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Environmentally suitable feeding pig production II

Comparing emissions

A comparison of two feeding pig housing systems through continuous emission measurements showed a clear difference in housing parameters temperature, relative air moisture, gas concentrations and air volume flow between fully slatted housing with forced ventilation (VSP) and a housing system with separate climate areas and free shaft ventilation (GK). The average daily measurements of NH_3, CO_2 and CH_4 emissions taking all recording days into consideration were lower by the factor of 1.5 for the GK system.

Continuous measurement of ammonia (NH_3), carbon dioxide (CO_2) and methane (CH_4) emissions from fully slatted housing with forced ventilation (VSP) and freely ventilated housing with separate climate areas (GK) was carried out over four feeding cycles from October 1999 to April 2001 for evaluating the environmental effect of different feeding pig production systems. In the first article of this series on environmentally sustainable feeding pig production [1] results on the sensitivity and reliability of the measurement equipment as well as the methods applied were presented and discussed. In this, the second part, the results of the recordings will be presented.

Material and methods

The investigation was carried out during four consecutive feeding cycles during different seasons. Investigation subjects were a fully slatted house (VSP) with forced ventilation (underfloor exhaust) compared with housing featuring separate climate areas (GK), partly perforated flooring and free ventilation (shaft aeration) in simultaneous all-in, all-out systems. The relevant recording parameters for calculating the emissions, the gas concentrations (NDIR spectroscopy) and volume flows (calibrated measurement fans) and factors influencing the emission process were as far as possible recorded continuously online with high time-related accuracy [1]. A comparison of the emissions between the production systems was carried out three times per hour so that the subsequently presented daily averages are based on 72 individual values. To avoid a falsifying of results through unrepresentative measurements (vide full version in LANDTECHNIK-NET) only around 30% to 60% of the daily average values were in used in data processing and selection for presentation of emission rate comparisons.

Results

The peripheral conditions stocking density (measured in large animal units) and liquid manure parameters did not differ to any great extent between the systems VSP and GK. The air temperature and relative air moisture in the interior of the GK system followed to

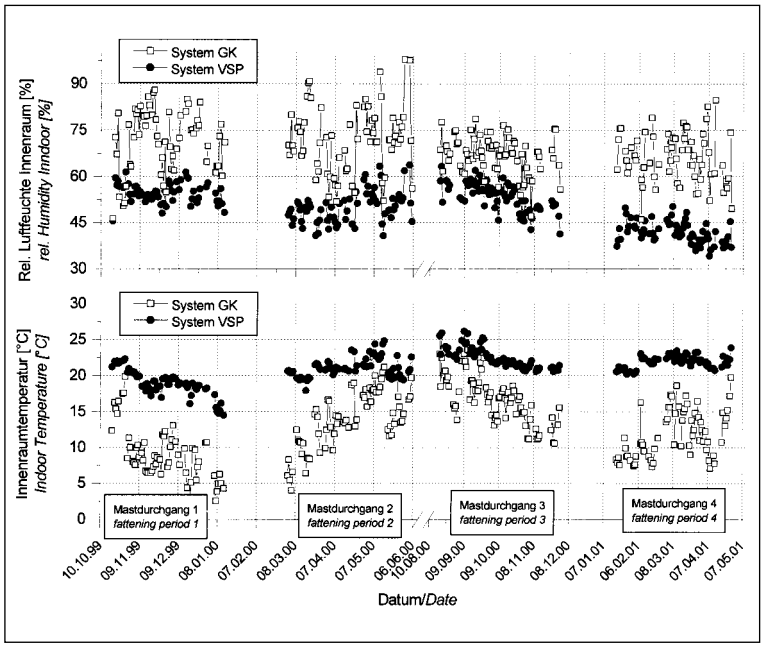

Fig. 1: Comparison of daily average temperatures and relative air moisture within production systems GK and VSP during the four investigated feeding cycles.

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a great extent conditions outdoors. As presented in *figure 1*, the GK temperatures lay basically, even on warm days, beneath those of the VSP system. The opposite was the case with relative air moisture with definitely higher values in the GK system.

The different functioning of the ventilation systems also led to clear differences between the housing systems. Above all in winter air volume flows in the GK housing were 2 to 4 times higher than those in the VSP system (*fig. 2* upper graphic).

The daily average of NH_3 emission rates (*fig. 2*, lower graphic) as well as those for CO_2 and CH_4, with all measurement days taken account of ended substantially lower for the GK system compared with the VSP system and a reduction in emissions could thus be determined based on large animal units.

The comparison of the average emission rates per feeding cycle between the production systems showed a very significant difference to the advantage of the GK system.

