

Effect of ambient temperature on lactating sows, a meta-analysis and modeling approach

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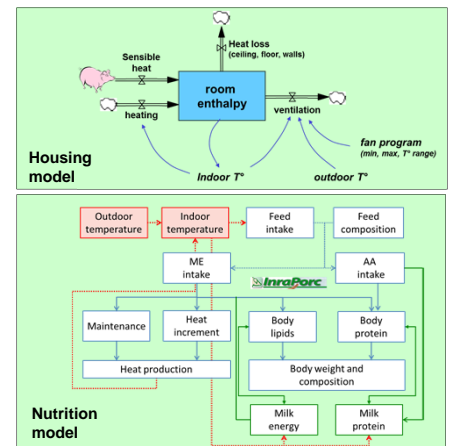
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Because of their intense metabolism, lactating sows are highly sensitive to high ambient temperatures, which induce a reduction in their voluntary feed intake and milk production. This also results in an increase in mobilization of body reserves, which may impair reproduction after weaning, and a decrease in piglet weight at weaning. In the context of climate change which increases the frequency of periods of heat stress, the aim of this work was to quantify the relationships between ambient temperature and sow and piglets performance, and to use these relationships in a prediction model of nutrient utilization by sows.

Material and Methods

- **Meta-analysis of literature.** A database with 46 publications and 254 observations was built in order to adjust prediction equations (Mixed model with random effect of experiment and fixed effect of temperature) for different criteria such as feed intake, respiratory frequency, body temperature, litter growth and milk production.
- **Modelling the effect of temperature on sow and piglets performance and nutritional requirements.** The model was built with two components:
 - a bioclimatic housing module predicting the effect of outdoor temperature on the indoor temperature perceived by the sow.
 - a nutrition module, based on InraPorc®, predicting the effect of temperature on animal performance and nutritional requirements.
- **Simulation with the model** of the effect of climate on sow's and piglets' performance using climator database for West and South France.



Results and discussion

- **Meta-analyses.** Equations were produced for the prediction of the effect of temperature on sows and litter performance (**Figure 1**).

$$\text{Feed intake (kg/d)} = 8.85 - 0.156 T - 0.00021 T^2 \quad \text{adj } R^2=0.80$$

$$\text{Litter growth (g/d)} = 3.28 - 0.0046 T \quad \text{adj } R^2=0.72$$
- **Simulations.** The results indicates significant effects of season ($P<0.001$) and region ($P<0.001$) on animal performance and nutritional requirements.
- **The effects of month and sow parity** are highly significant on feed intake (**Figure 2**), litter growth (**Figure 3**) and amino acid requirement (**Figure 4**). The simulations performed for years 2045 indicate that these effects tend to become more marked with climate change.

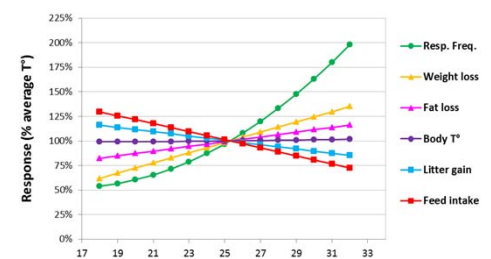


Figure 1. Evaluation from the meta-analysis of the effect of T° on respiratory frequency, sow weight and fat loss, body T°, litter weight gain and feed intake (expressed as a % of the mean value at 25.5°C)

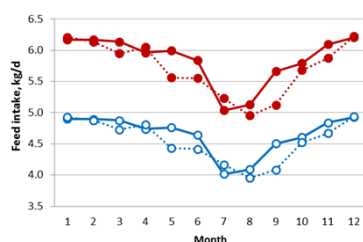


Figure 2. Simulation for South France of the effect of month on feed intake of **primiparous** or **multiparous** sows (2000: solid line, 2045 dotted line)

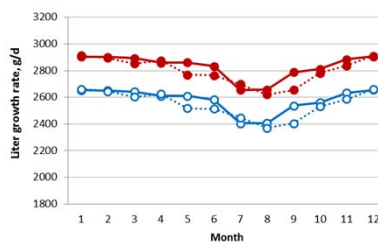


Figure 3. Simulation for South France of the effect of month on litter growth in **primiparous** or **multiparous** sows (2000: solid line, 2045 dotted line)

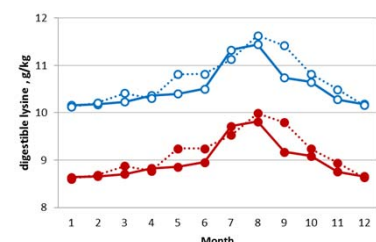


Figure 4. Simulation for South France of the effect of month on lysine requirement of **primiparous** or **multiparous** sows (2000: solid line, 2045 dotted line)

Conclusions

Equations have been produced from the meta-analysis to predict the effect of average daily temperature on performance of lactating sows and their piglets. They could be improved in the future to better take account of the daily fluctuation of temperature, but this requires more studies.

A model was developed from these equations to predict the effect of climate on performance and nutrient requirement of sows. Simulations with the model indicate that there is a clear effect of season and geographical location of farms. These effects are expected to become more pronounced with climate change.

In practice, the model developed should enable feed composition to be better adapted to the season and to the geographical location of farms and could also be used in the perspective of precision feeding of sows.