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AMMONIA EMISSIONS FROM TWO DIFFERENT FLOORING SYSTEMS FOR HEAVY PIGS

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ABSTRACT

This report presents the results of a study carried out on an experimental farm in the Lombardy Region (Italy) on ammonia emissions from two different flooring systems for growing-finisher pigs.

Five groups of pigs were grown on a Fully Slatted Floor (FSF) with concrete slats and a deep pit underneath, from which slurry manure is removed at the end of the fattening period. Six groups were grown on a Partially Slatted Floor (PSF) with deep pit underneath, from which slurry manure is removed periodically during the fattening period. The results show that emissions are reduced by 16% in the PSF compared to FSF. Moreover, emissions increase during the finishing period. Considering ammonia emission per t of live weight, from the end of the growing period (80 kg of live weight) to the end of the finishing period, the increase is around 65% on the PSF and only about 12% on the FSF.

As expected, PSF effectively reduces the emissions with reference to the FSF. However, this benefit can be cancelled by the pigs fouling the solid lying area as they grow, and sometimes in summer season.

INTRODUCTION

Numerous data have been reported on ammonia emissions from pig housing for growing-finishing pigs of 110 kg final weight (4, 5, 6, 7). Much fewer data have been collected for the heavy pigs (30-160 kg) raised in Mediterranean climatic conditions.

The objective of this research was to establish and compare the ammonia emission factors of two different flooring systems at different stages of the finishing period. The research was carried out on an experimental farm in the Lombardy Region (Italy), where a sector with fully slatted floor and a sector with partially slatted floor were present (2, 3, 8).

MATERIALS AND METHODS

Figure 1 shows the planimetric layout of the two sectors. The first sector has a solid concrete floor and a 1.1 m strip of slats at the external part (PSF). The second sector has a fully slatted floor (FSF). For both sectors, a deep pit is present under the slatted floor for the collection of the slurry manure, from which the slurry is removed periodically in the PSF and at the end of the fattening period in the FSF. Each sector is divided into 8 pens, arranged in two rows separated by a central corridor. Twelve pigs are situated in each pen of 14.9 m^2, with a space of 1.3 m^2 assigned to each pig. The finishing period monitored went from 80 kg to 166 kg of live weight.

For the assessment of ammonia emissions in the two flooring systems, we surveyed the weight of the animals, the ambient conditions, and the concentrations of ammonia in three periods of the finishing phase.

Table 1 shows the duration of the three periods, the number of animals present and respective live weight. The animals were fed with liquid feed supplied twice a day.

The temperature and relative humidity were monitored constantly both inside and outside the two sectors.

The sector with PSF is ventilated above the slats with air intake from the windows on the eastern wall and outtake from the opposite wall where the fans are installed. In the sector with FSF, the air enters from the central part of the roof and is extracted on both walls by fans under the slats. Ventilation was monitored, noting the rotation frequency of the fans and correlating this value to the expelled air speed, measured on various occasions and at various rotation speeds.

For monitoring the ammonia emissions, a *Bruel&Kjaer* analyser model 1302 was used. The ammonia emission factor, determined at the end of each monitoring period, was obtained by multiplying the ventilation rate of the housing by the difference in concentration between the point of emission and the immediate outside environment. This factor was then correlated to the number of head present during the monitoring period and to their live weight. The latter figure was calculated on the basis of intermediate weighings.

RESULTS AND DISCUSSION

Figure 2 shows the inside and outside temperature trend of the two sectors for each of the three monitoring periods; the ventilation rate is shown in **Figure 3**. The surveys were conducted during the course of the winter-spring period with particularly low outside temperatures (mean outside temperature 8.4 °C), which conditioned both the inside temperature and the ventilation rate. In the sector with PSF, mean inside temperatures of 18°C were recorded, which was two degrees lower than those recorded in the FSF sector (**Table 2**). Similarly, the ventilation rates were lower in the sector with PSF (36.8 m^3/head·h) with respect to the sector with FSF (41.3 m^3/head·h).

