Impact and management of heat stress in swine with live yeast

It has been estimated that heat stress generates economic losses to the swine industry of around $300 million per year in the US alone.

by David Saornil, Product Manager, Swine applications, Lallemand Animal Nutrition. www.lallemand animalnutrition.com

While the issues of heat stress and the mechanisms involved are well-known under tropical climates, it seems that the reality of the risk remains poorly estimated in other areas.

A field survey was conducted by Lallemand Animal Nutrition during the summer of 2016 to evaluate the reality of heat stress on farms in Europe. Temperature and humidity were recorded every 30 minutes in the barn, at the level of the animals, thanks to electronic probes placed next to the trough. This survey gives a picture of the situation in farm conditions.

Fig. 1 summarises the data gathered from 10 farms in Europe: the average amount of time spent daily above 25°C in the farrowing room is depicted. In addition, based on the literature (Quiniou et al. 2000), the associated reduction of sows' feed intake was calculated.

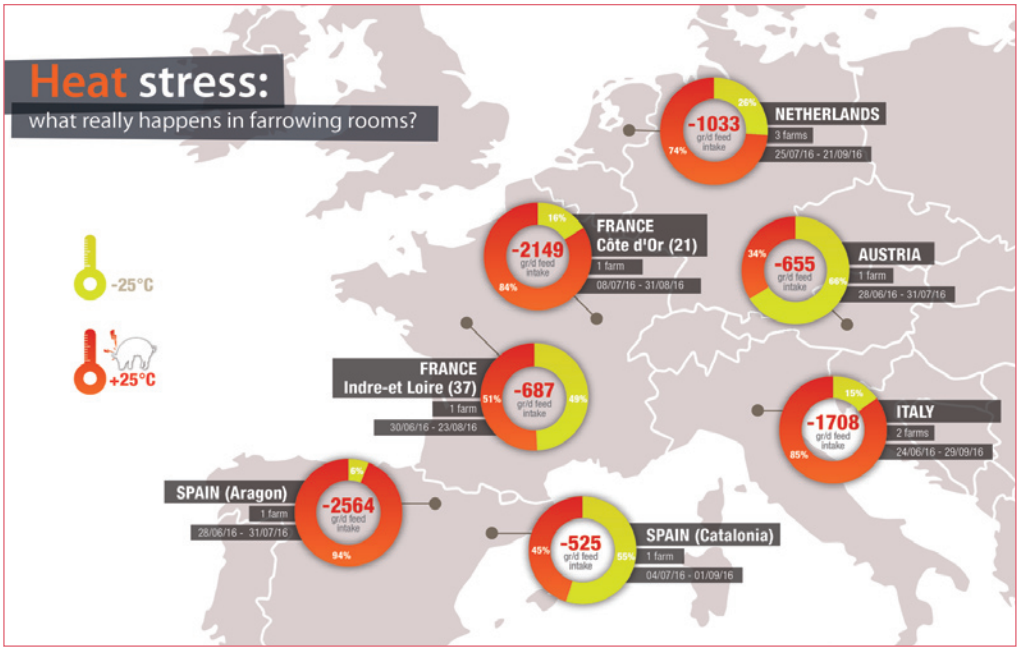

Fig. 1. Survey of heat stress risks in farrowing rooms in Europe. Average daily percentage of time spent above 25°C (significant heat stress) and estimation of the associated feed intake reduction.

First, the results indicate that, even in countries considered as 'temperate', heat stress is a reality: Netherlands and Austria for example, are also at risk. This shows that heat stress is not only due to the climate, but housing conditions and ventilation management of the barns play an important part as well. This survey also confirms the cost of heat stress in terms of feed intake loss: between 0.5-2.5kg per day of reduced feed intake in lactating sows have been calculated.

Table 1. Summary of field and university trials in lactating sows with live yeast S. cerevisiae boulardii I-1079 supplementation under heat stress conditions.

