Novel Strategies to enhance creep attractiveness and reduce piglet mortality

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Executive Summary

There has been widespread pressure on the pig industry to move towards more “welfare-friendly” farrowing and lactation housing systems for the sow which allow her greater expression of normal behaviours. Scientists, and the industry, have made a demonstrable commitment to this husbandry change and have had some success in development of alternative farrowing accommodation. However, many of these alternative systems lead to increased piglet mortality due to crushing by the sow (Edwards and Fraser, 1997) posing both a welfare and economic risk for the industry. One potential solution to this problem is to be able to attract piglets away from the sow into creep areas, especially in the first three days of life when crushing risk is at its greatest (Berg et al, 2006; Lynch 1983). This pilot project was designed to investigate three strategies that were hypothesised to be attractive to piglets in the first fortnight of life. These strategies being: the use of bedding with the scent of the dam, the use of sow vocalisations during piglet feeding and provision of extra heat. For each strategy four litters were tested on days 3, 7, 10 and 14 of lactation. The arena was a set up in a radial fashion with a central triangular area flanked by three creep areas containing one of the three treatments (positive control, neutral, negative control). Piglets were introduced into the arena for one hour on each day of testing and their behaviour recorded by video camera. Video footage was analysed using a group scan sampling method to measure the proportion of the litter in each treatment area at three-minute time intervals over each hour of video recording. Results were presented as percentage time of observations.

There was no overall preference shown for any of the applied treatments. Hence based on this study design it can be concluded that none of the strategies tested showed promise and further work on them is unwarranted. However, a review of the recent literature on heat gradients suggests warmer temperatures than those likely to have been achieved in our heat study may be preferable to piglets (42°C is suggested). The design of the current study may have not allowed any differences to be recognised since the temperature gradients were small. This may be an area for further investigation in an experiment focussed solely on this strategy, with an increased number of temperature assignments and larger gradients of temperature.

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1. Introduction

In an attempt to move towards more "welfare-friendly" post- farrowing housing systems for the sow which allow her to express more normal behaviours and engage in increased movement, there has been increased attention on alternative farrowing and lactation housing systems, by both the pig industry and scientific community. However, many of these systems, whilst going some way towards addressing sow welfare issues lead to increased piglet mortality due to crushing by the sow (Edwards and Fraser, 1997). This poses a major welfare, as well as economic issue for the industry. It has been widely recognised that a key solution to this problem is to attract piglets away from the sow into creep areas, especially in the first three days of life when crushing risk is at its greatest (Berg et al, 2006; Lynch 1983), since after three days, piglets spend more time in the creep area and less time in contact with the sow (Barber and Bourne, 1987; Zhang and Xin, 2001). There has been some focus on methods to increases the attractiveness of this area to piglets. These include; use of temperature gradients (Lynch, 1983; Barber and Bourne, 1987), location (Welch, 1986), lighting (Zhang and Xin, 2001) and lying comfort (Ziron and Hoy, 2003). These strategies have had mixed success and may be dependent on herd and type of creep area. This pilot project aimed to build on this work by investigating three novel strategies hypothesised to increase attractiveness of the creep area to piglets in the first fortnight after farrowing. A preference testing methodology was used to determine if the piglets would choose the hypothesised attractant strategy in a three-way preference test. The strategies tested were: the use of bedding substrate material with applied scents, the use of pig sound cues and the use of differential temperatures.

2. Methodology

General Methods

Animals

This study was carried out at the University of Adelaide Roseworthy piggery, South Australia using Large White/Landrace Cross animals. All sows and litters were housed indoors in standard farrowing crates with partially slatted floors. Piglets were subjected to routine husbandry procedures such as iron injection and were provided with creep feed from 10 days of age. Ethics approval was obtained through the University of Adelaide Animal Ethics Committee and all procedures were performed in accordance with the NHMRC Australian code of practice for the care and use of animals for scientific purposes (7th edition 2004).