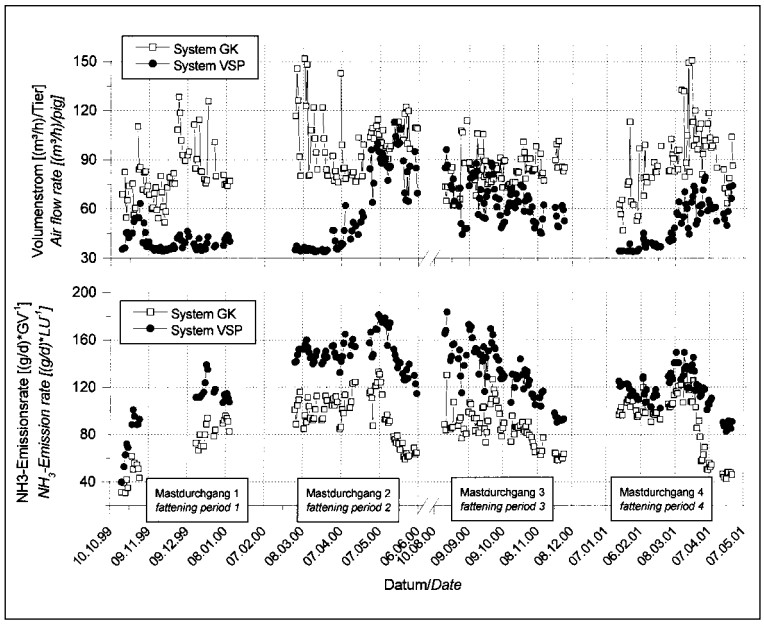

Fig. 2: Comparison of selected daily average recordings of air volume flow and NH_3 emission rates in the GK and VSP housing during four investigated feeding cycles.

Main reason for the higher emission rate in the VSP system was seen as the clearly higher interior temperatures and the expected effect on the liquid manure temperatures. Because of the positive influence of higher temperatures on the creation and release of higher emissions, a higher emission potential is given for the VSP system (vide full length version in LANDTECNIK-NET). In general, however, the effect must always be looked at in association with the ventilation rate and the air velocities on the emitting surfaces in each case [2].

Table 1: Comparison of NH_3, CO_2 and CH_4 emission rates in the systems GK (separate climate areas) and VSP (fully slatted flooring) over four feeding cycles

	Emission rate based on the selected daily average values from 0:00 to 24:00 in each case with 72 recordings					
	NH_3 [(g/d) • GV^{-1}]		CO_2 [(kg/d) • GV^{-1}]		CH_4 [(g/d) • GV^{-1}]	
Production system	**GK**	**VSP**	**GK**	**VSP**	**GK**	**VSP**
Feeding cycle 1 (17. 10. 99 - 13. 1. 00) 88 recording days						
Number of selected days	27 [A]	27 [A]	60	60	60	60
Average	67.2	100.8	11	17	21.6	72
5 % proportion	31.2	45.6	8.4	14	14.4	38.4
95 % proportion	93.6	136.8	14.6	20.5	60	91.2
Feeding cycle 2 (28. 2. 00 - 7. 6. 00) 100 recording days						
Number of selected days	64	64	64	64	64	64
Average	96	148.8	13.1	22.9	28.8	84
5 % proportion	62.4	127.2	9.2	16.1	21.6	55.2
95 % proportion	124.8	177.6	16.1	28.0	36	100.8
Feeding cycle 3 (14. 8. 00 - 1. 12. 00) 102 recording days						
Number of selected days	69	69	69	69	69	69
Average	86.4	134.4	10.7	18.8	36	134.4
5 % proportion	60	93.6	7.2	10.8	21.6	88.8
95 % proportion	115.2	168	16.9	32.4	48	189.6
Feeding cycle 4 (15. 1. 01 - 28. 4. 01) 102 recording days						
Number of selected days	63	63	30[B]	30[B]	30[B]	30[B]
Average	91.2	117.6	10.0	16.6	16.8	62.4
5 % proportion	45.6	86.4	3.5	5.4	7.2	38.4
95 % proportion	132	144	12.6	21.4	24	86.4

[A] Out of the first and last quarters of feeding period; [B] especially out of the first half of feeding period

Summary and outlook

The daily emission procedure and the peripheral conditions allow the cause and effect relationship to be precisely investigated. The results as well as the recommendations on emission reductions regarding gases relevant to climate and environment deduced from this work is to be presented in a subsequent and final text in these pages on environmentally sustainable feeding pig production.

Literature

[1] *Gallmann, E., E. Hartung und T. Jungbluth* : Umweltgerechte Mastschweinehaltung — Sensitivit t der Emissionsmessungen Landtechnik 55 (2000), H. 6, S. 439-431

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