

EFFECTS OF LACTATING ENVIRONMENT ON SURVIVAL OF PIGLETS AND ANIMAL WELFARE OF LACTATING SOWS

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ABSTRACT

The use of conventional farrowing crate is controversial issue from the view point of animal welfare. Two studies were designed to evaluate the effect of farrowing crate on the postpartum survival of piglets and the welfare of sows. In experiment 1, 24 multiparous TLRI Black Pig (TBP) sows were allocated to four treatments, where sow and her piglets were moved to concrete floor free pen on day 4 (F), 7 (S) or 10 (T) until day 28 post parturition. In experiment 2, 36 multiparous TBP sows were allocated to three treatments, where sow and her piglets were moved to wire-meshed floor free pen on day 4 (D-4) or day 7 (D-7) until day 21 post parturition. Sows and piglets stayed in farrowing crate throughout the experiment in both experiments was control group (C). The survival rate of piglets and physiological and the behavioural data of sows were collected in both experiments. The results showed that daily feed intake and the physiological parameters in terms of the concentration of salivary cortisol in experiment 1 and respiratory rate and rectal temperature were not different among treatments in both experiments. The F group decreased the survival rate of piglets from day 10-28 and day 14-28 compared to C and T groups ($P < 0.05$) in experiment 1 and the D-4 group in experiment 2 tended to decrease the survival rate of piglets from day 7-10 compared to C groups ($P < 0.10$). Behavioural data indicated that the sows raised in free pen totally changed postures more than the sows raised in conventional crate did. Lying occupied the most of time budget in both experiments. Therefore, these results indicated that the farrowing crate could protect neonate but the sows and piglets might be raised in free pen on specific day post parturition to improve the welfare of sows.

Key words: Lactating sows, Piglets, Survival Rate, Welfare

INTRODUCTION

Postpartum death is still one of the main causes of reduced production efficiency in swine herds for decades. Investigation from Dyck and Swierstra (1987), Marchant *et al.* (2000) and Rootwelt *et al.* (2013) have effectively described the timing and causes of piglet death. About 40-50% of the deaths occur during the first three-day after birth. The mortality reduces gradually at the seventh day post-parturition afterwards (Hartsock *et al.*, 1977; Dyck and Swierstra, 1987). In conventional production system, lactating sow is raised in narrow farrowing crate, which is a controversial issue regarding of animal welfare. The main purpose of such farrowing facility is to enhance production efficiency in terms of increasing number of sows raised within unit area. Furthermore, the farrowing crate limits the activity of sows as a result to protect the neonatal piglets from crushing when sows changing their posture particularly when sows are lying down. However, such confine of activity to sows impairs the

expression of normal behaviour of sows (Jensen, 1988; Fraser and Broom, 1997) and induce physiological stress (Jarvis *et al.*, 1997) of sows. Therefore, the aim of this study was to investigate whether sows could be raised without the crate on a certain day post-parturition during lactation period in which the survival rate of piglets and animal welfare of sows could be concerned at the same time.

MATERIALS AND METHODS

Animals and Management

The experimental subjects were 60 litters of TLRI Black Pig (TBP) multiparities sows. At approximately 1 week before the expected parturition day (calculated on the basis of 114 days of pregnancy), each sow was moved into a 0.55 x 2.08-m farrowing crate, with a 0.5 x 1.02-m creep area on the side. In the first experiment, 24 TBP sows were allocated to four treatments, where sow and her piglets were moved to concrete free pen (3.224 m²) without crate with a piglet creep area (0.51 m²), on day 4 (F), day 7 (S) or day 10 (T) until day 28 post parturition. In the second experiment, 36 TBP sows were allocated to three treatments, where sow and her piglets were moved to wire-meshed floor free pen (3.224 m²) without crate with a piglet creep area (0.51 m²), on day 4 (D-4) or day 7 (D-7) until day 21 post parturition. Sows and piglets stayed in the farrowing pen with crate throughout the experiment in both experiments was control group (C). A commercial pelleted lactation dry feed (14.4% crude protein, 3226 kcal/kg DE and 0.69% lysine) was offered twice daily to the sows and water was constantly available to the sows and piglets from a pressurized watering bowl at the front of the farrowing crate and free pen throughout the lactation period. All procedures were approved by the Institutional Animal Care and Use Committee of the Livestock Research Institute, Taiwan.

