

Phosphorus and calcium requirements of growing pigs predicted by mechanistic modelling

Authors

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Abstract

Phosphorus (P) is a key element for the sustainability of pork production systems. The response of pigs to P intake is complex and optimize P utilization requires a multicriteria approach. A mechanistic mathematical model representing the P and Ca absorption and bone and soft tissues deposition was developed and used to optimize these minerals utilization. Model P and Ca requirements (g/kg) were also compared to those of INRA (Jondreville and Dourmad, 2005; apparent total tract digestible P, ATTD-P) and NRC (2012; standardized total tract digestible P, STTD-P) requirements in different bone mineralisation scenarios (100 and 85%). The proposed model showed lower ATTD-P and STTD-P requirements than INRA (6%) and NRC (7%), between 29 to about 98 kg of body weight (BW) and higher (up to 17%) at other weights. The proposed model Ca requirements increase after 95 kg BW unlike NRC and INRA Ca requirements that decrease. For 100 % of bone mineralisation, INRA show the highest Ca requirements (21%) while NRC requirements are similar between 35 to 65 kg and the model requirements are higher for other weights. For 85% objective, the model showed lower Ca requirements than NRC from 25 to 82 kg of BW (9%). The Ca:ATTD-P ratio increased curvilinearly with BW varying from 2.2 to 2.6. The differences observed with the current model and NRC and INRA are due to the structure of the model, that simulates the bone independently of the protein, the first evolving linearly with the weight while the second follows a Gompertz function. Therefore a non-fixed Ca:ATTD-P (or STTD-P) ratio could be consider to maximize bone mineralisation. By predicting bone and muscle growth independently the model offers greater allometric insight into nutrient requirements and their interactions. Studies such as this one will help to usher in a new era of sustainable and eco-friendly livestock production.

Keywords

Model, phosphorus, calcium, requirements, pig