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CONTRIBUTION OF MODELING TO IMPROVE THE NUTRITIONAL EFFICIENCY OF SOWS

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Reproductive problems, which may result in a reduction of the sow's productivity and early culling, are often related to extreme variations in body reserves. During gestation, sufficient body reserves must be built to restore adequate body condition and compensate for possible nutritional deficits that may occur in the following lactation. However, these reserves should not be excessive to avoid farrowing problems, which are typical for fat sows, or that may impair feed intake after farrowing. During lactation, it is recommended to adapt daily nutritional supplies to requirements to maximize milk production and growth of the piglets, and to minimize the risk of reproductive problems of sows after weaning. Consequently, nutritional supplies to sows have to be modulated to maintain body reserves so that each sow will be in optimal condition throughout their productive life, thereby optimizing reproductive performance. On farm, this requires adjusting the feeding level and feed composition according to the performance of individual sows but also to housing conditions, which may affect nutrient utilization and voluntary feed intake.

The experimental results obtained during the last 25 years on energy, amino acids and minerals utilization by the pregnant or lactating sow have been integrated in the InraPorc® model and decision support tool, allowing a global approach to better understand nutrient use by sows, including the resulting performance. This decision support tool includes a simulation model which represents on a daily basis (dynamic) the utilization of key nutrient pools (mechanistic) for a given sow (deterministic). The end-users of InraPorc® are mainly nutritionists and teachers and students in animal nutrition. In InraPorc, the sow is represented as the sum of different compartments (i.e., body protein, body lipids and uterus) which change during the reproductive cycle. The main nutrient flows are energy, amino acids and minerals. The model can then be used to determine the nutritional requirements according to a classical factorial approach, or to predict performance and analyze nutrient utilization, including nutrient excretion, through simulations. In the current version of the software, reproductive performance data (*ie* litter size, piglet weight, milk production) are considered as user inputs and are therefore not sensitive to the nutrient supply. InraPorc can also be used to evaluate the short- and long-term effects of different housing or feeding strategies on nutrient utilization and body condition of the sows. The existence of nutrient deficiencies or excesses can also be identified.

Simulations can also be used to evaluate the sensitivity of body condition to changes in energy value of feed, or sows behavior. For instance it can be calculated that an increase by 4% of the energy value of the gestation diet results in an increase of 1 mm of backfat at farrowing. In the same way, the decrease of standing time of pregnant sows by 30 mn/day results in an increase of 1 mm sow BF at farrowing. During lactation, an increase by 5% of lactation diet energy value results in a decrease of almost 1 mm back fat depth.

Models and decision support tools such as InraPorc® can be used to evaluate different feeding strategies for sows, from both nutritional and environmental perspective. These tools address nutrient utilization in a dynamic way and allow identifying the limiting factors in the diets and/or excessive supplies. The equations used in the InraPorc model could also be used to develop algorithms which could be implemented in automated sow feeders or feeding station, for precision feeding.