Behavioural changes related to air temperature in sows kept in different housing conditions

M. Barbari and M. Bianchi
University of Firenze, Department of Agricultural and Forest Engineering, Via San Bonaventura 13, 50145 Firenze, Italy

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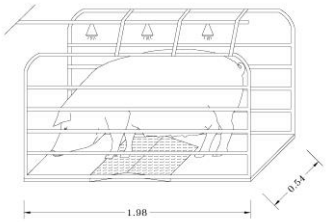
Introduction

The behaviour of pigs greatly changes in hot conditions. The pig takes the position of lateral decubitus, giving the maximum body surface to the air and to the floor contact. It tries to find isolated positions, far from other animals in the pen, and possibly in areas with air streams. Furthermore, the pig reduces the feed ingestion but drinks high amounts of water. When possible it uses the drinker as a "shower" and lies on the floor wetted with water or dung. Particularly the latter behaviours are of great importance in reducing the heat stress in adult pigs, if housed in pens with solid floors. On the other hand they involve a considerable worsening of hygienic conditions of the pen, an increase of ammonia emissions and a rise of air humidity.
The study aims to contribute to definition of temperature values, which can cause changes in the behavioural patterns of the sows. The individuation of thermal levels connected to behavioural changes can be useful to set the working parameters of cooling systems in pig houses.

Materials and Methods

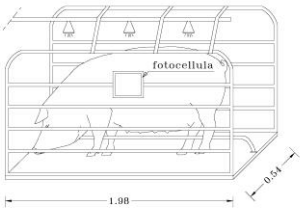
Three different experimental trials were carried out in a pig farm located in Po Valley (Italy), during summers 2004 and 2005.
A) In a first survey a static group of 4 pregnant sows was arranged; 6 cycles were repeated during summer. In the pen 4 areas were realized, treated with different cooling systems (A: not cooled; B: stream of air; C: stream of air and water on the floor; D: water on the floor). The use of the different areas by the sows was checked in relation to air temperature and THI. This first survey is topic of a specific paper of the Workshop, titled "*Use of different cooling systems by pregnant sows in experimental pen*". A description of the experimental trials can be found in that paper.
The goal of the present work is to try to define reference temperatures, useful to set cooling systems inside the buildings.

B) The second experimental trial was carried out in a dynamic group of sows (average number 192 pregnant sows, with a minimum of 169 and a maximum of 211), where two automatic showering cages were installed (figure 1). In both cooling stations, placed in the external feeding-dunging area, the water distribution time was regulated by an electronic controller: the shower time was fixed in 6 s, while the water consumption was on average 3.6 l/shower.
The sows clearly appreciated the cooling system with shower, based on the free access to the cage and on the possibility of taking showers all day. The aim of the study was to relate the use of the showering cages to the thermal conditions.



Solution "a"

- shower starting with pressure on the ***plate***
- system appreciated by the sows, particularly pluriparous
- suitable system for dinamic groups of sows



Solution "b"

- shower starting with ***photocell***
- system appreciated by the sows, particularly young ones (after first farrowing)
- suitable system for dynamic groups of sows

Figure 1.*Ttwo different individual stations for showering of sows, examined in the trials.*

C) A third experimental trial was executed in a farrowing room, with two different cooling systems:

- drip cooling system (drip nozzles, able to supply 2 l/h per sow); it started four times a day and worked for 30 min.
- Snout cooling system, coupled with drip cooling system. The air was directed close to the head of the sow, under the trough, with a flow of 88 m^3/h and a constant velocity of 7.2 m/s.

The air could flow over the lying sows, towards either the snout or the neck.
The farrowing crate used in the trials is long enough to allow the sows to lie in advanced or rear position. In such a way the animals freely choose to profit from cooling systems provided or not. THI (Ingram, 1965) was used to evaluate the behaviour of the sows during the trials.

