Beneficial effect of applying water –pad cooling barn for breeding sows during summer season [1] -Report of a two-year study (2005-2006)

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ABSTRACT

The objective of this study was to evaluate the effect of applying either the water-pad cooling barn or conventional open air barn on the reproductive efficiency of sows and growth of piglets during the hot season at southern Taiwan. A total of 30 Landrace sows were divided into 2 groups and raised in either the conventional open air barn (COAB) or in the water-pad cooling barn (WPCB) from 108th day of gestation to the 30th day of lactation when piglets were weaned. The experiment was performed during the hot season in Taiwan (from June to October). The reproductive performance of sows and growth performance of piglets were measured. The two years result showed that there was no difference in bodyweight, backfat thickness or feed intake of sows raised either in the water-pad cooling barn or in conventional open air barn. Sows in the WPCB tended to have larger backfat thickness loss than that of COAB. There was a shorter interval from weaning to oestrus for sows raised in WPCB ($P < 0.10$). For the nursing piglets, there were no difference in litter size, live piglets at birth or live piglets at weaning. The weight gain during lactation for piglets raised by sows under WPCB was larger ($P < 0.01$) than those of COAB. The two years result showed that there was a beneficial effect on the reproductive efficiency of lactating sows and growth of piglets when sows were raised in WPCB during the hot season in Taiwan.

Key words：Conventional open air barn, Water-pad cooling barn, Sows, Piglets, Reproductive efficiency.

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INTRODUCTION

Taiwan is located in the subtropic to tropic region. The duration of hot and humid season lasts for eight months per year, which leads to heat stress for animals. The high ambient temperature has a negative effect on reproductive performance of sows and growth performance of piglets (Black *et al.*, 1993; Quiniou and Noblet, 1999; Laspiur and Trottier, 2001; Renaudeau and Noblet, 2001). The thermoneutral zone for sows is 18 - 21℃. When the temperature reaches 30℃ or more, sows will reduce feed intake (18.8-45.7%) and subsequently, the milk output during lactating period (Christon *et al.*, 1999). The application of water-pad cooling system by increasing the cooling air ventilation rate can decrease the inner temperature of sow barn and possibly, increase the feed intake of sows. Therefore, the purpose of this experiment was to investigate the effect of applying water-pad cooling barn on the reproductive efficiency of sows and growth performance of piglets during the hot season in Taiwan.

MATERIALS AND METHODS

I. Animals and diets:

A total of 30 Landrace sows were used in this experiment. At the 108th day of gestation, sows were divided into two groups. Sows in control group were raised in the conventional open air barn（COAB）and sows in the experiment group were raised in the water-pad cooling barn (WPCB). At the far end of the WPCB, four multi-speed cooling fans were installed for ventilation. The compositions of experimental diets for prestarter, starter and lactation period were formulated according to the Feeding Standard for Pigs in Taiwan (1990) as shown in Table 1. The diet for lactating sow contained 15% crude protein and 3300 kcal/kg digestible energy. During the experimental period, sows were provided feed and water *ad libitum.* Piglets were weaned at the age of 30 ± 2 day. The backfat thickness of sows at farrowing and weaning were measured with the ultrasonic backfat detector (Scano-probe 731C, Ithaco Co., USA). Feed intake, body weight, and the interval from weaning to estrus of sows were measured. The litter size, live piglets and body weight at birth and weaning, survival rate of piglets were determined as well.

II. Statistical procedure:

Data collected were analyzed by ANOVA as a completely randomized design. Experiment units were individual sow. All procedures of statistical analysis were computing using the General Linear Model by Statistical Analysis System (SAS, 1990).

Table 1. The composition of experimental diets, %

	Diet		
	Prestarter	Starter	Lactation
Yellow corn	59.7	67.7	65.7
Soybean meal, 44%	20.2	19.0	18.0
Wheat bran			10.0
Fish meal	5.0	5.0	
Skimmed milk	5.0	2.0	
Milk whey	5.0	2.0	
Molasses			3.0
Soy oil	2.0	1.0	
Limestone, pulverized	1.0	0.8	1.0
Dicalcium phosphate	1.5	1.6	1.4
Iodized salt	0.4	0.5	0.5
Vitamin premix[a]	1.0	1.0	1.0
Mineral premix[b]	1.5	1.5	1.5
$CuSO_4 \cdot 5H_2O$	0.5	0.4	
Total	100	100	100

[a] Provided per kg of diet: vitamin A, 6000 I.U; vitamin D_3, 800 I.U.; vitamin E, 20 mg; vitamin K_3, 4 mg; vitamin B_2, 4 mg; vitamin B_6, 1 mg; vitamin B_{12}, 0.02 μg; niacin, 30 mg; pantothenic acid, 16 mg; folic acid, 0.6 mg; biotin, 0.01 mg; choline chloride, 50 mg.

[b] Provided per kg of diet : Fe, 50 mg; Cu, 5 mg; Mn, 20 mg; Zn, 80 mg; I, 0.2 mg; Se, 0.01 mg.