Preference Test

The study involved a simple three-way preference test with three creep housing areas set up in a radiating fashion around a central area, allowing free movement of piglets between pens (see schematic in Fig1).

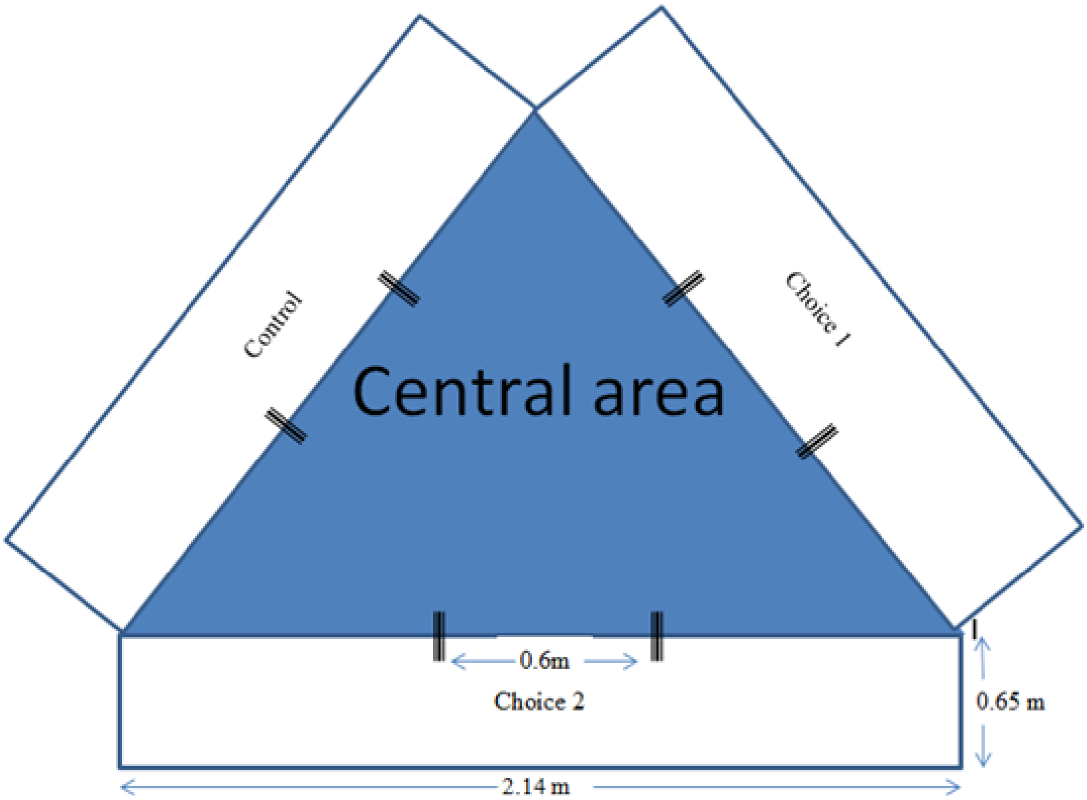

Fig 1: Schematic of preference testing set-up (not to scale)

The test location was a covered research building. The walls of the test area were composed of plywood. The floor was solid concrete. Each creep area measured 2.14 m by 0.65 m (height 0.6m), and was accessed from the central area by an opening of 0.6 m in length. Creep areas were identical to those that the piglets were familiar with to minimise the effects of familiarity, and all creep areas were identical in design, layout, substrate provision and temperature (unless the treatment applied required a change to these factors).

Four litters from mixed parity sows were tested in total for each experimental treatment. The preference test was performed once daily on days 3, 7, 10 and 14 following farrowing.On the day of testing, piglets were transported together from their home pen to the test arena. The testing was performed during the morning and litters were removed immediately after suckling i.e. piglets had been observed to suckle and nursing finished prior to removal. Behaviour recording commenced on piglet entry into the central location and was performed for one hour on each occasion. The piglets were not previously exposed to the test areas prior to the start of recording. The litters (and respective sow) were housed in their original crate in the farrowing shed between each observation period. The same litters were tested over the course of the experimental block.

