

Conceptual model of digestion for pigs and poultry and its factors of variation

S. Roger¹, A. Narcy¹, J. Van Milgen², M.J. Duclos¹, E. Recoules¹

¹INRA, UR0083, 37380 Nouzilly, France, ²INRA, UMR1348, 35590 Saint-Gilles, France;
sonia.roger@tours.inra.fr

Improving the efficiency of pig and poultry husbandry systems requires a better understanding of nutrient digestion. Mechanistic modelling is a useful tool to identify and quantify the impact of different factors affecting the digestion. Up to now, despite the genericity of physiological processes, models of digestion developed for monogastrics have been species-specific or focused on individual nutrients. In addition, practical nutrition has been mostly based on table values but ignores interactions among nutrients and among nutrients and the animal. The aim of this study was to develop a conceptual model of digestion for pigs and poultry while accounting for different factors of variation (e.g., species, sex, and physiological stage). The digestive tract of the animal is considered as a system where inputs correspond to the ingested nutrients, the compartments are the stomach, the small and large intestine, and outputs are the quantity of absorbed and excreted nutrients. For each compartment, the input and output kinetics were determined using literature knowledge. Preliminary results suggest that the output of the stomach was represented by a decreasing exponential function. For the small and large intestines, inputs of nutrients depended on outputs of the stomach and the small intestine, respectively, and outputs were formalized with decreasing sigmoid functions. The mathematical formalism is generic but model parameters will be modulated to account for differences related to factors of variation, while factors related to the feed (e.g., composition, technological processes) also need to be considered. This conceptual model is a first step towards the development of a generic predictive tool to determine absorption and excretion of nutrients and to explore how each factor of variation impacts the digestion process and how they interact. This knowledge could contribute to improve the efficiency of animal production and the sustainability of animal production.