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Preliminary model to predict P-requirement of growing pigs

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Phosphorus is an essential nutrient and, as phosphate, is involved in metabolic activities as well as in bone formation. There is evidence that a long term P deficiency reduces the growth rate of animals. However, an oversupply results in high rate of excretion that is critical from an environmental point of view. Modelling P metabolism allows to improve our understanding on the main factors affecting the P requirement. The aim of the work was to develop a mathematical model predicting the dynamics of P partitioning and retention in growing and fattening pigs over time. The model is a comprehensive description of the underlying mechanisms of digestible P and Ca utilization. Input parameters are related to the diet and include dry matter, the Ca and P content of the feed, as well as Ca and P digestibilities, and to the animal such as daily feed intake, protein and fat deposition rate. The model presents the distribution of true digestible P and Ca within the body. Absorbed P and Ca are used for maintenance purposes, soft tissues (i.e. muscle and backfat), and bone tissue development. Surplus P and Ca is excreted via the urine. Retention of P in the body is the sum of P retention in soft tissues and the skeleton. It is presumed that soft tissues have a priority in utilizing the absorbed P. Thus, an insufficient P supply results in a reduction in or even negative bone ash retention to ensure P for the development of soft tissues. However, there is a limit for rate of demineralization and, under the threshold level, the absorbed P has priority to be retained in bone over soft tissues. The bone formation depends on P bioavailability and Ca supply, and limited by potential bone P retention. The model is able to predict P retention, urinary P excretion and digestible P requirement of swine at different body weights and with a different body composition. The results show that the P requirement depends on growth rate and particularly on protein deposition of the pigs. This study is part of the Feed-a-Gene project and received funding from the European Union's H2020 program under grant agreement no. 633531.

Re-parametrization of a swine model to predict growth performance of broilers

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The aim of the study was to investigate whether a pig growth model is suitable to be modified and adapted for broilers. As monogastric animals, pigs and poultry share many similarities in their digestion and metabolism, many structures (body protein and lipid stores) and the nutrient flows of the underlying metabolic pathways are similar among species. For that purpose, the InraPorc model was used as a basis to predict growth performance and body composition at slaughter in broilers. Firstly, the backbone of InraPorc was translated to Excel and examined whether the equations were suitable for growing birds by evaluating the parameters and model behavior. After determining of differences the model was modified for predicting growth in broilers in relation to the nutrient supply. The model core is very generic in terms of representing the most important nutrient flows and the transformation from absorbed nutrients to protein and fat accretion during growth. The idea of nutrient utilization is mainly based on concepts used in net energy and ideal protein systems. The model is driven by feed intake, the partitioning of energy between protein and lipid deposition, and availability of dietary protein and amino acids. Parameters of the Gompertz function were adjusted using literature data to express maximum feather-free body protein deposition. A separate Gompertz equation was used to estimate feather growth and protein content of feather was assumed to be a nonlinear function of age. The amino acid loss with feathers was considered as a part of the maintenance requirement and the fasting heat production was used as the NE requirement for maintenance ($460 \text{ kJ}/(\text{kg BW})^{0.70}/\text{day}$). Feed intake for broilers was expressed on a NE bases and estimated by a Gamma-function (which expresses the NE intake as multiples of maintenance), as in InraPorc. Parameters of the Gamma function were adjusted to experimental data from different broiler studies. This study is part of the Feed-a-Gene project and received funding from the European Union's H2020 program under grant agreement no. 633531.