There was randomisation of treatments allocated to pens to ensure that location was not influenced by choice. A digital video camera (Aiptek AHD T7 Pro) was used for video analysis and was set up over the pens to record movements and preferences. No people were in the visual range of the piglets during the test.

Experimental Treatments

1. Use of bedding substrate material with applied scents

The three creep areas had either straw with the scent of the maternal sow of that litter, straw with the scent of an unfamiliar sow or clean straw with no scent (control). Scent was applied to the straw by rubbing it over the maternal or unfamiliar sow. The same amount of straw was used in each creep area to reduce confounding. Electronic heat mats were located in each creep area underneath the straw substrate. It was hypothesised that piglets would be attracted to the area containing the scent of the dam.

2. The use of pig sound cues

For this test, different recorded sounds were played from behind the three creep areas for the duration of the hours test. The sounds tested included pre-recorded piglet squeals and maternal sow grunts during piglet feeding. There was no sound played in the control pen. Recording was achieved using a hand-held digital voice recorder to record sounds in an MP3 format (Olympus Digital Voice Recorder VN-712PC, Olympus Australia, VIC). Playback used MP3 players attached to portable speakers (Ipod Shuffle, AppleInc, NSW). Some noise insulation of the test pens was achieved by lining each with a foam shell. Sounds were played at the same volume setting for each test, although differences in intensity at recording were likely due to the differing nature of the sounds. Substrate was not provided in any of the test areas but heat mats were provided as previously described. For this test it was hypothesized that animals would be attracted to the area containing the sounds of sows.

3. Differential temperature

This experiment was conducted to determine whether heat was attractive to piglets, and whether air movement across an area would be a disincentive to enter the creep area. In order to achieve temperature differences in the creep areas electronic heat mats were placed in all creep areas. The control area was maintained with just one heat mat throughout the test. In the positive control area an increased temperature was created through the provision of an extra heat mat. The negative control consisted of a fan blowing air at ambient temperature across the creep area from the side of the pen.

Video and Statistical Analysis

Video footage was analysed using a group scan sampling method to measure the proportion of piglets in each treatment area at three-minute time points over each hour of video recording. In order to calculate preferences, the scores of percentage number of piglets in each location were summed across all observation timepoints. This summated value was then divided by the maximum possible piglet % across these timepoints i.e 100% preference would have all of the litter occupying the particular chamber at every timepoint. Statistical analysis was performed using Genstat and made use of simple descriptive statistics and one way ANOVA for group comparisons. The litter was taken as the experimental unit. To determine significant interactions across time a repeated measures ANOVA test was performed. Differences between treatments were considered significant when $P<0.05$.

3. Outcomes

Results-Experiment 1

The piglets showed the highest preference for the central concrete area across all days of analysis, as shown by Figure 2. At three days of age piglets spent a similar proportion of their time in the dam sow area (32.2 ± 4.85) and central concrete area (39.7 ± 4.85). At seven and ten days of age they did not show any preference for the dam sow area over the unfamiliar and clean straw areas. At 14 days of age they spent a greater proportion of their time in the dam sow area (27.1 ± 4.25) than they did in unfamiliar sow area (2.8 ± 4.25) and clean straw area (1.1 ± 4.25). This difference showed statistical significance. The piglets did not show any preference for the clean straw area at any day of age. On day seven they spent a greater proportion of time in the unfamiliar sow area (24.1 ± 4.2) than they did in the dam sow and clean straw areas. Repeated measures ANOVA showed no effect of time on piglet preference.

