EVALUATION OF FLOOR HEATING PANELS FOR SUPPLEMENTARY HEATING OF SUCKING PIGLETS

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The objective of this work was to evaluate supplementary piglet heating on the basis of surface temperature of water heated panels in strawless farrowing house. Two water heated panels (0.48 m^2) for piglet heating were installed in each farrowing pen. Surface temperature of 120 panels in 5 sections was measured by infrared thermometer (GIM 3590) in winter period. At data evaluation we analyzed average surface temperature of panels in first till eighth pens in rows including frequency distribution of temperatures in the range 34 – 43 °C (with scale of 1 °C) and in the specific temperature limits (<37.8 °C, 37.8 – 38.9 °C, >38.9 °C). The data were analyzed using the Descriptive Statistics procedure and a General Linear Model ANOVA by the statistical package STATISTIX 10.0. Significance of differences between heated panels in pens was determined by LSD test (at α≤0.01). Outdoor average air temperature was 3.5 °C and average temperature in the farrowing sections was 18.7 °C during the measuring day. Water heated panels of second pens had the highest average surface temperature 40.6 ± 1.0 °C. The panels of eighth pens had the lowest temperature 37.9 ± 2.1 °C (p<0.01), because these pens were situated at external enclosure wall. In these pens, in addition, internal wall was not thermal insulated sidelong the heating panels, as it was in the first pens. As far as the average surface temperature is concerned, almost 94.2 % water heated panels had suitable temperature (37 – 43 °C) and 65.0 % optimum temperature (39 – 41 °C). It is possible to get improvement of temperature conditions by additional insulation of the external enclosure wall in the area of pens as well as by optimal heat regulation of panels according to the position of lying piglets.

Keywords: water heated panels, temperature, farrowing pen, piglets

INTRODUCTION

The newborn pig is extremely susceptible to cold, damp conditions. It has little fat and hair, a thin skin and a small mass in relation to its body surface area (Roese, Taylor, 2006).

Pigs have a normal temperature range of 38 – 40 °C. Piglets do not have the ability of thermoregulation at birth, because they need heat immediately to survive and grow (Blecha, 2001). Immediately after birth, a piglet's temperature can drop by 1 °C or more within the first half-hour, depending on environmental conditions. Under favourable conditions, this drop in temperature is regained in about 24 – 48 hours (Roese, Taylor, 2006).

Piglet upon its birth experiences a sudden 15 – 20 °C decrease in ambient temperature (Herpin et al, 2002). At birth, the new born pig leaves a draft free environment, 38.9 °C which is the sow's womb. Even a temperature of 35 °C is cold to the piglet in its first few hours. Temperatures less than 37.8 °C will result in the piglet using the sow milk to warm itself (Anonym, 2010). For new born pigs in its resting area the temperature should be 32 – 35 °C (Botto et al, 1995; Lean, 1994; Xin, Zhang, 2000), which is gradually decreased till 22 – 24 °C when weaned (Herpin et al, 2002). When the temperature drops below the piglets' thermoneutral zone (34 – 36 °C), piglets try to increase their heat production by means of energetically demanding muscular shivering thermogenesis (Berthon et al., 1994), and they try to reduce their heat loss by social and individual thermoregulation (Vasdal et al., 2009).

Because the newborn piglet requires quite a different environment from the sow, heated creep area (away from the sow) are essential in the farrowing pen (Roese, Taylor, 2006). Supplemental heat is routinely provided in the pig area of the farrowing pen to maintain such high temperatures for the piglets without raising the temperature to which the sow is exposed. It is necessary to use local heating of area for piglets, the best by heated panels. Recommended optimum range of the air temperature for piglets is 22 – 32 °C and for sows it is 16 – 22 °C at relative humidity 50 – 75 % (Botto et al, 1995; Pulkrábek, et al, 2005). To keep minimum ambient temperature of 20 °C till piglets' age of 1 month it is necessary to use local heating of their area (Botto et al, 1995; Weber, 1997; Pulkrábek, et al, 2005).

Electric or warm-water heated panels for bottom local heating are used. Warmth transmission to piglets occurs by their body contact with surface of heated panel. From the viewpoint of comfort zone for piglets (Anonym, 2010), correct regulation of temperature, either optimum (39 – 41 °C) or advantageous surface temperatures (37 – 43 °C) of heated panels (Anonym, 2009) are important factors. At birth, the surface temperature of warm-water heated panels is recommended to be about 38 – 41 °C (Anonym, 2014). The control of the surface temperature of heating areas is very important and Vasdal et al. (2010) showed that piglets have a preference for high infrared temperatures when different types of heating mats were tested.

MATERIALS AND METHODS

The objective of this work was to evaluate supplementary piglet heating on the basis of surface temperature of water heated panels in strawless farrowing house.

In farrowing house were 5 sections with 3 rows and 8 pens in each row. Farrowing pens with crate for sow and a plastic slotted floor were situated across the alley in sections. System of water heated panels was used for heating of piglets. Two water heated panels with dimensions 400 x 600 mm were installed in each farrowing pen. The water heated panels were installed in the pen next to each other so as to create a long strip of 1 200 mm with a total area of 0.48 m^2. Piglets had at disposal tipping covers with plastic sheets.

Water heated panels in first pens in all rows were situated at the enclosure wall adjacent to marginal lengthwise passage in stable. Water heated panels of last (eighth) pens were situated at external enclosure wall. Piglets had at disposal tipping covers with plastic sheets.

Surface temperature of 120 water heated panels in 5 farrowing sections was measured by infrared thermometer

(GIM 3590) in winter period. At data evaluation we analyzed average surface temperature of water heated panels in first till eighth pens in rows including frequency distribution of temperatures. Frequency distribution of surface temperatures of water heated panels was evaluated in the range 34 – 43 °C with scale of 1 °C and in the specific temperature limits (<37.8 °C, 37.8 – 38.9 °C, >38.9 °C).