Trial	Ambient temperature	Animals	Live yeast effect on performance
Huazhong Agricultural University, China (2014)	26-32°C in the farrowing room	70 Large White sows	+530g/d improvement in lactation feed intake, +11.4% improvement in piglet average daily gain (ADG) pre-weaning -5.5kg reduction of body weight loss in lactation
Univ. Federal de Minas Gerais (trial performed in Ceara State), Brazil (2016)	Min. Temp. 25.1°C Max Temp. 34.2°C (Humidity 51-97%)	300 sows	+800 g/d improvement in lactation feed intake +8.2% improvement in piglet ADG
Commercial farm, Colombia (2015)	High ambient temperature and relative humidity	14 batches of approx. 40 sows	+3.3% improvement in lactation feed intake (1st and 2nd farrowing sows) -9.6% reduction of body weight loss
Commercial farm, Iowa, USA (2012)	Av. 32.2°C, with peaks at 35°C	60 sows (2 consecutive batches)	+15.6% improvement on litter ADG pre-weaning -11.6% reduction of % of days with piglet diarrhoea

Health and performance are affected

Above 25°C the pig must adapt to maintain its body temperature: mechanisms that dissipate heat are increased while heat production is reduced. Digestion and metabolic utilisation of dietary nutrients is an important source of heat for the body and so feed intake is strongly reduced during heat stress periods, with repercussions on growth or milk production in sows.

The impact on feed intake is more important as the temperature rises (Fig. 2).

Black et al. (1993) showed that when ambient temperature increased from 18 to 28°C, milk production decreased by 25%.

Other physiological functions are also affected, such as immunity, reproduction, or intestinal epithelial barrier.

Overall, heat stress is translated in terms of animal signs and performance losses:

- Increased rectal temperature.
- Increased water consumption and urine quantity.
- Reduced feed intake.
- Inactivity.
- Reduced body weight/decreased growth.
- Paleness, dry skin.
- Tachypnea and bradycardia.
- Higher sensibility to disease.
- Reproduction issues (impact on fertility, farrowing rate, litter size).
- Convulsion.
- Mortality.

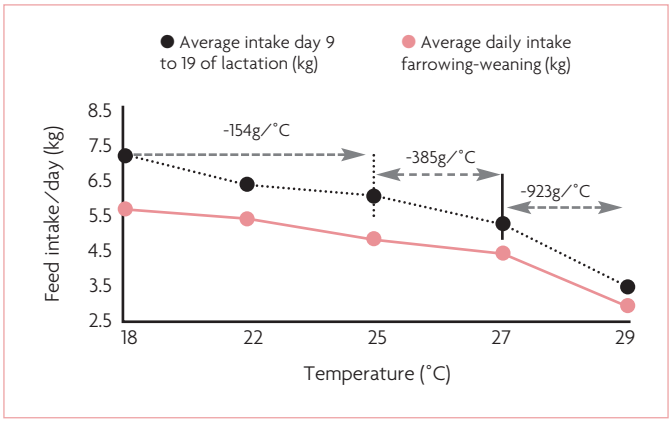

Fig. 2. Relationship between sow feed intake in lactation and room temperature (Quiniou et al, 2000).

Effects of S. boulardii

The use of probiotic yeast S. cerevisiae boulardii I-1079 (Levucell SB, Lallemand Animal Nutrition) to help control digestive process and performance, is extensively documented. User feedback indicated that its benefits could help ensure sow performance under heat stress situations.

Benefits of this live yeast under high temperature conditions is supported by various field trials, showing that sow feed intake is improved, which translates into improved piglet performance in lactation and at weaning (Table 1).

This was recently backed up by a scientific study on the modes of action involved, conducted by Etienne Labussière at INRA Pegase, in France.

More precisely, the trial conducted in Ceara State in Brazil under the supervision of Bruno Silva, from the University Federal de Minas Gerais, shows the effects of the live yeast supplementation of high-prolific sows both during gestation and lactation.

This trial involved 300 Topigs sows of mixed parity. The sows were supplemented from day 90 in gestation up to weaning (24 days).