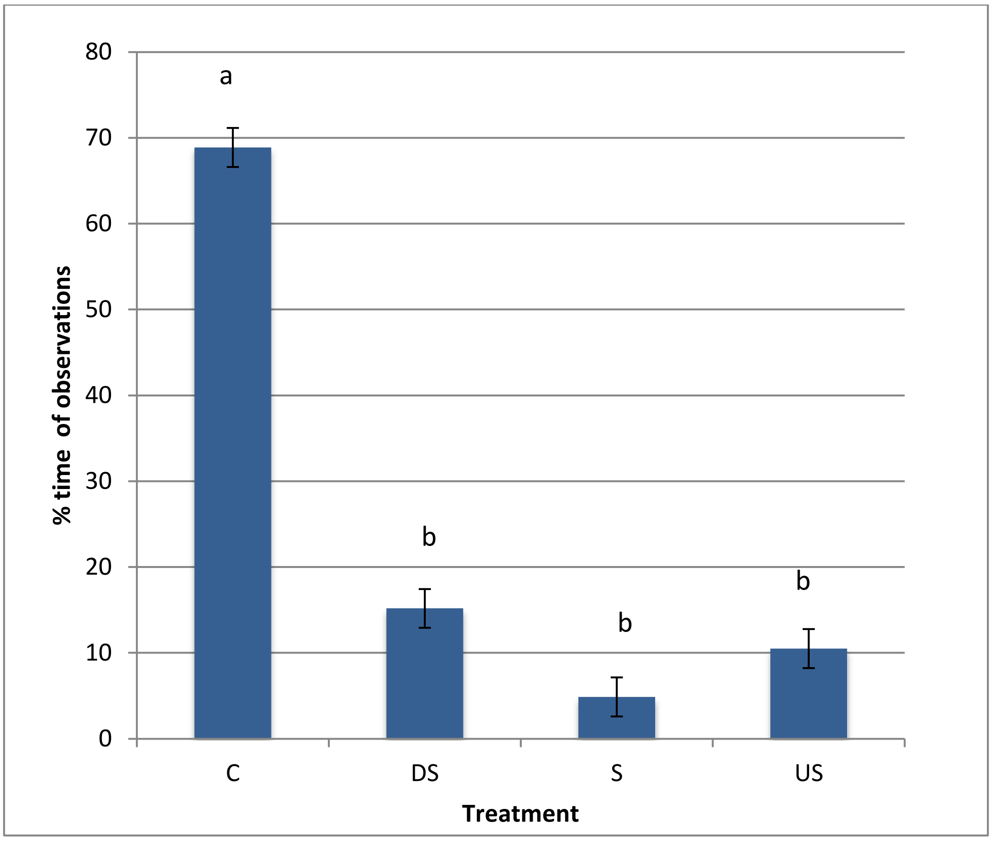

Fig 2: Mean (±SE) % time of observations spent in preference testing arena areas across all time points. C=central area, DS= dam scented straw, S=clean straw, US=unfamiliar sow scented straw. Means with different superscripts are significantly different (P<0.05).

