P81. Simulating nutrient digestion and absorption kinetics in PIGs based on diet and ingredient properties: SNAPIG

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While feeding tables present the chemical composition and extent of digestibility of feed ingredients for pigs, actual digestibility values depend on the kinetics of nutrient passage and digestion. Furthermore, the kinetics of these processes are also affected by diet and animal interactions. Accounting for these interactions will aid future predictions of the nutritional value of diets and feed ingredients. Therefore, an in silico nutrient-based mechanistic digestion model (SNAPIG) was developed, to predict the kinetics of nutrient digestion and absorption in the gastrointestinal tract of pigs. The model comprises 48 pools representing post-ingested protein, starch, fat, non-starch polysaccharides, their hydrolysis products, endogenous secretions, and microbial biomass. Concurrent fluxes in various anatomical compartments of the digestive tract are based on solubilization and hydrolysis kinetics of nutrients, physico-chemical properties of feed ingredients (determined in vitro), passage of digesta fractions based on mass-action approach (determined in vivo), and appearance of absorbable nutrients. Results were evaluated using observational data from nutrient absorption studies using (portal) blood in pigs (12 studies, 32 dietary treatments). Model predictions for the time of peak (44 ± 15 v. 56 ± 20 min after meal) and extent (69 ± 30 v. 63 ± 20% of intake) of glucose absorption after a meal were adequate (RMSPE = 39%). For amino acids, the mean, but not the variation in time of peak could be predicted (61 ± 11 v. 58 ± 34 min, RMSPE = 60%). The extent of amino acid absorption, based on ileal protein digestibility, was slightly over-predicted (70 ± 5 v. 78 ± 5%, RMSPE = 12%) but variation among diets and ingredients was well predicted. Overall, the results show that SNAPIG is able to predict nutrient digestion kinetics in pigs fed diets varying in feed ingredient composition and physicochemical properties. SNAPIG's use enables to identify knowledge gaps in pig nutrition and physiology. As such, it is a promising tool for researchers and nutritionists to improve future pig feed evaluation.

P82. Phytase supplementation and varying calcium level in pig feed: Effects on precaecal inositol hexakisphosphate degradation

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Inositol hexakisphosphate ($InsP_6$) interacts with calcium (Ca) at pH conditions in the gastrointestinal tract. Therefore, we hypothesised that Ca concentrations in the feed exceeding the requirement of pigs would reduce the precaecal $InsP_6$ disappearance, $InsP_6$ degradation products, and phosphorus (P) digestibility. In a completely randomized row column design with four periods, eight ileal-cannulated barrows (initial body weight 27 kg) were fed four maize-oilseed meal-based diets containing 4.8 (LowCa) or 7.6 (HighCa) g Ca/kg (limestone addition) and supplemented or not with 1,500 FTU/kg of a hybrid-6-phytase. No mineral P was added and the P concentration was 4.3 g/kg feed. Titanium dioxide was used as the inert marker. Data were analysed using the Mixed model of SAS 9.4 with Ca and phytase as the fixed effects and pig and period as the random effects. Additional limestone reduced precaecal $InsP_6$ disappearance in the presence of phytase (90 vs. 85%; $P < 0.02$), but not in the absence of phytase (22 vs. 23%). In the presence of phytase, the proportion of $InsP_5$ in $\sum InsP_{2\text{-}5}$ in ileal digesta was greater ($P < 0.01$) when Ca was added. However, the proportions of $InsP_4$ and $InsP_3$ in $\sum InsP_{2\text{-}5}$ were not affected by the Ca level. Consistently, precaecal P digestibility was slightly higher in LowCa than HighCa (64 vs. 60%), but this effect was not significant. The myo-inositol concentration in ileal content was significantly increased by phytase (7.0 vs. 1.5 μmol/g dry matter; $P < 0.01$) but not by Ca or the Ca × phytase interaction. The data indicate that the phytase effect on degradation of $InsP_6$ and $InsP_5$ up to the terminal ileum is impaired when the Ca concentration is increased by limestone addition. Nevertheless, it seems that the limestone addition in the range studied has relatively little relevance for the precaecal P digestibility in pigs when exogenous phytase is added to the feed.

