Livestock Science 199 (2017) 37–45

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Comparing gestating sows housing between electronic sow feeding system and a conventional stall over three consecutive parities

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ARTICLE INFO

Keywords:
ESF system
Group housing
Sow
Reproductive performance
Parity
Stall

ABSTRACT

This study was conducted to investigate the effects of gestating sows housed in groups with electronic sow feeding (ESF) system over three consecutive parities. A total of 83 pregnant gilts [Yorkshire×Landrace] were housed into ST: gilts housed in individual stalls, and ESF: gilts housed in groups with ESF system on the basis of body weight (BW) and backfat thickness (BFT) in a completely randomized design. Rice hulls were used as bedding material on the group housing floor. The same commercial gestating diet was provided daily at 2.0 kg, 2.2 kg and 2.4 kg/day in the first, second and third parity, respectively, in both treatments. All sows introduced farrowing crates five days before expected farrowing. BW and BFT of the sows were measured at d 35, and 110 of gestation as well as at 12 h and d 21 postpartum. Parturition time was recorded during farrowing. Reproductive performance, including total born, stillborn, mummy, born alive, mortality, weaning pigs as well as litter and piglet weight were recorded. Scratch incidence and locomotion scores in sows were assessed at d 36, 70, and 110, respectively. Ten sows in each treatment were randomly selected for blood sampling. Serum samples were analyzed for cortisol and oxytocin levels. In the gestation period, ESF tended to increase BW gain in the second parity (P=0.08), and consistently showed significance during the third parity (P < 0.01), resulting in higher BW at d 110 (P=0.10, P < 0.03 in parities 2 and 3, respectively). Similarly, BFT gain tended to be higher in ESF than ST (P=0.08, P=0.10 in parity 1 and 2, respectively). Estimated body fat contents changes are also higher in ESF regardless of the parities (P < 0.01, P < 0.02, P=0.10 in parities 1, 2, and 3, respectively). However, there were no significant differences on sow BW and BFT changes during lactation. There was a tendency of shorten duration of farrowing in the ESF treatment (P=0.07, P=0.09, and P=0.10 in parities 1, 2, and 3, respectively). In reproductive performances, higher piglet stillborn in ST was observed (P=0.06, P=0.07 in parities 2 and 3, respectively). In endocrinal analysis, ST higher serum cortisol was observed at d 110 of gestation (P < 0.01 in parity 1), whereas no detectable difference was observed in the serum oxytocin level. Higher incidence of body scratch was scored in ESF treatment in early gestation in all parities (P < 0.01). Likewise, ESF treatment were observed higher locomotor disorders in the middle and late gestation periods (P=0.07). In conclusion, our results suggested that the Group housing with ESF system showed higher growth performance and survival rate of piglets. However, more incidences of body scratch and higher locomotion disorder scores observed in the ESF sows was due to the combination of persistent fighting around the ESF machines and inadequate bedding materials. Consequently, it is necessary to consider an adequate space divider or barrier for gestating sows to avoid aggression in the group housing with ESF system.

1. Introduction

The European Union has prohibited the use of gestating crates for pregnant sows. Even though keeping pregnant sows in an individual crate is still widely used in the United States and Asia because of the ease of artificial insemination, smaller land requirements, individual feeding and minimize aggressive interactions (Harris et al., 2006). However, as public concerns for animal welfare issues are increasing gradually, group housing systems for most of the gestation sows are attracting an interest from pig producers.

The modern type of group housing for sows with individual feeding is the electronic sow feeding (ESF) system. ESF has been introduced in response to the impact of animal welfare over a decade ago. However, its effect on sow welfare is inconsistent because of the complexity and wide disparity in the design and management of commercial group housing systems, such as space allowance, group type and size, and

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http://dx.doi.org/10.1016/j.livsci.2017.02.023
Received 10 March 2016; Received in revised form 21 November 2016; Accepted 21 February 2017

feeding system (Verdon et al., 2015). Several experimental studies and reviews assessed the effect of the group housing system using multiple welfare indicators (Spoolder et al., 2009; Bench et al., 2013; Verdon et al., 2015). These categories predominantly included physiology, behaviour and health, reproductive performance and productivity (McGlone et al., 2013). Especially, sow injuries caused by aggressive interactions were mostly pronounced in the ESF system, which may negatively affect sow welfare (Jang et al., 2015). However, information is lacking on the long-term and carry-over effects of the static group during gestation to lactation on reproductive performance and body composition of the sows.

Therefore, an experiment was conducted to assess the welfare and productivity of gestating sows in groups with ESF during the first three parities.

2. Materials and methods

All experimental procedure performed in this study was approved by the Animal Care and Use Committee of the Seoul National University. The experiment was conducted from January 2013 to May 2014 at the Jacob Swine Research Farm, in Eumseong-gun, Chungcheongbuk-do, Korea Republic. Animals, housing conditions, and experimental designs are equal to our previous study (Jang et al., 2015).