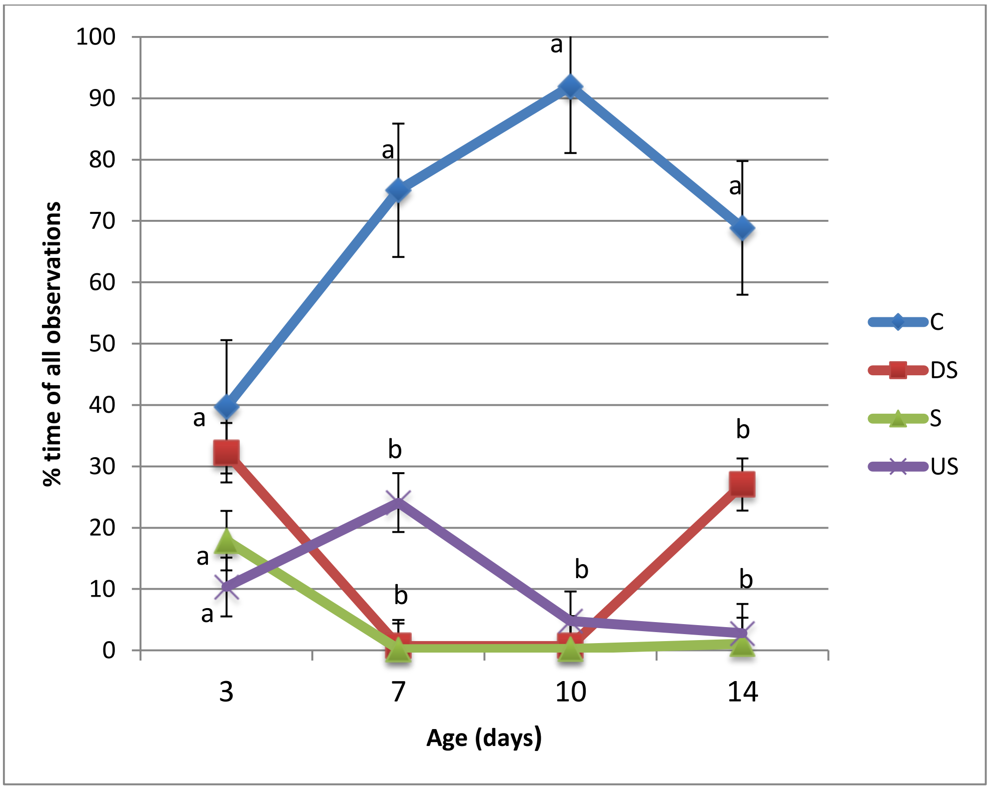

Fig 3: Mean (±SE) % time of observations spent in preference testing arena at each time point. C=central area, DS= dam scented straw, S=clean straw, US=unfamiliar sow scented straw. Means with different superscripts at each timepoint are significantly different (P<0.05).

Results-Experiment 2

In accordance with the hypothesis, piglets showed the highest preference for the area with sow sounds (38% of their time) across the course of the experiment when examining the numerical values for percentage time spent in areas (Fig 4). However, this preference was only statistically significant in comparison with time spent in the central area (P= 0.03). Given that no significant differences were shown between the three creep test areas it would be unwise to draw any assertions from this result.

Values for day 3 (Fig 5) are noteworthy, with a statistically significant preference for the sow sounds above the piglet sounds and central area (67% versus 0 and 9% respectively). However, no significance of this is shown over the control area with no sounds (P=0.08). Given greater animal numbers this may approach significance and possibly be an avenue for further investigation. Given the obvious attraction of piglets to their dam in the early post-natal period it would seem logical that the sow sounds would be preferable at a younger age. Repeated measures ANOVA showed no significant effect of time on piglet preference.