Figure 2. *Different cooling systems. From left: pipe of the drip cooling system; full steel sheet under the head of the sow; pipes of snout system; air coming out from the hole.*

Results

A) The graph of figure 3 clearly shows the changes in the behaviour of the four sows kept in the static pen, when the temperature drops.
Over 20°C, when the temperature rises, the use of cooled area with air stream (zone B) constantly increases. At 26-27°C the frequency rate of this area reaches the maximum value, with the 50% of preference. Then the rate starts to decrease. At the temperature of 30°C, the use of zone B drops below the value of zone C.
At the temperature of 26-27°C, the presence of the animals in untreated areas (A and F) declines under the 20%. Over the value of 30°C the use of these areas drops under the value of 10% of presence.
A further consideration is needed for zone C: how the graph clearly remarks, the use of cooled area with the coupled system (air and water) is practically nought and it progressively increases in an almost linear way up to the temperature of 26-27°C. Above such temperature the frequency rate goes on increasing and soars above 30°C.

The graph clearly shows that the use of zone C has an opposite trend in comparison with zone A. The lines of the two areas crosses at the temperature of 26-27°C, that is an important reference temperature of the behavioural changes of the sows. Another value to take into consideration is 30°C: above this temperature the use of the cooled area with the coupled system becomes predominant. At 31°C the sows remain for the 92.6% of the time in the three cooled areas.

