohygienic conditions could be one of the main factors causing an increase in piglet losses during suckling. At the same time air quality is usually not identified as a cause of the problem so losses can accumulate during prolonged periods of time, raising the question of cost-effectiveness in this phase of pig production. Therefore, increasing number of studies are being

conducted to provide a possible connection between certain health problems and mortality with air quality, thus at the same time searching to find a solution for improving housing conditions for animals including air quality. Modern housing systems with automated microclimate regulation can significantly influence air quality, which is demonstrated by the results of these studies. In fact, according to obtained data it is visible that farrowing unit A, with older and insufficiently maintained technology, had significantly larger numbers of individual microbe species in relation to farrowing unit B. At the same time, gram positive bacteria predominated in both units, from which streptococci and staphylococci constituted more than 80% (Aengst, 1984). Besides, lower values of airflow speed along with high relative humidity and ammonia concentration have been recorded in farrowing unit A. This is an indicator of insufficient ventilation, which can be very hazardous to animal health (Donham, 1995). Such values of primary microclimatic factors can affect an increase in airborne microbe concentration (Attwood et al., 1987), since high relative humidity is favorable in lowering the rate of microbe activity (Jones et al., 1982). It seems that this could be the reason for increased concentration of gram positive bacteria in farrowing unit A that are otherwise present in small numbers as a result of weak survival capability in air (Zucker and Müller, 2002). In so doing, *Enterobacteriaceae* were the predominant species from the family of gram-negative bacteria in the air of farrowing unit A. They will not cause disease by themselves but along with poor microclimatic factors and abundance of gasses they will cause disease and an increase of production losses (Robertson et al., 1990; Hamilton et al., 1998; Andreasen et al., 1999).

CONCLUSION

The results from farrowing unit A clearly demonstrate the connection between out-dated and insufficiently maintained technology on unacceptable microclimatic conditions, increased numbers of airborne microbes and poor production results in relation to farrowing unit B. Meanwhile in modern farrowing facility while maintaining adequate population density per unit of housing space we can expect the total microbe numbers to be under 10^4 CFU/m³ and 10^3 CFU/m³ of air for bacteria and fungi respectively.

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REFERENCES

1. Andreasen, M., P. Bækbo, J. P. Nielsen (1999): Effect of aerial ammonia on porcine infection of the respiratory tract with toxigenic *Pasteurella multocida*. *Acta Vet. Scand.* 40, 197–203.
2. Aengst, C. (1984): Zur Zusammensetzung des Staubes in einem Schweinemaststall. Disertation. Tierärztliche Hochschule, Hannover, Deutschland.

3. Attwood, P., R. Brouwer, P. Ruigewaard, P. Versloot, R. De Wit, D. Heederik, J. S. M. Boleij (1987): A study of the relationship between airbornecontaminants and environmental factors in Dutch swine confinement buildings. *Am. Ind. Hyg. Assoc. J.* 48, 745–751.
4. Bækbo, P. (1990): Air quality in Danish pig herds. Proceedings of the 11th IPVS Congress, 1. – 5. July, Lausanne, Switzerland. p. 395.
5. Donham, K. J. (1995): A review – the effects of environmental conditions inside swine housing on worker and pig health. In: *Manipulating Pig Production V* (Hennessy, D. P., P. D. Cranwell). Australasian Pig Science Association, Victorian Institute of Animal Science, Werribee, Australia. pp. 203–221.
6. Hamilton, T. D. C., J. M. Roe, C. M. Hayes, A. J. F. Webster (1998): Effects of ammonia inhalation and acetic acid pretreatment on colonization kinetics of toxigenic *Pasteurella multocida* within upper respiratory tracts of swine. *J. Clin. Microbiol.* 36, 1260–1265.
7. Jones, C. R., C. M. Wathes, A. J. F. Webster (1982): Release and clearance rates of airborne bacteria within controlled climate calf house. *Livestock Environment II: Proceedings of the Second International Livestock Symposium (ASAE Publication)*, 20.–23. April, Ames, Iowa. Vol. 2, pp. 529–533.
8. Methling, W., G. Mehlhorn, K. Beer, W. Erwerth, K. Förster (1981): Quantität und Qualität der mikrobiellen Kontamination der Luft in Schweinezuchställen. *Mh. Vet. Med.* 36, 732–739.
9. Pavičić, Ž., T. Balenović, H. Valpotić, A. Tofant, M. Popović, M. Balenović, K. Matković, I. Valpotić (2006): Influence of porcine housing density on species diversity and number of air microorganisms in fattening facilities. *Acta Vet. Brno*
10. Robertson, J. F., D. Wilson, W. J. Smith (1990): Atrophic rhinitis: the influence of the aerial environment. *Anim. Prod.* 50, 173–182.
11. Seedorf, J., J. Hartung, M. Schröder, K. H. Linkert, S. Pedersen, H. Takai, J. O. Johnsen, J. H. M. Metz, P. W. G. Groot Koerkamp, G. H. Uenk, V. R. Peggillips, M. R. Holden, R. W. Sneath, J. L. Short, R. P. White, C. M. Wathes (1998): Concentration and emission of airborne endotoxins and microorganisms in livestock buildings in northern Europe. *J. Agric. Engineer. Res.* 70, 97–109.
12. Zucker, B. A., W. Müller (2002): Untersuchungen zum Luftkeimhaushalt in Tierställen. 4. Mitteilung: Luftgetragene gramnegative Bakterien und luftgetragenes Endotoxin in Schweinställen. *Berl. Münch. Tierärztl. Wschr.* 115, 30–36.