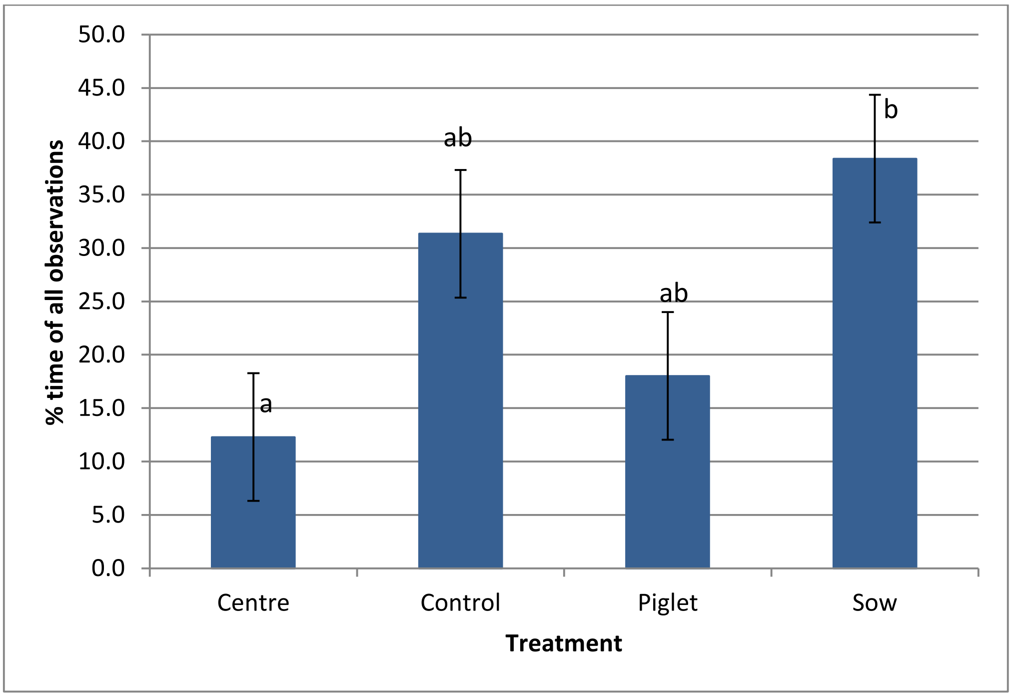

Fig 4: Mean (±SE) % time of observations spent in preference testing arena areas across all time points. Means with different superscripts are significantly different (P<0.05).

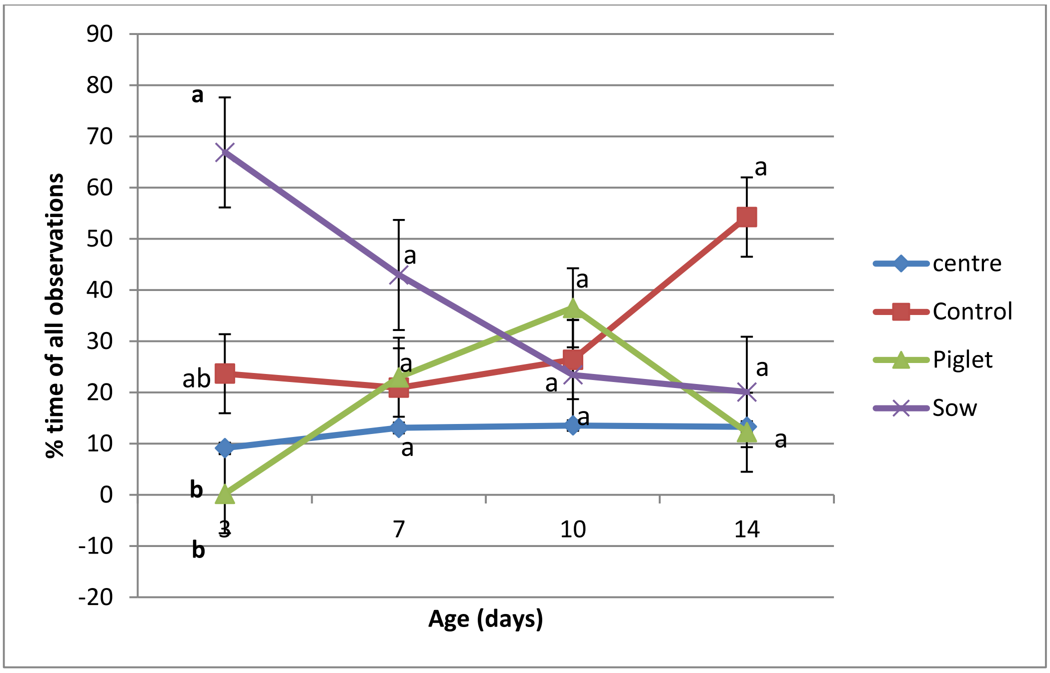

Fig 5: Mean (±SE) % time of observations spent in preference testing arena at each time point. Means with different superscripts at each timepoint are significantly different (P<0.05).

Results-Experiment 3

In this experiment there was a convincing preference for the central area over the time course of the experiment (59%) with significant differences shown between this value and all other location choices. This was not in accordance with our original hypothesis that increased heat would be attractive to piglets. However, ambient temperature over the experiment was warm (circa 28°C) and this may have influenced the piglets' preferences for heat.

