RELATIONSHIP BETWEEN THE CONCENTRATION OF DIFFERENT AIR CONTAMINANTS AND THE HYGIENIC CONDITION IN TWO PIG FATTENING HOUSES

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Introduction

Several studies have demonstrated the effects of sub-optimal air quality on health and production efficiency of housed animals as well as on health of working personal (e.g. Donham, 1989). Identifying sources and factors affecting the generation of air contaminants is important to control the concentrations of these contaminants. In this study the relationship between the concentration of different air contaminants and the hygienic condition in two pig fattening houses was investigated.

Material and Methods

Animal houses studied

A description of the studied pig houses is given in Table 1. The hygienic conditions in both pig houses were characterized by visual scoring.

Table 1: Information about the pig houses where the measurements were made

Parameter	Pig house 1	Pig house 2
number of animals	600	450
Sizes	52 m x 15 m x 2.8 m	45 m x 15 m x 2.8 m
area per animal	1.3 m²	1.5 m²
volume per animal	3.6 m³	4.2 m³
Floor	slatted floor	slatted floor
feeding system	slop feeding	slop feeding
Ventilation	fan forced draught ventilation, negative pressure	fan forced draught ventilation, negative pressure
manure handling system	flush system (gate valve)	flush system (gate valve)
all in/all-out management system	yes	yes
routine cleaning of pens	twice a day, directly after feeding	only sporadically in heavy contaminated pens

Bioaerosol parameters studied

The following parameters were determined in both animal houses on 10 different days:

inspirable dust (PGP dust-sampling system, Ströhlein GmbH, Kaarst, Germany)

endotoxins in inspirable dust (Limulus Amebocyte Lysate Assay, QCL-1000, Cambrex, Walkersville, USA)

concentration of total airborne aerobic bacteria (AGI-30 Impinger, Standard I-agar, 24h at 37 °C)

concentration of airborne gram-negative aerobic bacteria (6-stage Andersen Sampler; MacConcey 3-agar, 24 h at 37°C and 24 h at 22°C)

concentration of airborne *Clostridium perfringens* (6-stage Andersen-sampler, Dextrose-blood-agar, 48 h at 37 °C under anaerobic conditions)

Further, the species composition of the airborne gram-negative bacterial flora was investigated by using the api 20 NE and api 20 E systems (Bio Mérieux, Marcy-I'Etoile, France).

Results and Discussion

In the study presented here the relationship between the hygienic condition and the concentration of different air contaminants in two pig fattening houses was investigated. Both pig fattening houses were of the same building type and used identical feeding and manure handling systems. However pig house 2 showed deficiencies in routine cleaning of pens (Table 1). These were characterized by an increased soiling of animals and pen floors with faeces. These deficiencies were reflected by significantly increased concentrations of airborne dust, airborne endotoxins as well as significantly increased numbers of total airborne bacteria and airborne gram-negative bacteria (Mann-Whitney U test, $\alpha < 0.05$) (Table 2).

Table 2: Concentration of airborne dust, total airborne aerobic bacteria, airborne gram-negative bacteria and airborne *C. perfringens* in pig house 1 and 2

	Dust* (mg/m³)		Endotoxin* (EU/m³)		Total aerobic bacteria* (cfu/m³)		Gram-negative bacteria* (cfu/m³)		*C. perfringens* (cfu/m³)	
	House 1	House 2	House 1	House 1	House 1	House 2	House 1	House 2	House 1	House 2
Median	1,7	2,8	1584	2544	25000	330500	17,7	101,6	3,8	1,2
Maximum	2,7	6,3	3218	9452	239000	915000	84,8	325,1	54,2	5,9
Minimum	0,8	2,0	429	1566	12000	124000	3,5	14,1	n.d.	n.d.

EU = Endotoxin Units, *C = Clostridium*, cfu = colony forming units, n.d. = not detected

* = parameter, that were significantly different among both animal houses (Mann-Whitney U test, $\alpha < 0.05$)

Within the airborne gram-negative bacterial flora of pig house 2 especially the number of airborne *E. coli*, a faecal indicator bacterium, was increased. In pig house two 61% of all isolated airborne gram-negative bacteria were identified as *E. coli,* in pig house 1 only 34%, respectively. Therefore it is likely that dust particles, bacteria and endotoxins were generated

from dried faeces on stable and animal surfaces. Similar results were found in Australian piggeries (Banhazi et al., 2004).

However, the deficiencies in routine cleaning in pig house 2 were not reflected by the concentration of airborne *Clostridium perfringens* which were earlier postulated as an indicator of faecal pollution in the air of cattle barns (Chai et al., 1997, Draz et al., 1999). This should be the result of differences in the presence of *Clostridium perfringens* in the faeces of pigs and cattle. *Clostridium perfringens* can be isolated regularly and in higher concentrations from the faeces of healthy cattle. But faeces samples of healthy pigs show only a low presence of this bacterial species (Tschirdewahn et al. 1991, Miwa et al. 1997).

Conclusion

The results of these investigations indicated that faecal material deposited on stable and animal surfaces is an important source for airborne dust particles, bacteria and endotoxins. Daily cleaning of pen floors is recommended to reduce this source of air contaminants.

References

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