RESULTS AND DISCUSSION

During summer season, the lactating sows raised in WPCB tended to have a smaller body weight loss, shorter interval from weaning to estrus (Table 2). Nevertheless, the backfat thickness loss tended to be larger. Our results were not found in the reports of Liao and Hsu (1987) or Renaudeau *et al.* (2003). They reported that the larger body weight or backfat thickness losses for sows during lactating period prolonged the interval from weaning to oestrus.

There was no difference in the feed intake of sows reared under either WPCB or COAB (Table 2), or in the litter size and live piglets at birth, litter size at weaning and body weight at birth, survival rate of piglet between COAB and the WPCB groups (Table 3). Piglets raised in the WPCB had heavier ($P < 0.001$) body weight at weaning and larger ($P < 0.01$) weight gain during lactation. Liao and Veum (1994) indicated that the cyclic or constant heat stress had a detrimental effect on nutrient utilization. The application of water-pad cooling facility in this experiment could reduce the heat stress adverse effect and possibly enhanced the dry matter or gross energy digestibilities, which provided higher amount of available nutrient through milk to suckling piglets in the WPCB. This effect might be responsible for the larger weight gain for piglets nursed by sows under WPCB. Further study would be conducted to investigate the effect of applying water-pad cooling facility on the nutrient utilization of lactating sow during hot season.

Table 2. The effect of sows raised in either conventional open air barn or water-pad cooling barn on the reproductive efficiency of sows

Items	COAB[1]	WPCB[1]	SEM
Number of sows	18	12	
Body weight at farrowing, kg	201.6	209.9	6.1
Body weight at weaning, kg	187.5	196.9	6.3
Body weight loss during lactation, kg	14.1	13.0	2.4
The backfat thickness at farrowing, mm	18.6	20.1	0.6
The backfat thickness at weaning, mm	16.4	17.6	0.7
Backfat loss during lactation, mm	2.2	2.5	0.5
Feed intake during lactation, kg/d	3.56	3.71	0.18
Interval from weaning to estrus[a], d	15.3	7.2	4.8

[1] COAB: conventional open air barn; WPCB: water-pad cooling barn.
[a] $P < 0.10$.

Table 3. The effect of sows raised in either conventional open air barn or water-pad cooling barn on the growth performance and survival rate of nursing piglets

Items	COAB[1]	WPCB[1]	SEM
Number of sows	18	12	
Litter size at birth	12.1	10.5	0.7
Live piglet at birth	10.1	9.5	0.6
Litter size at weaning	9.2	9.0	0.5
Body weight of piglet at birth, kg	1.4	1.56	0.05
Body weight of piglet at weaning, kg	6.15[a]	7.75[b]	0.28
Weight gain of piglet, kg	4.75[c]	6.20[d]	0.28
Survival rate of piglet, %	92.5	94.9	2.2

[1] COAB: conventional open air barn; WPCB: water-pad cooling barn.
[a,b] Means within the same row without common superscripts differ significantly ($P < 0.001$) .
[c,d] Means within the same row without common superscripts differ significantly ($P < 0.01$).

The two years result showed that nursing piglets had larger weight gain when the sows were raised in the WPCB during lactating period. The application of WPCB during hot season in Taiwan could benefit the reproductive performance of sows and growth performance of piglets. Further investigation was underway so that a more clear conclusion of applying the WPCB for mitigating the adverse effect of heat stress on sows in the subtropical area could be drawn.

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夏季使用水簾式冷卻豬舍對母豬繁殖性能的影響(1)

---兩年結果(2005-2006)

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摘要

本研究的目的旨在評估使用水簾式豬舍以抒解台灣夏季熱緊迫對母豬繁殖性能之不利影響的效果。累積2005-2006年之試驗結果，總共有30頭藍瑞斯母豬完成哺乳期之測定，分別是對照組、即傳統開放式母豬舍18頭，以及水簾式冷卻母豬舍12頭，母豬於懷孕第108日分別趕入不同型式母豬舍，以迄分娩後30日離乳，測定哺乳期間母豬之體重以及背脂厚度變化，飼料攝食量以及仔豬之出生體重及哺乳期之增重，哺乳期仔豬存活率等性狀。結果顯示，於六月份至十月份，哺乳母豬飼養於傳統開放式母豬舍或水簾式冷卻母豬舍，其哺乳期體重以及背脂厚度變化，飼料攝食量，兩者間並無顯著差異，飼養在水簾式豬舍之母豬，其離乳至再發情間距較短（P ＜ 0.10）。仔豬之出生窩仔數，出生活仔數及離乳仔豬數，兩者亦無顯著差異，母豬飼養於水簾式冷卻豬舍者，其仔豬於哺乳期之增重，極顯著地（P＜0.01）較飼養在傳統開放式母豬舍者為大。綜合兩年之結果顯示，在台灣夏季炎熱季節（6-10月份），母豬飼養於水簾式冷卻豬舍，可抒解熱緊迫之不利影響，縮短母豬自離乳至再發情間距，且利於仔豬之增重。

關鍵詞：傳統開放式母豬舍、水簾式冷卻豬舍、母豬、仔豬、繁殖性能。

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