significantly affected by the iron supplement. In summary, the oral iron supplement may efficiently replace iron injection in newborn piglets.

P68. Can production modifications of a soy protein concentrate alter digesta kinetics and nutrient digestibility in weaned piglets?

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A soy protein concentrate (SPC) is on the market that used a pH reduction step and high temperatures (indicated as MSPC) and is suggested to improve piglet performance and health as a result of improved protein (CP) utilisation than other SPCs and soybean meals (SBM). In this trail the effect of MSPC or SPC/SBM (acidified or not) on nutrient digestibility and kinetics were evaluated. A total of 3 treatments were evaluated: 1) SBM + SPC; 2) SBM + SPC acidified; and 3) MSPC. The trial was performed with 6 piglets/ treatment (±30 days age) and diets were provided ad lib from d0. During the first 7d post-weaning (PW) piglets were housed in pairs. From d7 (BW 11.4 kg; SD = 1.01) piglets were housed individually and were fed semi ad lib (3.2 × maintenance). During d11-15 PW faeces and urine were collected. Piglets were euthanized at d15 PW. The data were analysed with ANOVA. The acid binding capacity at pH 4 (ABC-4) of the diet was 260, 138, and 126 meq/kg for treatments 1, 2, and 3. Average daily gain between d0-7 PW was 307, 316, and 390 g/day for treatments 1, 2, and 3. Treatments 1 and 2 resulted in lower stomach protein hydrolysis (P = 0.04), lower faecal CP digestibility (P = 0.02), and lower N retention (P = 0.02) than treatment 3 (81, 80 and 84% respectively for faecal CP digestibility and 15, 15, and 16% respectively for N retention). Treatment 1 had a lower jejunal digesta viscosity (P = 0.02) than treatment 2 and 3 (3.18, 2.10, and 2.14 cP, respectively). Lastly, treatment 1 and 2 resulted in a higher SCFA colon content than treatment 3 (P = 0.03). The results indicate that MSPC positively influenced nutrient digestion and that MSPC can modify digesta kinetics.

P69. Determination of the net energy in soybean meal fed to group-housed pigs

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In addition to providing amino acids, soybean meal (SBM) also provides energy to diets for pigs, but the net energy (NE) in SBM fed to group-housed pigs has not been reported. Therefore, the objective of this experiment was to test the hypothesis that NE in SBM from the U.S. fed to modern genotypes of group-housed pigs is greater than the value that is currently used in diet formulation. A basal diet contained corn as a sole source of energy. Five additional diets were formulated to contain corn and 15, 25, 35, 45, or 55% SBM, respectively. A total of 24 growing pigs (initial body weight: 26.5 ± 1.0 kg) were housed in groups of 4 pigs in 6 calorimeter chambers and allotted to a 6 × 6 Latin square design with the 6 diets and six 15-d periods. Throughout the experiment, pigs were allowed ad libitum access to feed and water. Oxygen consumption and CO_2 and CH_4 productions were measured during the fed and fasting states and faecal and urine samples were also collected to calculate energy and N losses. Intakes of digestible energy (DE), metabolizable energy (ME), and NE from SBM were regressed against SBM intake and concentrations of DE, ME, and NE in SBM were obtained from the slopes of regressions. Results for this experiment indicated that the apparent total tract digestibility of DM and GE linearly decreased (P < 0.01) by adding SBM to the diets. Concentrations of DE and ME did not differ among diets, but NE in diets decreased (quadratic, P = 0.011) with increased SBM in diets. Concentrations of DE, ME, and NE in SBM were calculated by regression and values of 3,228, 3,103, and 2,233 kcal/kg (P < 0.001), respectively, were obtained. In conclusion, NE in SBM was greater than previous values, which confirms the hypothesis of this experiment.

