

67.9% at 0, 500, 1000 and 2000 FTU/kg, respectively. Increasing phytate-P level exponentially increased ($P < 0.01$) digestible P content. High soluble limestone reduced digestible P in NC and low phytase dose groups, and 2000 FTU/kg PhyG compensated the negative effect. In conclusion, phytase dose response, phytate P level and limestone solubility are the factors to be considered when determine P, Ca and Na matrix in pigs.

P75. Effect of a novel consensus bacterial 6-phytase variant on inositol hexa-phosphate degradation profile in growing pigs

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This study evaluated the effect of a novel consensus bacterial 6-phytase variant (PhyG) on phytic acid (inositol hexa-phosphate, IP6) degradation profile and apparent ileal digestibility (AID) of phosphorus (P) in growing pigs. It was hypothesized that complete IP6 degradation with higher phytase doses improves P digestibility. A negative control (NC) diet with standardized total tract digestible P and total Ca that were 0.16% and 0.15% below the NRC requirements was formulated. Net energy and standardized ileal digestible amino acids content were 33 kcal/kg and 0.02 percentage units below requirements. Five additional diets were prepared by adding 250, 500, 1,000, 2,000 or 4,000 FTU/kg of PhyG to NC. All diets were based on corn, soybean meal and canola meal. Eighteen ileal-cannulated pigs (17.8 ± 1.7 kg) were allotted to a 6 × 3 incomplete Latin square design with six diets and three periods. In each period after 7-day acclimation, ileal digesta were collected continuously for a total of 9 h on days 8 and 9. Data were analysed using the Fit Model platform of JMP 14.0 with diet as fixed effect and period as random effect. Phytase dose response was tested using exponential curve fitting. Increasing PhyG dose exponentially ($P < 0.0001$) reduced ileal IP6 content and increased IP6 degradation. At 500, 1000, 2000 and 4000 FTU/kg of PhyG, the IP6 disappearance was 80.6, 92.1, 93.7, and 96.4%; and IP (sum 3–6) disappearance was 62.0, 76.0, 86.5, and 93.0%, respectively. This indicates reduced lower IP ester accumulation with increasing phytase dose. As a result, AID P increased exponentially from 36.1% in NC to 53.6, 54.6, 69.5, 71.3, and 75.6% in diets with 250, 500, 1000, 2000, and 4000 FTU/kg, respectively. In conclusion, PhyG efficiently breaks down IP6, increasing phytase dose completely breakdown lower IP esters and increase P digestibility in pigs.

P76. Meta-analysis: The effect a novel consensus bacterial 6-phytase variant on inositol hexa-phosphate degradation and phosphorus digestibility in young pigs

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This meta-analysis evaluated the effect of a novel consensus bacterial 6-phytase variant (PhyG) on degradation rate of inositol hexa-phosphate (IP6) and total tract digestibility (ATTD) of calcium (Ca) and phosphorus (P) in pigs. It was hypothesized that complete IP6 degradation with higher phytase doses improves mineral digestibility. The impact of limestone solubility and phytate-P levels in diets on IP6 degradation was also determined. Database was constructed using 3 studies (PIC or large white breeds; average body weight of 24.6 kg at sampling), contributing 254 data points. All studies had a negative control (NC) diet with reduced Ca and digestible P (total or partial removal of inorganic P). Pigs were fed corn or corn-wheat based diets with soybean meal and canola meal differing in phytate-P (2.2 to 3.3 g/kg) and total Ca (5.1 to 7.5 g/kg). Limestone solubility (at 5 min) varied from 51.8 to 92.0%. The NC was supplemented with PhyG at 250, 500, 1000, 2000 or 4000 FTU/kg. Ileal digesta were collected by ileal T-cannulation (9 replicates/treatment) or slaughter technique (8 replicates/treatment). Faecal samples were collected for 4 days. Data were analysed using Fit Model platform of JMP 14.0. The effect of limestone solubility and phytate-P on IP6 degradation was analysed by multivariate analysis. PhyG improved ($P < 0.05$) ATTD P and Ca, with up to 44.4 and 26.7 percentage points at 4000 FTU/kg, respectively, vs. NC. PhyG addition exponentially improved ($P < 0.05$) ileal IP6 degradation by 64.3 percentage points at 4000 FTU/kg. A negative correlation was observed for limestone solubility ($r = -0.60$, $P < 0.001$) and phytate-P content ($r = -0.30$, $P < 0.001$) on IP6 degradation. In conclusion, PhyG efficiently improved IP6 degradation and ATTD P and Ca and increasing phytase dose mitigates negative effects of high soluble limestone and high phytate-P in pig diets.