P83. Dietary particle size and gelling affect digesta transit through the stomach of pigs

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Physicochemical properties of feed ingredients influence digesta transit behaviour and thereby nutrient digestion but are not included in current feed evaluation systems. We investigated the effects of particle size and gelling properties of fibre-rich ingredients on digesta transit in the proximal and distal stomach of pigs. We hypothesized that particle size reduction and increased gelation would reduce gastric segregation of liquids, solids, and fibres. Twenty-four boars (52 kg body weight at start) were allocated to one of four diets; two contained wheat straw (150 g/kg), either coarsely chopped (20 mm; coarse) or ground through a hammer mill passing a 1-mm sieve (fine); two contained wheat bran (270 g/kg) with or without pectin addition (100 g/kg). Upon sacrifice and in steady state, mean retention time (MRT) was quantified using Co-EDTA as tracer for liquids, TiO2 for solids, and Cr-mordanted wheat straw or -bran for fibres. A general linear mixed model, with dietary treatment as fixed effect, was used. In the proximal stomach, fine straw reduced MRT of liquids, solids, and fibres compared with coarse straw (5 v. 40 min, 36 v. 189 min, and 48 v. 311 min; $P < 0.05$). In the distal stomach, fine straw reduced MRT of liquids, solids (7 v. 20 min and 85 v. 150 min; $P < 0.10$), and fibres (103 v. 384 min; $P < 0.05$). In the proximal stomach, pectin addition to the wheat bran diet reduced MRT of solids and fibres (80 v. 217 min and 99 v. 315 min; $P < 0.05$). In the distal stomach, pectin addition reduced MRT of fibres (176 v. 376 min; $P < 0.05$), however, MRT of liquids was increased (35 v. 22 min; $P < 0.05$). In conclusion, particle size reduction and increased gelation strongly influenced gastric sieving, reducing separation of liquids, solids and fibres in the proximal and distal stomach of pigs.

P84. Effect of short-term Cu supplementation on biochemical parameters of liver and growth performance in pigs

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High levels (75–250 mg Cu/kg) of copper (Cu) have a beneficial effect on improving the growth performance of pigs. However, excessive ingestion of Cu may exert a toxic effect. We hypothesized that addition of 250 mg Cu/kg from copper sulphate ($CuSO_4$) or dicopper oxide (Cu_2O) may improve pigs' performance and may alter biochemical parameters of liver. To test the hypothesis, 120 pigs (28 days- old) were allotted to 3 treatments for 46 days: negative control (NC, contained 20 mg Cu/kg), and NC supplemented with 250 mg Cu/kg from $CuSO_4$ or Cu_2O (8 replicates/treatment, 5 pigs per replicate). Daily feed allotments and pig body weight (BW) were recorded. On days 0 and 46, blood samples were collected from one animal per pen to measure blood cholesterol, and animals were then euthanized to obtain liver samples. Statistical analyses were performed using ANOVA with SAS GLM MIXED procedure. Supplementation of 250 mg Cu/kg from both sources increased BW ($P = 0.032$) by 6.3% on d 46 (30.7 ± 2.1 kg) compared with the NC (28.8 ± 1.6 kg). No differences between the two sources of Cu were observed for feed intake or gain to feed ratio. Supplementation of $CuSO_4$ decreased ($P < 0.05$) blood cholesterol by 9.9% (no differences among treatments at d0) and liver total protein by 10.5%, whereas increased liver Cu concentration by 57% compared with Cu_2O. There are no differences between NC and Cu supplementation treatments on blood cholesterol and liver protein, and between NC and Cu_2O on liver Cu concentration. To conclude, Cu supplementation at therapeutic levels (250 mg Cu/kg) improved growth performance. However, high levels of $CuSO_4$, but not Cu_2O, increased Cu accumulation in the liver and modified the liver composition and blood parameters, this may cause long-term negative health implications and requires to be studied further.