The ammonia emissions from the two sectors, calculated as hourly emission per head and per t of live weight, are shown in **Table 3**. For the sector with PSF, mean emissions of 225 mg/head·h were recorded, equivalent on average to 1.54 kg/head·year (1 head = 100 kg). For the sector with FSF, mean emissions of 255 mg/head·h were recorded, equivalent on average to 1.93 kg/head·year (1 head = 100 kg).

Figure 4 shows the ammonia emission trends in the two sectors during the three monitoring periods per t of live weight present. The results show that ammonia emissions are reduced by 16% in the PSF sector compared to the FSF sector. Moreover, emissions increase during the finishing period, according to the increase of the ventilation rate and the fouling of the lying area. If we consider the amount of ammonia emitted per t of live weight, from the end of the growing period (80 kg of l.w.) to the end of the finishing period (about 160 kg of l.w.), the increase is around 65% in the PSF sector and only 12% in the FSF sector. The high increase of emissions in the PSF sector is due to the deposition of excreta in the solid lying area as a consequence of the insufficient slatted surface for the pigs in the last finishing period.

The tendency to foul the solid part of the pen in the PSF also increases with the high summer temperatures, when the pigs tend to lie down on the slatted part to better dissipate body heat (1, 9). To prevent this phenomenon, the animals need to be provided with an adequate extension of the slatted area and the inside environment should be efficiently climatised.

Table 1 - Animal parameters monitored during experimental periods

	Animals age	Partially slatted floor			Fully slatted floor		
	[days]	[n°]	[t]	[kg/head]	[n°]	[t]	[kg/head]
First period	86	78	6.8	87.0	96	7.8	80.9
Second period	132	78	9.3	119.1	96	10.8	111.6
Third period	182	78	12.6	161.3	96	14.5	150.9

Table 2 - Climatic conditions and ventilation rate monitored during experimental periods

	External conditions		Partially slatted floor room			Fully slatted floor room		
	T [°C]	Rh [%]	T [°C]	Rh [%]	Air flow [m^3/h.t lw]	T [°C]	Rh [%]	Air flow [m^3/h.t lw]
First period	5.3	93.2	17.5	97.1	218	19.3	80.7	433
Second period	7.3	80.5	16.1	75.9	301	19.7	69.7	320
Third period	12.6	72.8	20.4	67.8	343	21.7	58.2	353

Table 3 - Ammonia emissions monitored during experimental periods

	Partially slatted floor			Fully slatted floor		
	[mg/h]	[mg/h.head]	[mg/h.t lw]	[mg/h]	[mg/h.head]	[mg/h.t lw]
First period	8955	115	1321	16314	169	2090
Second period	16382	210.0	1763	23268	241.4	2164
Third period	27394	351	2174	34262	356	2356