Examining the data by timepoint shows a similar result with a clear preference for the central area at all time points except day 14 where the control area was preferred. The influence of temperature may again be of significance here with ambient temperature being lower on day 14 (around 23 ° C). Time was again an insignificant factor on preference using repeated measures ANOVA.

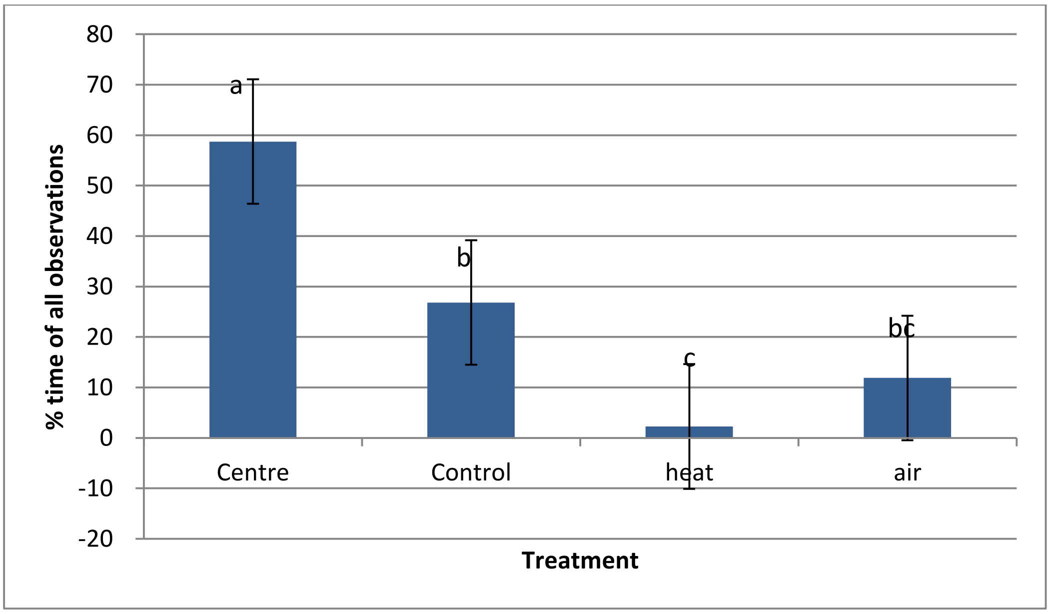

Fig 6 : Mean (±SE) % time of observations spent in preference testing arena areas across all time points. Means with different superscripts are significantly different (P<0.05).