Recorded Variables

In both experiments, piglets were identified by ear notching within 24 h of birth. Once piglet died, the date of death was recorded and survival rate of piglets was calculated. Feed intake of the sows was measured during lactating period. On day 14-15 post parturition in experiment 1, behaviour of the sows was filmed. The 24-hour posture pattern of the sows were analysed from the record by playback. In addition, respiratory rate and rectal temperature of the sows were measured and saliva was collected of sows at 13.30 h on day 14 post parturition. The recorded variables in experiment 2 were the same as experiment 1 despite of the experiment was carried out from day 1 to 21 post parturition and the behavioural parameters were recorded for 6 h from 09.00 h to 15.00 h on day 14 post parturition and without saliva collection. The behaviours were defined as below: (a) Stand: Sow was upright with legs extended and all four feet on the ground; (b) Lie ventrally: Lying on udder with neither shoulder touching the floor; (c) Lie laterally: Lying with udder exposed and one shoulder completely in contact with the floor. Spine line is either left or right of centre; (d) Kneel: Front legs bent with two back feet on the floor and back legs extended. This is a transitory posture during lying down or when the sow was trying to reach something under the trough or bars; (e) Sit: Rear end on the floor with two front feet on the floor and front legs extended.

Statistical Analyses

Statistical analyses were performed using the general linear model procedure of SAS (2002) for a completely randomized design. Sow served as the experimental unit for feed intake,

physiological and behavioural data. In addition, litter served as the experimental unit for survival rate of piglets. Differences among means were tested using Duncan's multiple-range tests. Treatment effects were considered significant at $P < 0.05$, whereas $P < 0.10$ was considered a statistically significant trend.

RESULTS AND DISCUSSION

Feed intake and physiological parameters of sows

No matter the sows raised in conventional crate or partial time in the crate and partial time in either concrete floor or wire-meshed floor free pen, it would not affect the feed intake of sows (Tables 1 and 2). On day 14 post parturition, the physiological parameters in terms of respiratory rate and rectal temperature were not significant different among treatments in both experiments (Tables 1 and 2). The concentration of stress-related hormone i.e., salivary cortisol was not significant different among treatments in experiment 1 (Table 1).

Table 1 Effects of lactating environment on feed intake and physiological parameters on sows (experiment 1)

Items	Treatment ⁽¹⁾				SEM
	C	F	S	T	
Daily feed intake, kg /d	3.00	2.60	2.60	3.10	0.60
Respiratory rate, no./min	49.30	50.30	63.00	69.90	22.70
Rectal temperature, °C	38.70	39.10	38.90	38.90	0.50
Salivary cortisol, ug/dL	38.70	39.10	38.70	0.70	0.70

⁽¹⁾C: control group, sow and her piglets stayed in farrowing crate throughout the experiment. F, S, and T represented sow and her piglets were moved to concrete floor free pen on day 4, 7 and 10, respectively until day 28 post parturition.

Table 2 Effects of lactating environment on body weight, backfat, feed intake and physiological parameters on sows (experiment 2)

Items	Treatment ⁽¹⁾			SEM
	C	D-4	D-7	
Daily feed intake, kg /d	3.1	3.2	3.1	0.4
Respiratory rate, no./min	59.2	59.3	59.0	11.5
Rectal temperature, °C	39.1	39.7	39.6	0.8

⁽¹⁾C: control group, sow and her piglets stayed in farrowing crate throughout the experiment. D-4 and D-7 represented sow and her piglets were moved to wire-meshed floor free pen on day 4, and 7, respectively until day 21 post parturition.

The respiratory rate of pigs is mainly affected by the surrounding environment and the heat loss efficiency of the pigs. Pond and Maner, (1984) found that the respiratory rate of growing pigs was 30.6 times every minute under 30°C environment while the respiratory rate

increased to 78.8 times every minute when the ambient temperature increased to 32.2°C. This study was carried out during hot season, therefore the respiratory rate of the sows ranged between 50 to 70 times every minute.

The rectal temperature of growing pigs was 39.2°C under 26-27°C environment and the rectal temperature would increase to 40.0°C when the ambient temperature increased to 37.8 °C and lasted for 1 week (Pond and Maner, 1984). Pigs are homoiothermal animals. Unless facing extreme high temperature, the rectal temperature would not change dramatically. Therefore rectal temperature of the sows in this study kept in a constant range.