2.1. Animals, housing and experimental design

Initially at breeding, 90 crossbred gilts (F_1, Yorkshire×Landrace, Darby, Anseong-si, Gyeonggi-do, Korea republic) with an average age of 180 d and about 105 kg of body weight (BW) were housed in groups with an electric sow feeding (ESF) system. During adaptation, five gilts were excluded because of the poor adoptability of the feeding machine. Gilts bred on at least their second estrus were introduced into individual gestation stalls in an environmentally controlled barn. Estrus was diagnosed twice daily in the presence of a mature boar, using the backfat pressure test. Gilts were twice served artificial insemination (AI) with fresh diluted semen (Darby A.I. center, Chungju-si, Chungcheongbuk-do, Korea Republic) at 12 h intervals. Pregnancy of the gilts was diagnosed by an ultrasound analyzer (Easyscan, Dong-jin BLS Co., Ltd., Gwangju-si, Gyeonggi-do, Korea Republic) on d 28 and 35 postcoitum. Two gilts that returned to estrus after the first insemination were not used in this experiment, and pregnant gilts were housed either in ESF (n=42), or ST (n=41) on the basis of BW and backfat thickness (BFT) in a completely randomized design (Fig. 1). Both treatments were fed corn-soybean meal based commercial gestation diet containing 3265 kcal of ME/kg, 12.60% crude protein, 5.76% crude fat and 4.9% crude ash, respectively. Diets were provided daily at 2.0, 2.2, 2.4 kg/day for the first, second and third parity, respectively.

ST treatment gilts were housed in a gestation barn with an individual crate (2.15×0.6 m) with a fully slatted concrete floor. Beddings were not provided. Air temperatures and ventilation rates were measured and determined with sensors, which were installed near the sows and were manipulated by an automatic climate control system (KO-850, KUN OK Co., Ltd., Nonsan-si, Chungcheongnam-do, Korea Republic). The average temperature during the entire experimental period was 20.4 °C, with a range from 13.7°C to 29.2 °C. Lights were provided with eight windows and three fluorescent lights, which were switched on at 08:00 and switched off at 20:00. Feed was accurately weighed by a scale (SW-1W, CAS Co. Ltd., Yangju-si, Gyeonggi-do, Korea Republic), and was provided twice a day (08:00 and 16:00) by feed buckets through an individual feeder with one waterer per gilt.

ESF treatment gilts were housed in two gestation pens (15.2 m×10.2 m, 3.8 m^2/head) with a full concrete floor. As bedding materials, three sacks of rice hulls (120 kg) were provided around the lying area every two weeks. Minimum bedding depth was approximately 10 cm. The same automatic control system for air temperature and ventilation was installed in the barn. The average temperature in the ESF barn during the entire experimental period was 20.9 °C, with a range from 14.0°C to 29.5 °C. Manure and drains were cleaned every morning (09:00) by same stockperson. Water was provided ad libitum by five nipple drinkers per pen. There are four windows on the pen for natural light. Additionally, four fluorescent lights (60 W) were supplemented, which were turned on 08:00 to 18:00. The ESF station (Compident VII, Schauer, Prambachkirchen, Austria) was located in the middle of the pen and operated from 08:00 to 18:00. An Expert engineer calibrated the feeders and inspected the computer system every week. Gilts were identified by a radio-frequency identification (RFID) tag and provided an allocated amount of feed individually.

At d 110 of gestation, all sows were moved to the farrowing crates (2.20×0.65 m) with partition walls (2.50×1.80 m) after washing and disinfecting their body. During lactation, the room temperature and air conditioning of the farrowing barn were kept automatically at 25 ± 3 °C by heating lamps and ventilation fans. After weaning, sows were moved to the breeding barn again for the next conception. The same treatment was continued on their assigned treatment through three successive reproduction (gestation-lactation) cycles.

2.2. Sow and litter performance

In the gestation barn, BW and BFT of sows were measured at days 35, and 110 of gestation and 12 h, 21 d postpartum. BFT was measured at the P_2 position (last rib, 65 mm from the center line of the back) on both sides of the back bone using an electric measuring device (Lean-Meater®, Renco Corp., Minneapolis, MN, USA). Values from the two measurements were averaged to record a single BFT. Muscle and protein composition during gestation of the sows were calculated on the basis of BW and BFT, using the equations adapted from Dourmad et al. (1996, 1997), respectively.

$$\text{Muscle (kg)} = -9.2 + 0.61(\pm 0.052)\text{BW} - 0.86(\pm 0.29)\text{BFT}$$

$$\text{Protein (kg)} = 2.28 + (0.178 \times \text{EBW}) - (0.333 \times \text{BFT})$$

*EBW (kg) = sow empty live weight estimated from the live weight ($= 0.905 \times \text{BW}^{1.013}$)

In the lactation barn, the duration of farrowing, which is defined as the interval between the complete expulsion of the first and the last piglet, was recorded by full-high digital camcorders (HMX-M20BD, Samsung, Suwon-si, Gyeonggi-do, Republic of Korea). Litter traits included the number of piglets born alive, stillborn, mummies, and losses. Within 24 h after birth, the litters were weighed individually by scale (SW-1W, CAS Co. Ltd., Yangju-si, Gyeonggi-do, Korea Republic), given a gleptoferron injection (463 mg/mL equivalent to elemental iron 200 mg/mL; Gleptosil, Intervet Korea Ltd., Seoul, Republic of Korea), ear-notched, needle teeth and tails clipped. Male piglets were castrated after the age of three days. Cross-fostering was performed within each treatment when possible. Litter size after fostering for each sow was determined by the number of functional teats. The piglets had no access to creep feed throughout lactation during the entire experimental periods. Litter and mean pig birth BW, weaning BW, and mean BW gain from birth-to-weaning were calculated. All sows were moved to gestation stalls as soon as all piglets were weaned (approximately 21 days), and then wean-to-estrus interval (WEI) was scored for the next pregnancy.

2.3. Health status

For health descriptors, skin injuries and locomotion scores were recorded in both treatments on each of d 36 (one day after mixing), 70, and 110 as described by Karlen et al. (2007). Both measurements are described in more detail in Jang et al. (2015). Skin injuries were categorized into three regions: front (head, ear, neck, shoulders and