- During the last days of gestation, the supplementation leads to improved farrowing process (a benefit of S. cerevisiae boulardii CNCM I-1079 extensively documented). The number of live-born piglets was increased (13.37 vs.13.87 piglets/sow), while the mortality rate at birth decreased (5% vs. 4%).
- In lactation, sow feed intake was significantly higher under heat stress with the supplementation; leading to better preservation of sow body reserves during this critical phase. Hence, the sows are better prepared for the next reproductive cycle.
- Consequently, piglets show better growth performance in lactation. Average daily gain is significantly improved by +8.2% vs. control (Fig. 3). At weaning, piglets are heavier (5.88kg for control sows vs. 6.30; P<0.01).

Scientific evidence

The INRA team used a state of the art experimental facility to conduct an in-depth study about the effects of the live yeast supplementation on thermal heat acclimatisation and energy balance in swine.

In this experiment, finishing pigs were used as a model for swine and sows, since, as Labussière presented it: 'the bigger the animal, the more sensitive to heat stress'.

- 12 Pietrain × (Landrace × Large White) pigs received a cereal and soybean meal based diet supplemented or not with S. cerevisiae boulardii I-1079, supplementation starting two weeks before the test.
- For each diet, the pigs housed individually in the respiration chambers were subjected to one week at 22°C (thermo-neutrality,) followed by two weeks at 28°C (heat stress) (temperature increased gradually over two days to allow for animals' adaptation).
- Different parameters were monitored, including individual live weight, eating behaviour, energy and nitrogen balances. Heat production was calculated through gas exchange measurements according to the principles of indirect calorimetry.

Results of this study indicate that the live yeast had a positive effect on growth performance under both thermo-neutral and heat stress ambient temperatures.

However, the supplementation had a greater impact under heat stress as it was able to 'compensate' for the negative impact of heat on pig growth. This could be linked to two effects of the supplement:

- **Improved feeding behaviour:** The number of meals per day was significantly improved during heat stress and the total daily feed intake was not affected by ambient temperature with the supplemented diet, while it was reduced in the control diet (Fig. 4).
- **Positive effect on energy metabolism:** Less energy is consumed for heat production, hence made available for pig growth (higher energy retention).

This trial represents proof of concept of the effects of probiotic yeast on pig adaptation to heat stress. Nevertheless, metabolic regulations involved in pig adaptation to heat stress when fed probiotic yeast remains to be identified.

Conclusion

Heat stress in pig production is an important and underestimated issue. Its effects are detrimental to performance and welfare, particularly through a reduction of feed intake and redirection of the animal metabolism.

Beyond performance, health and reproductive performances can be affected in the long term (loss of body reserves, risks due to increased intestinal permeability and lower immunity). It is crucial for producers to be aware of heat stress issues, and for example, the use of temperature/humidity sensors in the farrowing room can help alert the risks.

An innovative scientific study clearly demonstrates the benefits of managing the animal digestive microflora with specific live yeast under heat stress conditions, translating particularly to higher feed intake and improved feed efficiency, effects which have already been demonstrated in production situations in gestating and lactating sows. This supplement could represent a valuable tool to help alleviate the heavy toll of heat stress on swine production, as a complement to relevant heat abatement strategies in the barn. ■

References are available from the author on request

Fig. 3. Growth performance in lactation (University Federal de Minas Gerais, Brazil, 2016).

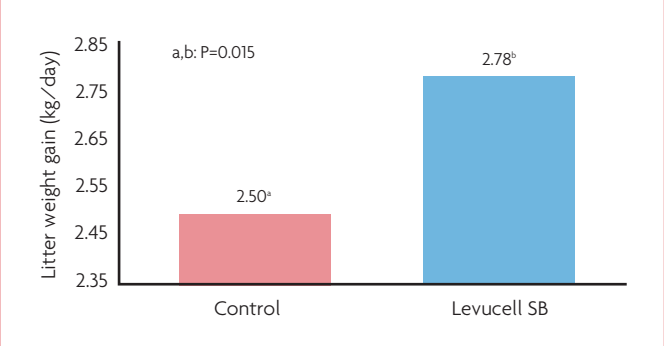

Fig. 4. Effect of Levucell SB supplementation on pig dry matter intake during the heat stress test (blue: thermoneutral week, pink: 1st and 2nd weeks of heat stress conditions) (INRA, France, 2015).