Salivary cortisol is an indicator of stress. In experiment 1, the saliva was collected on d14 post parturition. At that time, for F, S and T sows, they had stayed in the free pen for 10, 7 and 4 days, respectively. Though the space of free pen is higher than the conventional crate, such free pen environment could not decrease the concentration of salivary cortisol.

Survival rate of piglets

When the sows and their litter moved to free pen on day 4 post parturition, it would significant decrease the survival rate of piglets from day 10-28 and day 14-28 compared to C and T groups ($P < 0.05$) (Fig. 1). There was not significant difference between F and S groups and among C, S and T groups. Similar results were found in experiment 2 that D-4 group tended to decrease the survival rate of piglets from day 7-10 compared to C groups ($P < 0.10$) (Fig. 2). The survival rate of piglets from day 7-21 was not different among treatment (Fig. 2).

Most of the deaths of neonatal piglets occur during the first three-day after birth (Dyck and Swierstra, 1987; Marchant *et al.*, 2000 and Rootwelt *et al.*, 2013). The mortality reduces gradually at the seventh day post parturition afterwards (Hartsock *et al.*, 1977; Dyck and Swierstra, 1987). Based on present study, it might be too early to move the sows and the litters to the free pen on day 4 post parturition. Nevertheless, they could be moved to free pen on day 7 or day 10 post parturition.

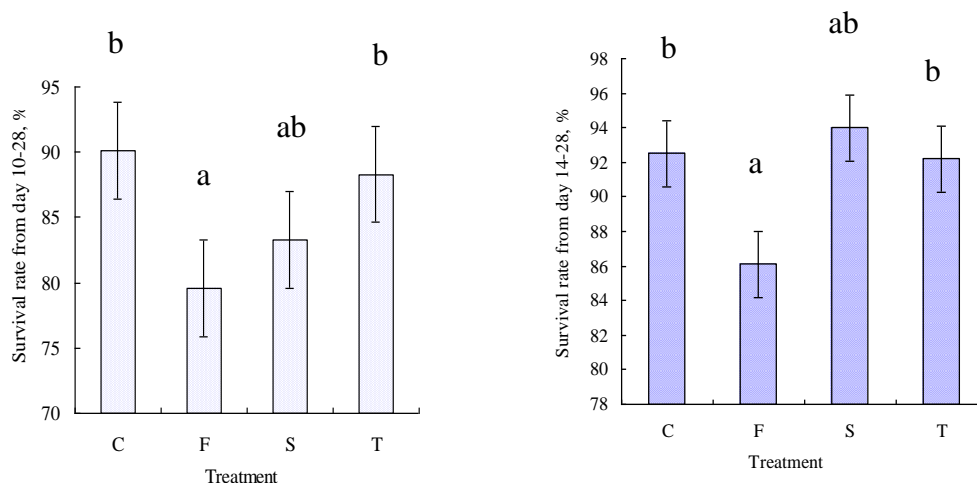


Fig. 1. Survival rate of piglets from day 10-28 (left) and day 14-28 (right) post parturition in experiment 1. Abbreviations of C, F, S and T, see footnote to Table 1.

^{a,b}Letters above the bars without the same differed significant ($P < 0.05$).

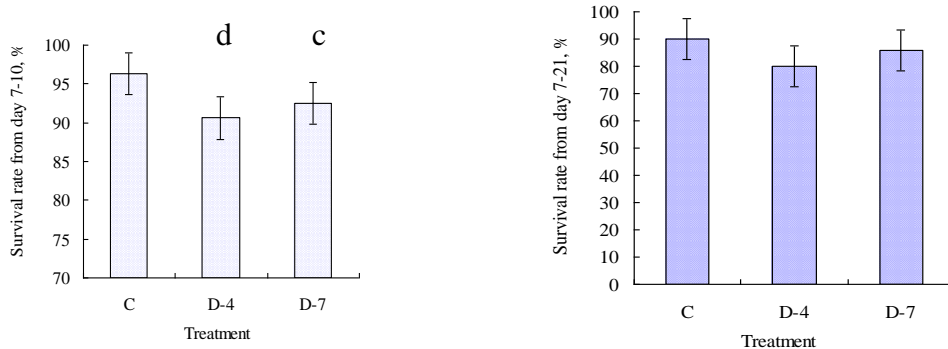


Fig. 2. Survival rate of piglets from day 7-10 (left) and day 7-21 (right) post parturition in experiment 2. Abbreviations of C, D-4 and D-7, see footnote to Table 2. ^{c,d}Letters above the bars without the same tended to differ ($P < 0.10$).