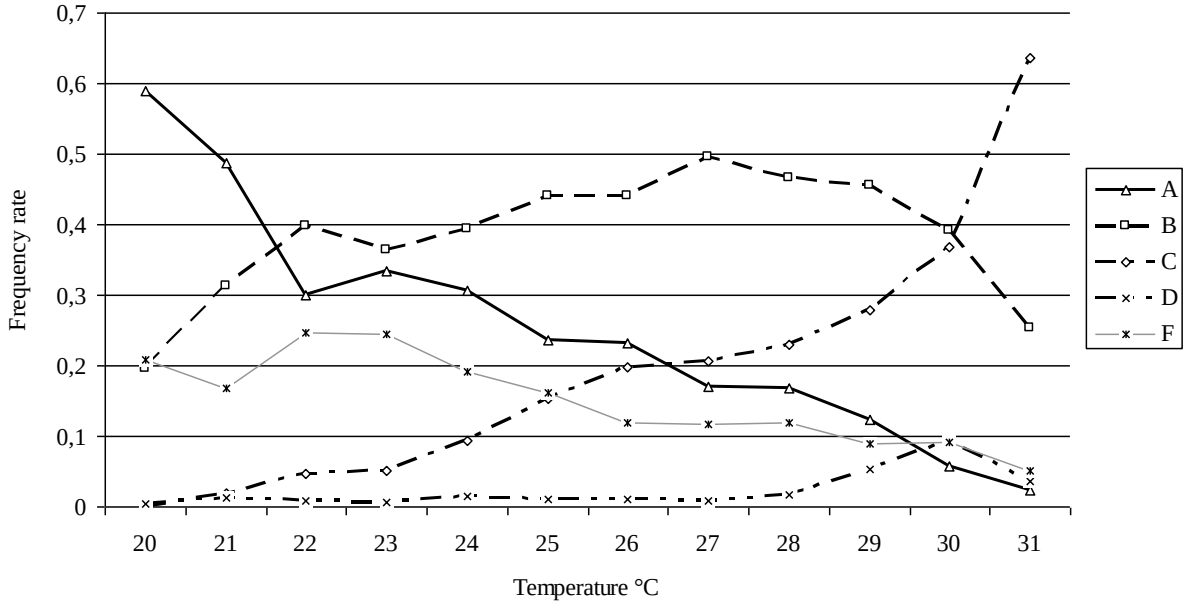


Figure 3. *Use of different areas in relation to air temperature.*

B) The results of the use of the two automatic showering cages are very positive. Figure 4 shows the results of the percentage of use of solutions "a" and "b" by the dynamic group of sows during 26 examined days. During the trial the average temperature was 23.6°C, with daily maximum values of 29.1°C. The maximum temperature in the whole period was not very high (33.9°C), in relation to the temperatures of previous years.
The percentage use of the automatic showering cages, that is the number of sows taking at least a shower during the day on the total number of sows in the group, was 50.4% on average (± 15.89). On the hottest day (i.e. 23rd July) the number of sows taking showers considerably increased up to 76.9%. However on the coldest day (i.e. 12th July) the percentage of sows taking showers decreased to 23.7%. Therefore it was possible to show the positive correlation ($r = 0.86$) between daily maximum temperature and the percentage of animals making use of the cooling stations.
Further considerations concerning the employment of the stations are the following: the total number of showers in the hottest day was 788; in six consecutive hot days the percentage of sows using the automatic cages reached 86.3%. A single shower had an average length of 59 s, but this value fluctuated in relation to outside temperature, arriving at a daily value of 80 s on average.
In the warmest day of the period the distribution of the total number of showers, when 140 sows (76.9% of sows) went under the shower at least once, was: 22 sows took just one shower, 61 took from 2 to 5, and 57 took 6 or over. With lower daily maximum temperatures the number of sows which went to the automatic showering station at least 6 times was strongly reduced: on the 11th of July only 2 animals (on a total of 62) took more than 6 showers.

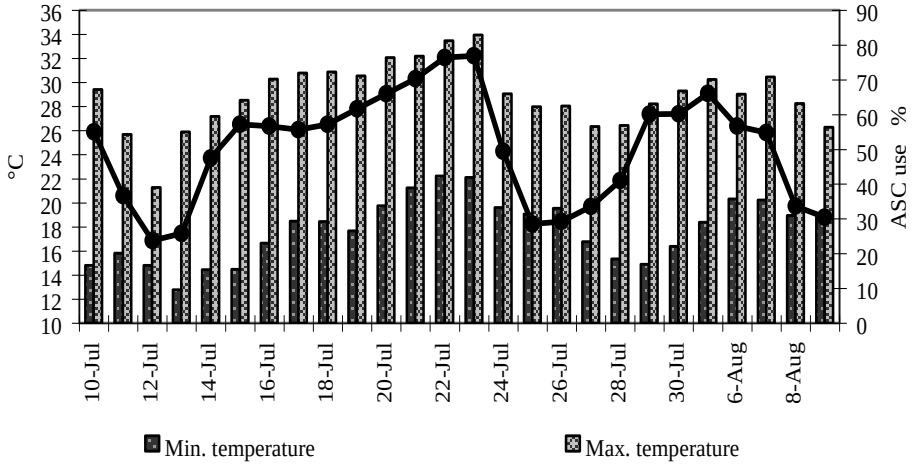


Figure 4. *Use of the automatic showering cages (black unbroken line) during the 26 days.*

The data on the use of the showers from the sows were processed also to verify the changes in relation to the outside temperature. For this kind of processing 12 hours of the day were considered, chosen in the daylight period, including the coldest hours (5-7 a.m.) and the hottest ones (1-8 p.m.). The night time period was excluded from the processing, due to the different behavioural patterns of the sows: during the night the use of the individual showering cages is reduced, owing to the sleeping time, and then not strictly related to thermal conditions.
The analysis of the period of 12 daily hours has shown a high positive correlation between air temperature and the use of the showers from the sows (r = 0.731). The graph of figure 5 clearly shows how the use increases with temperature. The rise is particularly important above the temperature of 26°C. At this temperature the use of the showers increases very quickly, in a linear way.