P77. Dietary variables affecting efficacy of a combination of Bacillus spp. direct-fed-microbial and a protease on growth performance in pigs: meta-analysis

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A meta-analysis was conducted to determine the effect of dietary variables on a combination of multi-strain Bacillus spp. direct-fed-microbial (DFM) with a protease enzyme (PRO) to improve growth (ADG) and feed efficiency (FE) in grower and/or finisher pigs, from 20-120 kg BW. It was hypothesized that fibre content and protein quality have a positive or negative correlation, respectively with the efficacy of DFM-PRO. The database was created with data of 22 pig studies, with 1475 datapoints. The datasets were obtained from 11 locations globally. The basal diets were corn- or wheat-soybean meal based with variable inclusion of corn-DDGs, wheat middlings, rice bran and variation in the levels of digestive lysine (0.58–1.37%), phytase enzyme (from 500 to 1000 FTU/kg), soluble fibre (1.1–2.8 %) and insoluble fibre (5.3 to 14.7 %). All diets were formulated to meet NRC requirements. Data were analysed using Fit Model platform of JMP 14.0. Multivariate stepwise regression analysis was used to evaluate the effect of main dietary variables on the response criteria (ADG and FE). Logistic regression model was used to predict the effect

of each dietary variable on ADG when diets were supplemented with DFM + PRO. Based on the stepwise regression analysis, the main dietary variables affecting ($P < 0.0001$) overall ADG response in decreasing order were phytase dose, digestive lysine, soybean meal inclusion and soluble fibre. The FE response was significantly ($P < 0.0001$) affected in decreasing order by soluble fibre, digestible lysine, insoluble fibre, phytase dose and soybean meal inclusion level. Across all datapoints, increasing phytase dose up to 1000 FTU/kg, increasing soluble fibre, increasing low quality protein, or limiting digestive lysine levels at or below nutritional requirements showed tendency to have positive ADG response with DFM + PRO. In conclusion, supplementation with DFM + PRO in grower-finisher pigs can improve ADG and FE, leading to a greater positive response with more challenging diets.

P78. Isoquinoline alkaloids influence intestinal health and function in weanling pigs fed diets formulated below amino acid requirements

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Isoquinoline alkaloids (IQ) are phytochemical feed additives that have demonstrated to improve growth and intestinal health by improving digestibility of nutrients, including amino acids (AA). The hypothesis of the present study is that growth performance and health of weanling pigs receiving diets formulated below AA requirements would not be affected when supplemented with IQ. Two-hundred weanling pigs (6.11 ± 0.61 kg) were allotted to 4 treatments for a 27 d, 2-phase experiment. Diets were arranged in a 2×2 factorial design with AA at or 10% below requirements and with IQ at 0 or 120 mg/kg feed. Growth performance was determined and faeces (d 14 and 26), and tissue samples (d 27) were collected. Data were analysed as a 2×2 factorial, considering the AA levels, IQ levels and the interaction as fixed effects, and the pen as the random effect. Pigs fed diets with IQ tended to have greater ($P < 0.10$) ADFI, whereas G:F was reduced if dietary AA were reduced ($P < 0.05$). If diets contained adequate AA on d 14, IQ increased phenol in the faeces, whereas when diets with reduced AA were fed, IQ decreased phenol in the faeces (interaction, $P < 0.05$). If AA were at requirements, lamina propria thickness in the jejunum was not affected by IQ inclusion, but if AA were below requirements, IQ decreased lamina propria thickness (interaction, $P < 0.05$). Jejunal villus height tended to increase ($P < 0.10$) with IQ regardless of dietary AA concentration. If AA were below requirements, IQ tended to increase occludin in the jejunal mucosa, whereas if AA were at requirements, IQ did not influence occludin expression (interaction, $P < 0.10$). In conclusion, if AA are provided below requirements, dietary IQ improves intestinal function and modulates faecal metabolite synthesis in weanling pigs.