Behavioural parameters of sows

Behaviour analysis revealed that the sows raised in concrete or wire-meshed free pen totally changed postures more than the sows raised in conventional crate did (left of Figs. 3 and 4). Lying occupied the most of time budget in both experiments (right of Figs. 3 and 4).

Sows lived in semi-nature environment spent much time in activity. Their activity could range for miles away (Stolba and Wood-Gush, 1989). The present study showed that the crate indeed limits the activity of the sows and sows raised in free pen expressed more flexible activity.

In conclusion, the advantage of protection function for piglets of farrowing crate might not outweigh its disadvantage in terms of the detriment of animal welfare for sows on specific day. The sows and piglets could be raised in a more space free pen on day seven post parturition afterwards to improve the welfare of sows without reducing survival rate of piglets.

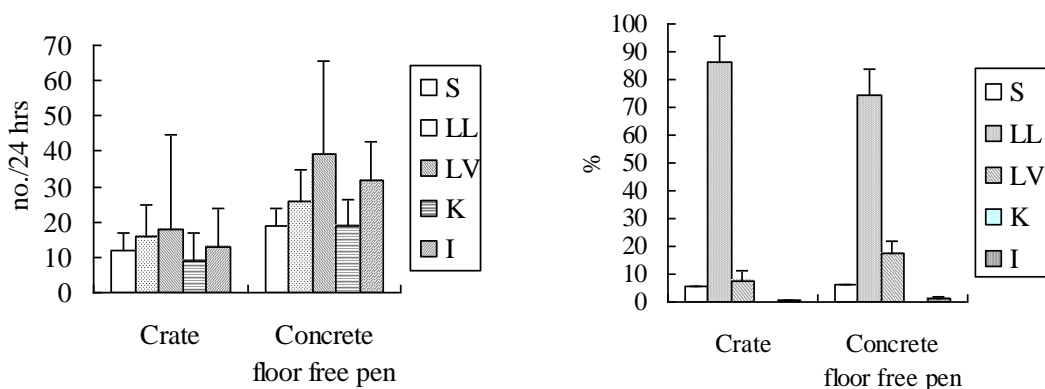


Fig. 3. Changing number of posture (left) and the proportion of time budget of posture pattern (right) of sows raised in crate or free pen on day 14-15 in experiment 1. Abbreviations of S, LL, LV, K and I: See the definition in Material and Methods.

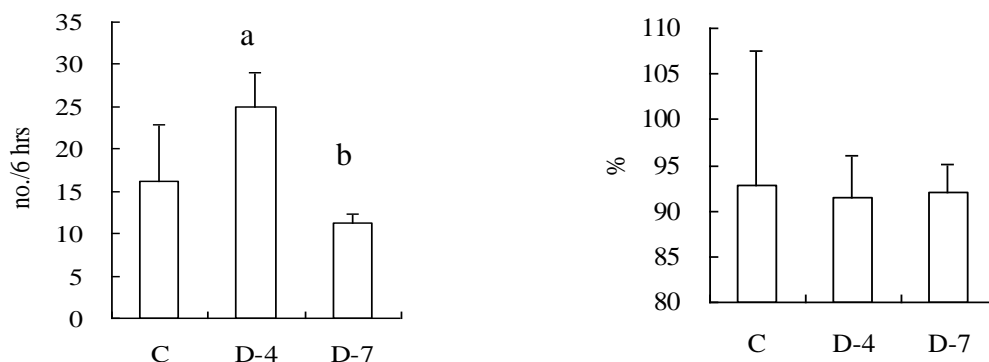


Fig. 4. Changing number of posture (left) and the proportion of time budget of posture pattern (right) of sows raised in crate or free pen on day 14 in experiment 2. Abbreviations of C, d-4 and d-7, see footnote to Table 2.

^{a,b}Letters above the bars without the same differed significant ($P < 0.05$).

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