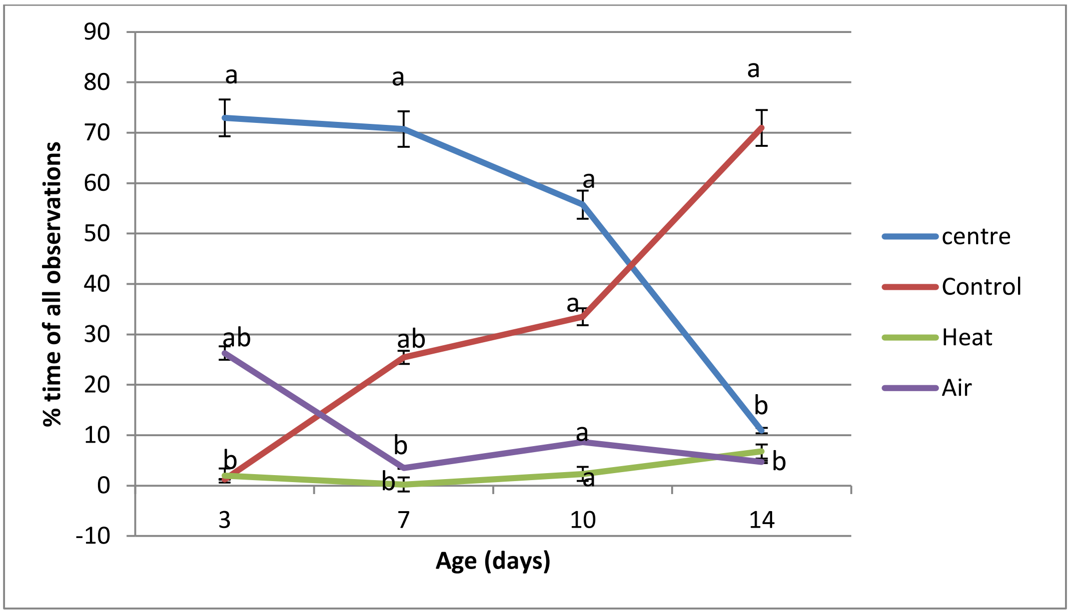

Fig 7: Mean (±SE) % time of observations spent in preference testing arena at each time point. Means with different superscripts at each timepoint are significantly different (P<0.05)

4. Application of Research

This study was essentially a pilot study to determine whether any of the suggested strategies might be candidates for further investigation. Based on the results presented above there is no strategy that is convincingly preferred by the piglets above others. This may be as a result of insufficient power but given that data was also combined across the timepoints to still yield no reliable preference this seems unlikely.

The validity of this preference testing set-up may be called into question since the central area was essentially playing a similar role to the control area. Given that, at some time points, piglets spent a considerable proportion of their time in this area a confounding influence on the results may have occurred. A similar radial test design was however used in the study of Parfet and Gonyou, 1991 but all outer locations represented a different treatment choice. The preference testing model used by Vasdal et. al 2010 only used two test areas with a central neutral compartment.

The central area was also used differently both within experiments, and between experiments. As an area for transiting between creep areas some use of this area will be expected, but in experiment 1 the % observed time spent in this area was frequently above 70%. This contrasts with experiment 2 where values were around 10%. This difference may have been brought about due to seasonality and differences in ambient air temperature. Experiment two was performed in the Winter, whilst experiments 1 and 3 were performed in Spring. The central area was the only unheated area and as such it may have been preferable to the heated creep areas in warmer weather. This may also explain the increased preference for this area as piglets aged since there is a general resumption that warmth is more attractive to smaller (younger) animals due to their increased surface area to volume ratios. The decline in use of the central area over the time course of experiment 3 is something of an anomaly but temperature may also be a confounding factor since there was an environmental temperature decline over the course of the experiment. This discussion would suggest that in future studies involving preference testing it would be advisable to locate the arena in a temperature-controlled building to reduce the risk of confounding. This unfortunately was not available to us at the study location.

Hence, at this time, and based on this study, there is no application of this work to the industry. However, recent literature has shown that piglets show a preference for higher temperatures (42° C), although it was also shown that they were unable to differentiate between reduced temperature differentials (30, 34 and 38° C) (Vasdal et al, 2010). This latter finding may have been a contributing factor to the lack of preference in our study, and the high environmental temperature may also have had a confounding influence. Thus, there may be some value in conducting further research on this using more controlled and more extreme heat gradients, and during different seasons.

5. Conclusion

In conclusion, none of the strategies utilized in this study show particular promise in being attractive to piglets and hence no further investigation of them is warranted.

6. Limitations/Risks

None applicable.

7. Recommendations

As a result of the outcomes in this study the following recommendations have been made:

1. None of the strategies tested show potential in attracting piglets towards creep areas and there is little value from pursing further research on them, at least using this testing modality.
2. In future preference testing, the model used should be revisited. Refinements would be to use the same arena design but use the central area as the control or neutral zone with three preference creep areas or create a simple two way preference test with the boxes arranged linearly. Environmental variables should also be controlled to the greatest extent possible.
3. The use of heat gradients as a strategy has shown promise in other research and may be worth further investigation in a study tailored specifically to this aspect.

8. References

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