Figure 1 - Layout of experimental pig housing

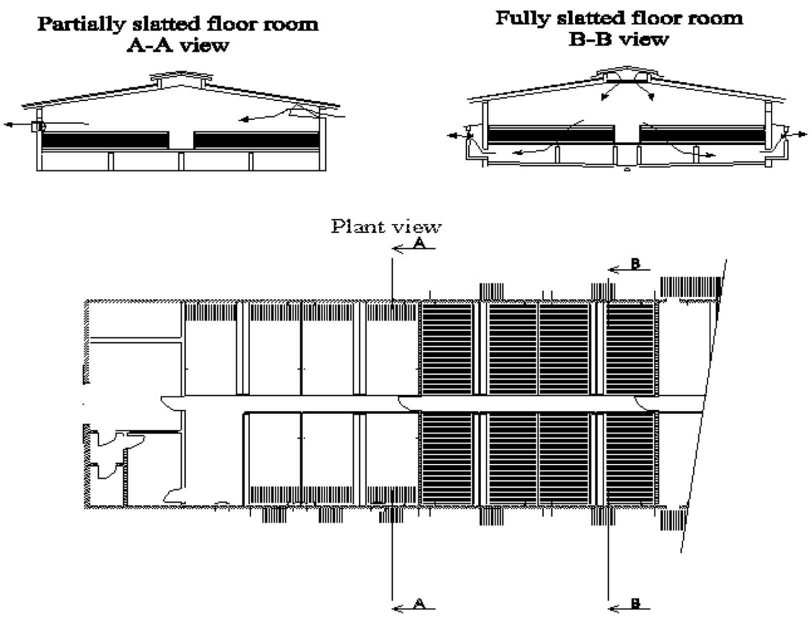


Figure 2 - Temperature patterns monitored during experimental periods

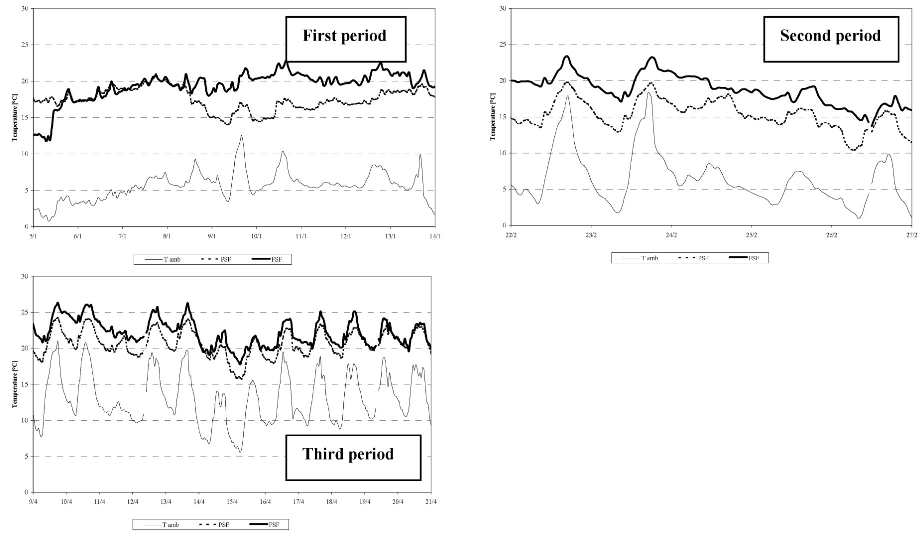
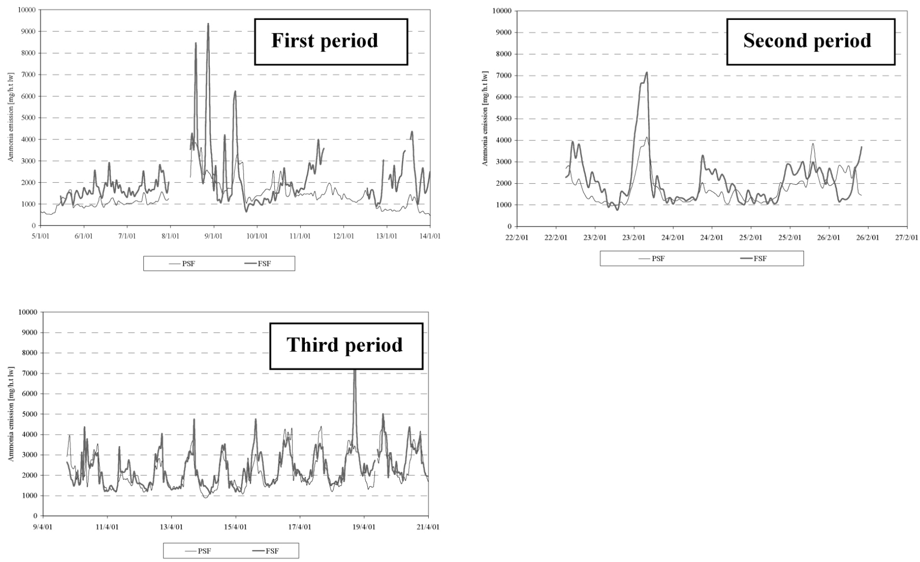


Figure 3 - Ammonia emission patterns monitored during experimental periods



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