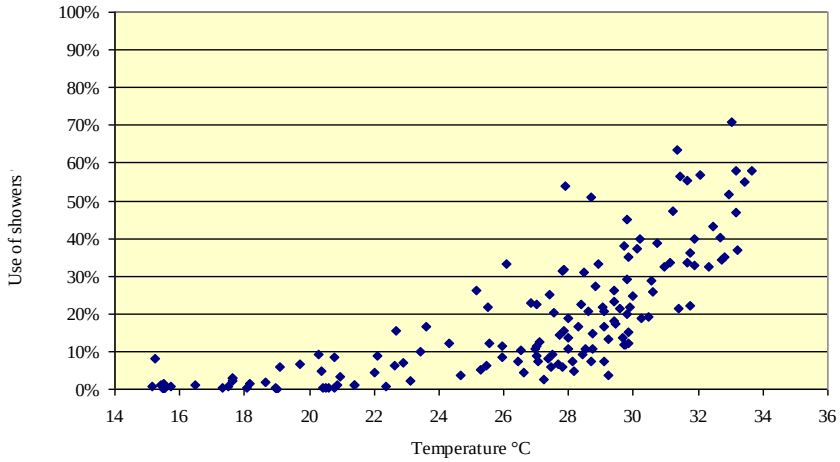


Figure 5. *Use of the automatic showering cages in relation to temperatures.*

C) The system based on the drip cooling alone does not provide satisfactory results. The sows seem to appreciate the air flow provided by snout cooling ducts in the front area of the farrowing crate. The sows remained for long periods with the snout or the neck near the air outlet hole. With long enough farrowing crates (2.50 m) the sows could freely move back, lying in such a position as to optimize the effects of the cooling systems.
The graphs of figure 6 clearly shows the changes in the behaviour of the sow during days with different thermal conditions. The same sow during a warm day (graph on the top) remains for long times lying ahead. It is clear how during the central hours of the day (mean value from 5

to 7 p.m. 30.16 °C), THI moves from comfort to alert and dangerous zones and the sow chooses to lie ahead: in this situation the fresh air coming out from the pipes is a valid help against the heat stress of the sows in farrowing room.
In the graph on the bottom temperatures were not very high during the day for a sudden storm (max 24.07°C; min 21.78°C). Anyway the sow chooses to lie ahead in the cage practically for all the time, except the central hours of the day. From 3 to 7 p.m. when the temperatures fall down, the sow changes position inside the crate, avoiding the air on the snout.
In conclusion it is possible to remark the considerable use of the system by the animals which can choose to profit or not from the air flow, according to the microclimatic conditions inside the farrowing room.

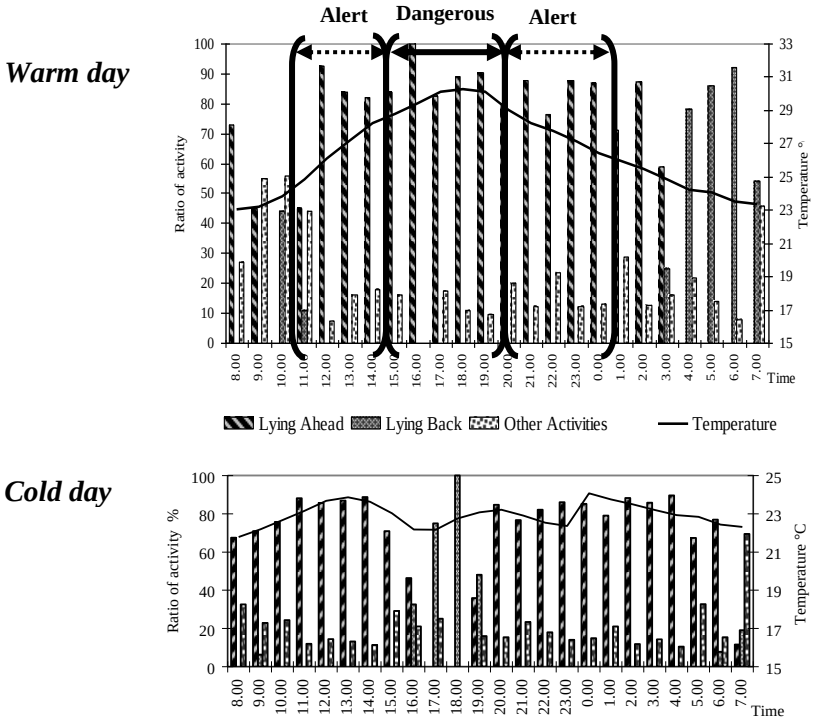


Figure 6. *Behaviour of a sow related to temperature and THI: "hot day"(above); "cold day" (bottom).*

Conclusions

The experimental trials shown in the present work aim to provide some suggestions useful in the planning of cooling systems. The sows always need systems of heat protection, both in pregnancy and in farrowing phase.
The temperature of 27°C seems to be a first critical threshold to take into consideration, as the behavioural changes of the sows can prove. When the temperature rises above 30°C the sows strongly uses the cooling systems available in the pen. In addition to the temperature value, relative humidity is another critic parameter. So further studies can be useful to define in a better way the relations between the behaviour of the sows and comfort indexes, such as THI.

References

Barbari M., 2006. Evaluation of Individual Systems for Cooling Pregnant Sows in Collective Pens. Ageng2006, Bonn, 3-7 September.