Digestible calcium requirements for 25 to 50 kg pigs

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Introduction. It is more accurate to formulate diets for pigs using values for standardized total tract digestibility (STTD) than values for apparent total tract digestibility because values for STTD are additive in mixed diets. In addition, formulating diets based on values for STTD results in less excretion of nutrients to the environment and in formulation of more cost-effective diets. The NRC (2012)[1] reported the requirements for phosphorus (P) as STTD P, but the requirements for calcium (Ca) were reported as total Ca because of a lack of data for digestibility of Ca in Ca-containing feed ingredients. However, recent studies have generated data for digestibility of Ca in different feed ingredients, which makes it possible to determine the digestible Ca requirement for pigs. The Ca:P ratio is important in diet formulation because the interaction between Ca and P may influence the utilization of both minerals. Likewise, the inclusion level of each mineral in the diet is also important to consider because a high concentration of Ca in a diet decreases the digestibility of P[2]. It is, therefore, important to know the levels of Ca and P in the diets that are needed to optimize performance of pigs. As a consequence, the objective of this experiment was to determine the requirement for STTD Ca in 25 to 50 kg pigs by determining the quantities of STTD Ca that are needed to maximize average daily gain (ADG), Gain:Feed (G:F), and bone ash.

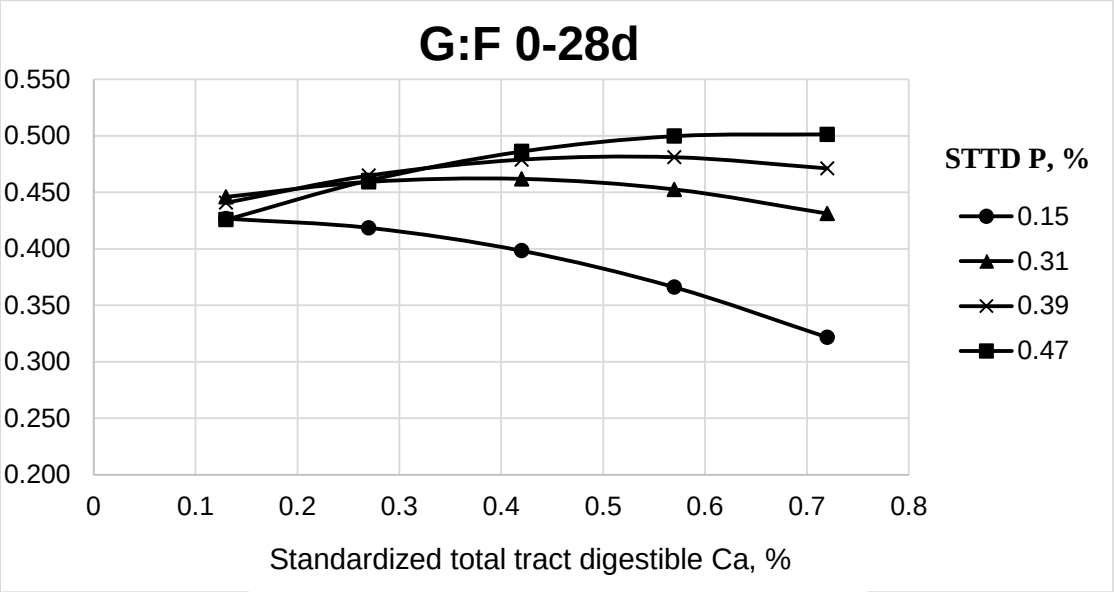
Materials and methods. Two hundred forty pigs with an average initial BW of 24.70 ± 1.27 kg were randomly allotted to 20 diets in a randomized complete block design with 6 replicate pens per treatment. Each pen had one gilt and one barrow. Feed and water were available at all times. Twenty corn-soybean meal based diets were formulated to contain different concentrations of Ca and P, but to keep the level of phytate constant, all diets contained the same amount of corn and soybean meal. Diets were formulated using a 4 × 5 factorial arrangement with diets containing 0.15, 0.31, 0.39, or 0.47% STTD P and 0.18, 0.42, 0.66, 0.90, or 1.14% total Ca (0.13, 0.27, 0.42, 0.57, or 0.72% STTD Ca, respectively). The P concentrations ranged from 48 to 152% of the STTD P requirement and the Ca concentrations ranged from 27 to 173% of the Ca requirement established by NRC (2012). All diets contained the same concentration of sodium because inclusion of sodium chloride was reduced as more monosodium phosphate was included in the diets. Pigs were weighed at the beginning and at the end of the 4- week experiment when they were close to 50 kg. The amount of feed provided to the pigs was recorded every day and the amount of feed left in the feeders was recorded at the end of the experiment and subtracted from the feed offered. On the last day of the experiment, all barrows were euthanized via captive bolt stunning. The right femurs were removed, cleaned, broken, and then soaked in petroleum ether under a chemical hood to remove bone marrow and fat for 72 h. Bones were dried overnight at 130ºC and then ashed at 600ºC for 24 h. The ADG, average daily feed intake (ADFI), G:F, and bone ash were calculated. The program NLREG was used to determine the parameter estimates for the surface response model of ADG, ADFI, G:F, and bone ash to increasing levels of Ca and P and to determine the maximum response. The parameter estimates of the model that were not significant and were not included in a significant interaction were removed from the model and the estimates were recalculated. The surface response model was:

$$Y = a + b \times Ca + c \times Ca^2 + d \times P + e \times P^2 + f \times Ca \times P$$

Coefficients were used to make the graphs.

Results and discussion. Results indicated that if diets had a low concentration of P (0.15% STTD P), increasing the dietary concentration of Ca from 0.27 to 0.42, 0.57, or 0.72% STTD Ca had a negative effect ($P < 0.05$) on the final body weight, ADG, ADFI, and G:F of the pigs (Graph 1), but bone ash was not affected. This observation was expected because high levels

of Ca negatively affect the digestibility of P[2] due to formation of Ca-P complexes, which results in less P available for growth. However, growth performance of pigs fed diets with high levels of P (0.39 and 0.47% STTD P) was not affected by the concentrations of Ca in the diets. This observation indicates that at these levels of dietary P, pigs were able to absorb enough P to meet the requirements despite the negative effects of high concentrations of dietary Ca on P digestibility. To maximize ADG, it was necessary to include at least 0.45% STTD Ca and at least 0.43% STTD P. To maximize feed efficiency, the STTD Ca needed to be between 0.45 and 0.72% with a STTD P between 0.42 and 0.47%.To maximize bone ash, it was necessary to provide at least 0.52% STTD Ca and 0.47% STTD P.



Graph 1. Overall gain to feed ratio (G:F) of pigs fed diets with different levels of STTD Ca and STTD P.

Conclusion. The STTD Ca requirement for 25 to 50 kg pigs to maximize growth performance was between 0.45 and 0.72% with a STTD P between 0.42 and 0.47%.

Implications. If dietary P is provided below the requirement of in marginal concentrations, it is very important to not oversupply diets with Ca. Future work should be directed at establishing requirements for digestible Ca for all groups of pigs.

References. [1]NRC. 2012. Nutrient Requirements of Swine. 11th rev. ed. Natl. Acad. Press. [2]Stein HH. et al. 2011. J Anim Sci 89:2139-2144.

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