P79. Impact of enzyme supplementation, sampling period, meal size and frequency on the digestibility amino acids and minerals in growing pigs

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This study aimed to determine the effects of meal size and frequency, xylanase and phytase supplementation as well as digesta sampling period, on the digestibility of protein (CP), amino acids (AA), calcium

(Ca) and phosphorus (P). Pigs ($n = 6$) were fitted with a T-cannula, and each received all treatments using a 6×6 Latin square experimental design (6 pigs, 6 treatments, 6 experimental periods lasting 14 d each). The treatments were formulated with and without enzymes and distributed differently: 2 meals per day that met $3 \times$ the maintenance energy (ME) requirement (2 M), the same amount in 8 meals (8 M), and 8 meals per day that met $5 \times$ the ME requirements (8 M+). Digesta was sampled from 0800–1200, 1200–1600, 1600–2000 and 0800–2000. To evaluate the effect of sampling schedule, the model included as fixed variables the addition of enzymes, type of meal and digesta sampling period. The results indicate an improvement in the apparent ileal digestibility (AID) of dry matter (DM), CP, P, Ca, Val and Thr with enzyme supplementation (Enzyme effect, $P < 0.05$). AID of Ca in the 0800–1200 period was reduced in 8 M+ treatment compared to 2 M and 8 M whereas no difference was observed for 1200–1600 and 1600–2000 periods (Interaction Meal \times Period, $P = 0.017$). Apparent total tract digestibility (ATTD) of Ca (Meal effect, $P = 0.003$) was higher by 8% in pigs fed 8 M compared to 8 M+ (Contrast 8 M vs 8 M+, $P = 0.040$). Saturation of the absorption processes because of high intake in Ca in 8 M+ (37% superior to 2 M and 8 M) can explain lower digestibility. Enzyme efficiency was not affected by meal size or frequency indicating minor modifications of transit time and pH. The impact of the sampling schedule after meal on the ileal digestibility results confirmed that a continuous collection many hours following the meal is important to have a representative sample of digesta.

P80. Faecal nutrient digestibility in growing-finishing pigs kept under low and high sanitary conditions

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We hypothesized that low sanitary conditions could increase endogenous protein losses and reduce nutrient digestibility. Therefore we evaluated the effects of low or high sanitary conditions (LSC or HSC) on faecal nutrient digestibility in growing pigs kept in floor pens (9 pigs per pen) fed either one of four experimental diets varying in dietary energy source (starch vs starch/fat) and either or not containing increased levels of energy and essential amino acids to accommodate for assumed increased nutrient requirements of pigs under low sanitary conditions. A contrast in sanitary conditions was imposed via differences in strategy for vaccination against a number of pathogens, cleaning of the pens, hygiene protocol, and antibiotic and deworming treatment. During the growing and finishing period (21–124 kg; 14 weeks), pigs had ad libitum access to the diets. Apparent faecal nutrient digestibility (dry matter, ash, organic matter, crude protein, fat, starch and energy) of the starter, grower and finisher diets were determined. In week 5, 9 and 13 from 4 pens per treatment twice a day fresh faecal grab samples were taken. Diets contained titanium oxide as marker. The apparent faecal digestibility of dry matter, organic matter and energy of the starter diet was lower in LSC than HSC pigs (79.9 vs 80.6%; 84.7 vs 85.5%; 83.2 vs 84.1%, respectively; $P < 0.05$). For the grower diets the apparent faecal N and fat digestibility was lower in LSC than HSC pigs (78.4 vs 79.5%; 81.9 vs. 83.4%; $P < 0.05$). For the finisher diets, no effects of sanitary status was observed. It is concluded that low sanitary conditions have small negative effects on faecal nutrient and energy digestibility in pigs, especially in the starter and grower phase, thereby reducing the nutritional value of the diet and contributing to a lower growth performance of animals kept in such conditions.