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Research Paper

Does rearing system (conventional vs. organic) affect ammonia emissions during the growing and fattening periods of pigs?

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Ammonia emissions from organic (ORG) and conventional (CON) rearing systems in relation to pig growth rate and behaviour were studied. Microclimatic conditions and ammonia concentrations were monitored. Excretory behaviour was recorded in the growing and fattening periods using video cameras. Throughout the experiment, significantly lower ammonia emission was detected in facilities of the ORG pigs ($P < 0.001$). The differences in ammonia emission may be partially explained as a consequence of lower level of crude protein, lower feed intake and different growth performance of ORG pigs. Urination and defecation indoor (on the slatted and solid floors) were higher in the CON group ($P < 0.05$). The results of the present study show that the minimum requirements specified in organic legislation are well suited to normal pig excretory behaviour in both growing and fattening stages and provides pigs cleaner indoor space as well as an improved environment for human and pigs, with around 40% of reduced ammonia emission.

1. Introduction

The housing standards for organic pig production are based on creating an environment in which the animals can express their natural behaviour, ensuring a high welfare standard (EC, 889/2008). Organic standards are higher than conventional standards for housing, nutrition, breeding and veterinary management. Changes in housing conditions such as floor type, space allowance, and access to an outdoor area, as well as in diets that do not use synthetic amino acids and growth promoters, could affect pig performance and carcass and meat quality (Lebret, 2008). Therefore, it has been suggested that performance and carcass and meat quality of pigs reared under organic conditions could be the same (Hansen, Claudi-Magnussen, Jensen, & Andersen, 2006; Millet, Hesta, & Seynaeve, 2004), or even better, than pigs from conventional rearing systems (Oksbjerg, Strudsholm, Lindahl, & Hermansen, 2005; Olsson, Andersson, Hansson,

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Nomenclature

ORG	Organic rearing system
CON	Conventional rearing system
mean	Arithmetic mean
SE	Standard error
GLM	General linear model
GLIMMIX	Generalised linear mixed model
CP	Crude proteins
Lys	Lysine

& Lundstrom, 2003; Sundrum, Butfering, Henning, & Hoppenbrock, 2000).

To meet organic and conventional legislation regarding gas concentrations in animal facilities (EC, 889/2008; UL RS, 2007 – adopted EU legislation), gaseous emissions from facilities should be decreased as much as possible. With regard to ammonia production, pig production is one of the major contributors (Aneja, Chauhan, & Walker, 2000; Groot Koerkamp et al., 1998). High ammonia concentrations and emissions have a negative effect on the environment (Pain, van der Weerden, Chambers, Phillips, & Jarvis, 1997), human health (Urbain, Gustin, Prouvost, & Ansay, 1994) and on the health of pigs (Gerber, Mancl, Veenhuizen, & Shurson, 1991). However, only a few studies have evaluated the impact of organic pig production on ammonia emissions (Dalgaard, Halberg, & Kristensen, 1998; Ivanova-Peneva, Aarnink, & Verstegen, 2006; 2008) and none has compared ammonia emissions in conventional and organic rearing systems under similar conditions throughout different pig growing stages. Therefore, the aim of the present study was to compare the ammonia emissions during different growing periods of pigs from conventional and organic rearing pig facilities. In addition, fattening and growing characteristics, as well as the behaviour of pigs with regards to urination and defecation were determined.

2. Material and methods

2.1. *Animal and feed*

The study was conducted during one full growing period of pigs from birth to slaughter. The experiment started in June 2010 and lasted until December when pigs were 26 weeks old. Sixty-six pigs, progeny of Landrace × Large White dams and Landrace × Pietrain sires, were divided into 2 homogeneous groups according to sex and body weight at farrowing. The conventional group (CON; $n = 33$) was reared according to Slovenian conventional practices (UL RS, 2007), while the organic group (ORG; $n = 33$) was reared under EU organic legislation (EC, 889/2008). From the second week of lactation, all the piglets were provided additional feed as pellets. Table 1 presents the composition of the feed according to the manufacturer.

Feed intake was determined daily, while drinking water was available *ad libitum*. The pigs were weighed individually one day after birth and at 4, 11 and 26 weeks of age. Daily gains were calculated using the data on body weight and age at weighing for the whole experimental period and for the periods between sequential weight measurements. Feed intake was recorded per pen and divided by the number of pigs to give the daily intake per pig. Feed conversion efficiency was calculated per pen as the ratio between feed intake and individual live weight gain for each period.

2.2. *Housing facilities*

The investigation was conducted in the Pig Research Centre at Faculty of Agriculture and Life Sciences, University of Maribor, Slovenia. National legislation on animal protection rules was followed (UL RS, 2007). The ORG pigs also had access to an outside area, as prescribed in EU organic legislation (EC, 889/2008).

Two equal farrowing rooms with 4 pens each were assigned to one of the rearing systems (CON, ORG). Each farrowing pen with crates ($1.8\ m \times 2.5\ m = 4.5\ m^2$) consisted of solid and slatted floors. The solid concrete floor ($3.0\ m^2$) was located beside the feeder and drinker, and was covered with insulating panels. The floor at the back side of the pen was slatted with slits 5 mm × 50 mm. The pen partition wall was 1.0 m high, with a corridor 1.2 m wide.

At weaning (28 d for the CON group and 42 d for the ORG group), pigs were transferred to two growing facilities within the same building. In this phase, the pen size was $2.00\ m \times 1.80\ m = 3.6\ m^2$. Each pen consisted of two thirds plastic slatted floor (slits 50 mm × 10 mm) in the front and one third solid floor covered by a plate and closed with plastic flaps. Each pen had a drinker over the slatted floor. In addition, ORG piglets had access to a fully slatted outdoor area ($2.4\ m^2$) with a pit slurry underneath.

In the fattening phase (11–26 weeks of age), rooms with areas of $86\ m^2$ were used for each group. Pens ($7.9\ m^2$) consisted of two thirds solid concrete floor and one third slatted floor. Fatteners were fed in a feeder trough with 0.33 m per pig in the CON and ORG group. Drinkers were positioned above the slatted floor. In addition, ORG fatteners had access to an outdoor area ($6.6\ m^2$). The outdoor floor areas were fully slatted, with a pit slurry underneath.

Pigs were kept in buildings with a combination of natural and artificial lighting. Light intensity was above 40 lux for 8 h per day (UL RS, 2007). The slurry pit was 2.0 m deep and was emptied two weeks before the start of the experiment. Fresh air entered the room through a diffuse ceiling, and each room had one exhaust unit with a ventilator.

2.3. *Microclimatic measurements*

The outdoor temperature was measured with an EL-USB-2 data logger (Lascar Electronics Limited, Salisbury, Great Britain). An ECHO monitoring system (ECHO D.O.O, Slovenske Konjice, Slovenia) was used to measure ammonia (NH_3) concentrations, carbon dioxide (CO_2), air velocity, relative humidity, temperature, barometric pressure and light intensity indoor for each group separately.

The ammonia concentration was measured with an electrochemical galvanic cell. The sensor measurement accuracy