P70. Apparent and standardized ileal amino acid digestibilities in heat stressed pigs fed wheat-soybean meal diets supplemented with L-arginine and DL-methionine

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Exposure of pigs to heat stress (HS) is associated with damage of the small intestine epithelia affecting digestibility and absorption of amino acids (AA). Both Arg and Met can enhance antioxidant and intestinal cell proliferation activity, thus supplementing them in diets might alleviate epithelia damage and correct the reduced AA digestibility. A 10-d experiment was conducted with 10 ileal-cannulated pigs exposed to HS to evaluate the effect of adding extra L-Arg and DL-Met to the diet on the apparent (AID) and standardized ileal digestibility (SID) of AA. Ileal lumen temperature was continuously monitored at 15-min intervals during the experiment. Following adaptation to diets, pigs were divided into two treatments: Control, wheat-soybean meal diet supplemented with L-Lys, L-Thr, DL-Met, L-Trp; and Control diet added with 0.20% L-Arg and 0.20% DL-Met (Arg-Met). Pigs were exposed to HS conditions (29.6 to 36.1 °C) and fed twice a day for 8 days. Ileal digesta was continuously collected for 12 h, starting at 0700, on d 9 and 10 of the study. Chromic oxide was used as indigestible marker. Data was analysed as a completely randomized design; treatment means were compared using Tukey. Ileal temperature ranged from 40.3 to 41.5 °C. The AID of Arg, His, Met, and Thr, and SID of His and Met were higher in pigs fed the Arg-Met diet (P < 0.05). Threonine and Val had the lowest whereas Arg, Met and Lys had the highest AID values. Intake of Arg (r = 0.64) and Met (r = 0.84) was highly correlated with their AID values. Methionine intake was also highly correlated with its SID value (r = 0.72). Valine was the AA with the lowest SID, whereas Arg had the highest SID value. In conclusion, supplementing L-Arg and DL-Met to diets fed to HS pigs partially improves the AID of AA but only the SID of Arg.

P71. Digestibility of amino acids is not affected by increasing calcium from deficient to over-sufficient concentration in diets fed to pigs

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Dietary interactions between Ca and P include precipitation of Ca and P in the intestinal tract of pigs and chelation of Ca ions to phytate. Increasing dietary Ca thus reduces P digestibility. It is possible that high concentrations of Ca in diets increase pH of the digesta, which may negatively affect activation of proteases. However, effects of increasing

dietary Ca on the digestibility of AA in pigs have not been reported. Therefore, the objective of this experiment was to test the hypothesis that the concentration of Ca in diets affects apparent ileal digestibility (AID) of AA in pigs. Six corn-soybean meal diets containing Ca from 50 to 175% of the requirement (i.e., dietary Ca = 0.26 to 0.91%) and P at the requirement were formulated. Dietary Ca was increased by increasing inclusion levels of calcium carbonate. Six growing barrows (initial body weight: 81.43 ± 1.14 kg) were equipped with a T-cannula in the distal ileum and allotted to a 6 × 6 Latin square design with 6 diets and six 7-d periods. Ileal digesta were collected and analysed for dry matter, Ca, P, and AA. The statistical model included diet as fixed variable and period and animal as random effects. Contrast coefficients were used to determine linear and quadratic effects of increasing dietary Ca. Results indicated that the AID of dry matter was not affected by the level of Ca in the diets. The AID of Ca increased linearly ($P < 0.001$), but the AID of P decreased in a quadratic manner ($P = 0.022$) with increasing Ca in diets. The AID of crude protein and all indispensable and dispensable AA was not affected by dietary Ca levels. In conclusion, increasing dietary Ca did not affect digestibility of AA in pigs.

P72. First-pass extraction of amino acids by the small intestine in pig – How important is it?

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The small-intestine is a metabolically very active tissue, able to extract a significant share of dietary amino acids (AA) in first-pass for its own needs. The objective of this study was to gather and analyse existing data on first-pass metabolism in pigs to identify influencing factors. A database was created (n = 20) from in vivo trials, investigating net portal balance (NPB, n = 18) and dual tracer balance (DTB, n = 11) as response variables. Both variables measure the proportion of dietary AA appearing in the portal vein after absorption by the small intestine and that are not metabolized in first-pass. Kruskal-Walis test was used to detect differences in NPB or DTB in between AA and Wilcoxon test was used for pairwise comparisons. For NPB, there was no difference ($P = 0.16$) in between essential amino acids, while there was for non-essential amino acids ($P < 0.05$). The average NPB of Glx and Asx was close to zero, while that of Ala exceeded 100%. For Cys, the NPB averaged 45%. A strong variation of NPB among articles was observed, which could not be reduced by expressing the NPB of each AA relative to Lys. Study profiles of NPB were similar among treatments within publications, suggesting a strong study effect. Data obtained with DTB were only available for seven AA and showed a value of 60% for Thr, while it was 100% for Met. The results confirm the disappearance of Glx and Asx across the intestine and a net production of Ala as NH_3 acceptor. The important disappearance of Cys might be related to its role as a sulphur donor and the sparing of Met for non-digestive tissues. However, the variation among studies was such that it was not possible to precisely quantify first-pass metabolism, nor it was possible to identify influencing factors.