P85. Xylanase supplementation improves performance and alters the microbiome of lactating sows fed low or high fibre diets

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High fibre diets for lactating sows can reduce costs and increase gut fill and satiety, but also reduce nutrient digestibility and performance. The present study aimed to assess the impact of a new xylanase from Thermopolyspora flexuosa, expressed in Pichia pastoris, on the performance and faecal microbiome of lactating sows. At transfer to farrowing crates, 48 sows were assigned to four groups in a 2x2 design: a low fibre control diet (LF), LF supplemented with 45,000 U/kg xylanase, a high fibre control diet (HF), and HF supplemented with 45,000 U/kg xylanase. Diets were commercially relevant and fed ad libitum. BW was recorded at transfer, d0, d14, d28 of lactation. P2 backfat thickness was recorded at transfer, d14, and d28. Faecal samples were collected from all sows at d14 and sent for 16S rRNA sequencing. Performance data were analysed as 2x2 factorial in the Fit Model platform of JMP 15; means separation was conducted using Tukey's HSD ($P < 0.05$). Microbiome data was analysed using Kruskal Wallis pairwise comparison ($P < 0.05$). Across the study, HF and xylanase-supplemented sows consumed significantly more feed ($P = 0.003$ and $P = 0.002$, respectively). Weight loss was significantly higher in unsupplemented sows ($P = 0.001$); more specifically, the percentage of weight loss was significantly higher in unsupplemented sows ($P = 0.002$) and tended to be higher in the LF than in the HF group ($P = 0.056$). Xylanase supplemented sows lost less backfat during lactation compared to control sows ($P = 0.030$), driven by changes between d14 and d28. The faecal microbiome of sows receiving HF diet + xylanase showed a higher diversity and evenness of bacterial taxa compared to sows on LF diets + xylanase ($P = 0.031$) as measured using the Shannon-index. In conclusion, supplementation with xylanase improved performance in lactating sows, and influenced the composition of their faecal microbiome.

P86. Zinc oxide augments early nursery pig feed intake

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Our objective was to evaluate the effect of pharmacological zinc and copper on feed intake in weaned pigs. We hypothesized that pharmacological minerals would enhance feed intake via increasing stomach ghrelin. Three-hundred weaned pigs (5.7 ± 1.03 kg BW) were allotted across three dietary treatments (n = 10 pens/treatment, 10 pigs/pen) fed over 2 phases (P1: day 0–7, P2: day 8–21). Treatments were: 1) Control diet with no pharmacological minerals, CON; 2) CON + 3,000 ppm Zn and 200 ppm Cu (P1), no pharmacological minerals in P2, ZC1; and 3) CON + 3,000 ppm Zn and 200 ppm Cu (P1), CON + 2,000 ppm Zn and 200 ppm Cu (P2), ZC2. Pen bodyweights were collected at day 0, 7, and 21, feed disappearance was recorded daily from day 0–14, and within phase. On day 7 and 21, 5 pigs/treatment were randomly selected, euthanized and gastric fundus ghrelin abundance assessed by immunohistochemistry. Pen was the experimental unit. The ZC1 and ZC2 pigs had 29% higher feed intakes by day 5 and 73% by day 7 compared to the CON pigs; $P < 0.0001$); Compared to ZC2, within 2 days of phase 2 diet change, ZC1 pig feed intake decreased to similar amounts to that of the CON pigs (0.22 vs. 0.17 and 0.14 kg, $P < 0.05$). Overall, ZC2 pigs had 15% higher ADG and 13–24% ADFI compared to CON and ZC1 pigs ($P < 0.05$). ZC1 pigs had 51% more ghrelin-positive cells than CON pigs, and ZC2 pigs had 27% more ghrelin-positive cells at day 7 ($P = 0.005$). By day 21, ghrelin-positive cells were 126 and 61% greater in ZC2 pigs compared to CON and ZC1 pigs, respectively ($P < 0.001$). In conclusion, pharmacological zinc and copper enhanced feed intake in nursery pigs and this may be via ghrelin.

P87. Effects of graded dietary copper concentrations on performance, copper levels in blood, faeces and bristles, and on red blood count

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Elevated dietary copper levels within legal limits are often used after weaning to support gastro-intestinal eubiosis. However, environmental and health concerns have been raised regarding high dietary copper. The study aimed to investigate the impact of increasing dietary copper