NOXIOUS GASES EMISSIONS FROM DIFFERENT PIG HOUSING SYSTEMS

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Introduction

In the age of an increasing threat posed by the global effects of the economic activity of man, increasing attention is given to the quality of obtaining different products. This also concerns pig management as a source of gas emissions that increase the greenhouse effect, acid rain and the ozone layer (Bolin and Kheshgi, 2001; Donham, 2000; Chetner and Sasaki, 2001; Michaelowa and Rolfe, 2001; Kennett, 2002). Research is carried out in many countries to estimate the amount of compounds released in this way into the atmosphere. As studies on emissions from pig farming operations are progressing, the high welfare systems become criticized as a source of above-standard amounts of released gases (Ahlgrimm and Brford, 1998; Chetner and Sasaki, 2001). The aim of the present research was to compare the extent of greenhouse gas emissions from the most common pig housing systems in Poland.

Material and methods

The studies were conducted with 120 Polish Large White × Polish Landrace × Duroc × Pietrain pigs that were kept for 90 days from the body weight of 45 kg. The animals were housed in 6 climatic chambers (Fig. 1), each representing a different housing system. For the purposes of the experiment, the most common systems in Poland were used: on litter in a Swedish-type pen, on litter in a self-cleaning floor system (with a 10 degree of slope), a deep-litter pen, pen with slatted floor pen, without litter in a concrete-floor pen, pen with partially slatted floor. The pens were of identical area in terms of one animal (0.8 m^2) and cubic capacity (2 m^3 per pig). For each chamber an identical volume of exchanged air per hour and animal was assumed in keeping with IZ standards (80 m^3/h/pig). There were 10 animals per each pen/climatic chamber. Air temperature was 18°C and relative humidity ranged from 65-75%. Measurements and comparisons were made on the volume of carbon dioxide, methane, nitric oxides and water vapour emissions. The control group was formed by a climatic chamber with a Swedish-type litter pen. Concentrations of different gas admixtures were measured with electrochemical probes, which are measuring elements of the electronic gas meter Multiwarn II (Dräger), and periodically (24 hours once a week) with gas chromatograph Photovac10+. A predefined volume of air was run through the chamber. The air was mechanically forced through the ventilation inlet and removed mechanically through the exhaust pipe. Inlet and exhaust air composition was also monitored. Air flow was steered by an electric controller. Emissions of particular gas admixtures per unit of time and in terms of one animal were calculated from the volume of air flow and air gas concentration, divided by the number of animals The data were analysed statistically with Statgraph software, using multifactorial analysis of variance.

Results

The results are shown in table. The volume of emissions of particular gas compounds is followed by significant differences between the systems analyzed. The differences reach even 50%, which shows the extent to which the gas compounds can be reduced in these systems. The results, especially those for the litter-free system, are similar to the values reported in the literature on the subject (Ahlgrimm and Brford, 1998; Chetner and Sasaki, 2001; Groenestein and Vanfaassen, 1996; Nicks et al., 2000).

Discussion

The present findings indicate that in respect of some gases only, the high welfare systems are characterized by higher emissions. Gas concentrations also play a specific role in forming house microclimate, thus affecting the animal welfare level (Hoy et al., 1996; Donham, 2000). This concerns deep litter and the release of carbon dioxide and water vapour. This is naturally related to the presence of carbon in straw, easily available for microbiological changes. More CO_2 is released in the litter-free system. Both systems dominate in terms of the emission amount for the whole range of gas measurements. It seems that the volume of emissions from deep litter is generally affected by the method of its use, and especially periodical treatment related to aeration (Muller and Hoy, 1995). In the present experiment, in keeping with Polish practice, the bed was not processed. The smallest amounts of released greenhouse gases were noted in the self-cleaning system and in the partially slatted system. This is evidence that modern solutions geared towards animal welfare are also environmentally safe. It is worth noting the most labour-intensive system of shallow litter with daily removal and bedding of the floor with straw. When cleaned thoroughly, it is not such a great environmental threat as it might appear.

Conclusion

The problem of the site of biochemical processes remains an open question, for it is easier to reduce emissions in a relatively controlled environment of livestock buildings than on dunging gutter or in the environment of the soil sorption complex. This goes to show that the problem of gas emission volume must be viewed in a comprehensive way that accounts not only for the cycle, but also for the form of elements in nature.

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Table Volume of gas emissions from basic pig housing systems (kg/year/pig)

Emitted gas	Housing system					
	Litter	**Self-cleaning**	**Deep litter**	**Litter-free**	**Slatted**	**Partially slatted**
- water vapour	728.45aBcd	799.64aef	1068Beghi	832.88cfgjk	803.47dhjl	783.04ikl
- carbon dioxide	773.89abc	728.91ade	818.34bdg	837.65cehi	797.89fhj	748.6gij
- methane	1.91ab	1.64cde	2.5acf	2.40bdg	2.25eh	1.83fgh
- nitric oxides	0.054aB	0.043b	0.071abcde	0.042c	0.048d	0.039e
- ammonia	773,89abc	2,31acde	3,67bcfgh	6,85adf	5,24beg	2,89h
-hydrogen sulfur	2,93ab	0,084afGH	0,108GfIJK	0,261cGICM	0,322DHICN	0,129ekMN

aa – differences significant at P≥0.05; AA – differences significant at P≥0.01

Fig. 1. Climatic chambers