The data were analyzed using the Descriptive Statistics procedure and a General Linear Model ANOVA by the statistical package STATISTIX 10.0. Significance of differences between water heated panels in pens was determined by LSD test (at $\alpha \leq 0.01$). Temperature and relative humidity of air was registered in sections and in external environment during the measuring day.

RESULTS AND DISCUSSION

Average temperature of air in the farrowing house was 18.7 ± 0.49 °C during the measuring day and average air temperature in external environment was 3.5 ± 0.93 °C (table 1).

Table 1. Temperature and relative humidity of air during measuring day

Parameter	Air temperature, °C	
	Indoor	Outdoor
Average	18.7	3.5
SD	0.49	0.93
Minimum	17.6	1.0
Maximum	19.6	4.6
Parameter	**Relative humidity of air, %**	
	Indoor	**Outdoor**
Average	56.2	77.1
SD	3.19	4.85
Minimum	49.6	68.6
Maximum	62.6	86.2

Indoor air temperature ranged from 17.6 to 19.6 °C and outdoor air temperature ranged from 1.0 to 4.6 °C. Average relative humidity of air in the farrowing house was 56.2 ± 3.19 % and in external environment was 77.1 ± 4.85 %. The indoor relative humidity of air ranged from 49.6 to 62.6 % and outdoor air relative humidity ranged from 68.6 to 86.2 %. Measured internal temperatures of air were lower than the bottom limit of the presented optimum for piglets. The values of indoor relative humidity come under the required optimum (Botto et al, 1995; Pulkrábek, et al, 2005; Xin, Zhang, 2000).

Water heated panels of second farrowing pens had the highest average surface temperature 40.61 ± 1.00 °C adjacent to lengthwise passage in the farrowing house (table 2).

Table 2. Surface temperatures of water heated panels in pens according to their order in rows

Pens order in a row in sections	Parameter			
	Average*	SD	Min	Max
1st	40.18^{ab}	1.40	36.6	42.1
2nd	40.61^{a}	1.00	38.5	42.3
3rd	40.26^{ab}	1.12	38.7	42.2
4th	40.24^{ab}	1.24	38.5	42.8
5th	40.45^{ab}	0.71	38.9	41.5
6th	39.95^{ab}	0.74	38.6	40.8
7th	39.28^{b}	1.33	35.6	40.7
8th	37.92^{c}	2.05	34.6	41.1

* Significance of differences at p<0.01, $^{a-c}$ Data with an equal superscript are not significantly different from one another (LSD test at α=0.01).

The lowest temperature 37.92 ± 2.05 °C (p<0.01) had panels of eighth pens in rows, which were situated at external enclosure wall, and internal wall in the area of pen was not thermal insulated (by plastic plate) as most of the first pens (80 %). Water heated panels of first pens, which were closest to the regulation unit, had average surface temperature 40.18 ± 1.40 °C, i.e. by 0.43 °C lower than panels of second pens. It most likely could be affected by the fact that the panels in first pens in all rows were situated at the enclosure wall adjacent to marginal lengthwise passage in farrowing house and some of them did not have insulation in the form of plastic plate like all eighth pens.

From frequency distribution of surface temperatures of water heated panels results (table 3) that average surface temperature 37 – 43 °C, i.e. advantageous temperature, had 94.2 % panels and temperature in the range of 39 – 41 °C, i.e. optimum temperature (Anonym, 2009), had 65.0 % panels. Nearly 76 % of water heated panels had the surface temperature in the range 38 – 41 °C, at which to set the water heated panels after farrowing (Anonym, 2014).

Table 3. Frequency distribution of surface temperatures of water heated panels

Range of surface temperatures of water heated panels in °C	Parameter	
	Number	%
34-35*	1	0.83
35-36	3	2.50
36-37	3	2.50
37-38	3	2.50
38-39	13	10.83
39-40	31	25.84
40-41	44	36.67
41-42	116	13.33
42-43	6	5.00

* The lower limit of range includes the value and the upper limit is less than the value.

From the evaluation of frequency distribution of surface temperatures according to specific temperature limits (table 4) results that only 8 % of water heated panels had average surface temperature below 37.8 °C.

Table 4. Specific frequency distribution of average surface temperatures of panels

Parameter	Specific range of surface temperatures of water heated panels in °C		
	< 37.8 °C[1)]	37.8°C[2)] – 38.9 °C[3)]	> 38.9 °C
Number	10	13	97
%	8.33	10.83	80.84

[1)] the temperatures at which milk can be used for the heating of piglet body and not to growth, [2)] the temperature providing comfort zone for piglets, [3)] the temperature environment in the sow's womb

This means that the panels with these temperatures do not provide the comfort zone for piglets and a certain amount of milk received can be used for the heating of their body and not to growth (Anonym, 2010). Nearly 11 % of water heated panels had the surface temperature from 38.7 °C (the temperature ensuring the comfort zone) up to 38.9 °C (the temperature environment in the sow's womb). The largest share, nearly 81 %, of the water heated panels had the surface temperature above the 38.9 °C, which is favorable in terms of providing temperature comfort for piglets.

CONCLUSION

The lowest temperature had panels of eighth (last) farrowing pens in rows, which were situated at external enclosure wall without thermal insulation. As far as the average surface temperature is concerned, almost 94.2 % water heated panels had suitable and 65.0 % optimum temperature.

It is possible to get improvement of temperature conditions by additional insulation of the external enclosure wall in the area of pens as well as by optimal heat regulation of water heated panels according to the position of lying piglets.

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