P73. Expression of intestinal amino acid transporters, gut morphology, and amino acid digestibility in pigs fed proteins or free amino acids

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Dietary amino acids (AA) supplied as protein or in free form are digested and absorbed at different rates which can induce differences in gut physiology, like digestive and absorptive capacities, and metabolism. We compared the AA digestibility, expression of AA transporters, and gut morphology of pigs fed diets providing different forms of AA. Growing pigs (n = 30; 33.7 ± 4.1 kg) were fed one of the three experimental diets that provided AA as intact feather meal (INT), as free AA by extensive hydrolysis of feathers (HYD), or as synthetic AA with the same AA profile as HYD (FAA). Pigs were fed the same quantity of feed, energy, and AA. After 14 days, pigs were slaughtered 3 hours after feeding the experimental diet with indigestible markers. Digesta and tissue were collected from different sections of the small intestine. Jejunal digesta was used to measure AA digestibility as there was not enough ileal digesta during collection. Duodenum, jejunum, and ileum samples were analysed for expression of intestinal AA transporter genes and gut morphology. The AA digestibility from INT was lower compared to HYD and FAA ($P < 0.05$). Digestibility of Cys, Gly, Pro, and Thr was lower for FAA compared to HYD ($P < 0.05$). Crypt depth in the jejunum was lower ($P < 0.01$) and villi area in the ileum was higher ($P < 0.05$) for HYD suggesting greater surface for digestion and absorption. In the duodenum, INT expressed more PepT-1 ($P < 0.01$), while HYD expressed more CAT-1 ($P = 0.04$). Furthermore, HYD expressed more ASCT2 ($P = 0.02$) and CAT-1 ($P = 0.04$) in the jejunum compared to other treatments. The expression of these transporters along the intestine depended on the relative abundance of dietary absorbable AA. Results showed that the dietary AA form influences the expression of different AA transporters and morphology of the small intestine, which can impact AA absorption and bioavailability for peripheral tissues.

P74. Modelling improvements in phosphorus, calcium and sodium digestibility by a novel consensus bacterial 6-phytase variant in pigs: meta-analysis

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A meta-analysis evaluated the effect of a novel consensus bacterial 6-phytase variant (PhyG) on the apparent total tract digestibility (ATTD) of phosphorus (P) and calcium (Ca) each using 527 datapoints from 12 datasets and sodium (Na) using 321 datapoints from 10 datasets. The hypothesis was increasing phytase dose would further improve ATTD P, Ca and Na. The dataset incorporated variations in diet composition, feed form (mash or pellet), breed and age at sampling (BW 16 to 75 kg). The diets were based on soybean meal, corn or wheat, with different inclusion rate of rapeseed meal, sunflower meal, rice, rice bran, DDGS and wheat bran to obtain varied phytate-P. In all trials, diets were formulated without inorganic P (except one trial), the analysed Ca, total P, phytate-P, limestone solubility at 5 min was in a range of 5.4–7.5 g/kg, 3.2–5.4 g/kg, 2.2–3.4 g/kg, and 42 to 97%, respectively. In these studies, PhyG was included in the dose range from 0 (NC) to 4000 FTU/kg (the analysed phytase activity of 173–4492 FTU above NC). The ATTD P, Ca and Na response with increasing analysed phytase dose levels were evaluated across all datasets using non-linear curve fitting (JMP14.1). Increasing PhyG dose exponentially (y = Asymptote + Scale*EXP(Growth Rate*analysed phytase dose) increased ($P < 0.001$ based on growth rate from the exponential curve) ATTD P, Ca and Na. Across datasets, the estimated ATTD P was 37.7, 54.8, 62.6 and