

diet. During the starter phase (12-28 days of trial) and over the whole experimental period, all treatments that were offered access to a diet with saccharin (T-2 to T-6) showed numerically lower values for total feed intake and growth than the double control treatment (T-1). It is concluded that the addition of saccharin at doses up to 2000 ppm did not improve feed preference or weanling pig performance.

Key Words: piglet, feed intake, saccharin

206 Interaction between the palatabilities of cereal and protein source in diets for pigs. D Solà-Oriol¹, E Roura^{*2}, and D Torrallardona¹, ¹IRTA, Mas de Bover, Constantí, Spain, ²Lluc SA, Barcelona, Spain.

Differences in feed palatability due to individual ingredients have been reported for pigs. However, little is known about the interactions between ingredients. To study the interaction between cereal (C) and protein source (P) on feed preference, a series of double choice preference trials were conducted with a common reference diet (REF). A total of 24 diets was tested: 4 cereals (barley or oats at 30 or 60%), 4 proteins (lupine or rapeseed at 10 or 20%) and 16 diets consisting of all possible cereal-protein combinations. A double control (REF vs. REF) was used. Preference was calculated as the percentage contribution of the tested diet to total feed intake. Additionally, hardness, fragility, chewing effort and stickiness of the diets were also measured with a texture analyzer. For each of the 16 combinations, the interaction between C and P was studied, using the values of the four corresponding diets (REF, cereal, protein and cereal-protein). A 2x2 factorial arrangement of treatments was used, taking C and P as main factors. Pearson's correlation coefficients between the preference of each diet and its texture parameters were obtained. The GLM and CORR procedures of the statistical package SAS were used. C and P affected ($P < 0.05$) preference for most combinations. Interactions were observed ($P < 0.05$) between cereals and protein sources, indicating that lupine, combined with either barley or oats, reduces palatability to a larger extent than when tested by itself (11.8, 5.0 vs. 58.4% preference; SEM=3.06) and that the independent effects of oats and rapeseed (6.9, 13.1 %; SEM=1.61) are not additive when presented in combination (5.2%; SEM= 3.06). Similarly significant ($P < 0.05$) effects of C, P and CxP were observed on the texture parameters for most combinations. Significant ($P < 0.05$) Pearson's correlation coefficients between preference and hardness, fragility and chewing effort were observed ($r = -0.51, -0.52$ and -0.62 , respectively). In conclusion, the effects of cereal and protein source on the palatability and texture of a diet for pigs are not independent. The texture characteristics of the diets partially explain their palatability.

Key Words: piglet, palatability, texture

207 The effects of frequent out-of-feed events on growth performance of nursery, grower, and finisher pigs. S. K. Linneen*, S. S. Dritz, R. D. Goodband, M. D. Tokach, J. M. DeRouchey, and J. L. Nelssen, *Kansas State University, Manhattan.*

Two experiments were conducted to determine the effects of out-of-feed events on nursery and finishing pig performance. In Exp. 1, 190

pigs (initially 6.35 kg) were used in a 35-d trial (8 replications with 6 pigs/pen). Treatments included a 20-h (12:00 noon to 8:00 am) feed withdrawal for 1, 2, or 3 randomly selected days or a control treatment in which feeders were never withdrawn. Feeders were withdrawn on d 11, d 8 and 23, or d 9, 14, and 20 for pigs with 1, 2, or 3 out-of-feed events, respectively. During each week in which pigs experienced an out-of-feed event, ADG decreased ($P < 0.06$) compared to control pigs. From d 7 to 14 and d 14 to 21, ADFI decreased ($P < 0.07$) for pigs with out-of feed events, compared with control pigs. If the out-of-feed event occurred early in the week, pig growth performance was usually intermediate to that of control pigs and the pigs with an out-of-feed event later in the week. In the following week, however, pigs that had an out-of-feed event in the previous week had improved ADG and G/F compared with pigs that did not have an out of feed event. Overall, there were no differences in ADG (492, 487, 495, 488 g/d; $P < 0.94$) or G:F (0.733, 0.727, 0.736, 0.735; $P < 0.86$) among pigs with none, 1, 2, or 3 out-of-feed events. In Exp. 2, 479 pigs (initially 41.6 kg) were used in an 85-d trial in a commercial finishing barn (8 replications with 19 or 20 pigs/pen). Treatments included a control treatment in which pigs had access to feed for the entire trial, feed withdrawal (20 h; 12:00 noon to 8:00 am) one day per week for the entire trial, or one day per week from d 45 to 85 (market wt). Feed withdrawal occurred on a randomly selected day, with the exception of Saturday, Sunday, or a day before weighing. There were no differences ($P > 0.12$) in growth performance throughout the trial. In conclusion, results suggest that out-of-feed events (20 h or less per week) will have no long term effects on growth performance in nursery or growing-finishing pigs.

Key Words: pigs, feed management, feed availability

208 The effect of two versus six meals per day on performance of developing pigs being restricted in feed intake. J. D. Schneider*, M. D. Tokach, S. S. Dritz, R. D. Goodband, J. L. Nelssen, and J. M. DeRouchey, *Kansas State University, Manhattan.*

Three trials (Exp 1 and 2 = 42 d; Exp 3 = 28 d) were conducted to evaluate the effects of feeding frequency on the performance of restrict-fed growing pigs (initially 67 kg in Exp. 1, and 71 kg in Exp. 2 and 3). In all experiments, pigs were housed in 1.8 x 3.1 m pens with half-solid cement and half-slatted flooring that contained one nipple waterer. Pigs were fed a corn-soybean meal based diet formulated to 1.15% TID lysine and 3,294 kcal of ME/kg. Energy and lysine were supplied to pigs to target an average growth rate of 794 g/day based on NRC (1998) values. Pigs were fed by dropping similar daily amounts of feed, either 2 (07:00 or 14:00) or 6 times (3 meals within 2 h at AM and PM feedings) per day, by an Accu-Drop Feed Dispenser® (AP Systems, Assumption, IL) on the solid cement flooring. Data from all experiments were analyzed as a complete randomized design using the MIXED procedure of SAS. In Exp. 1, there was an increase ($p < 0.01$) in ADG (683 vs. 606 g/d) and G/F (0.41 vs. 0.36) for pigs fed similar amounts of feed 6 times per day compared with pigs fed 2 times per day. In Exp. 2, increasing the feeding frequency of pigs fed a restricted diet from 2 to 6 times per day improved ($P < 0.02$) ADG (623 vs. 504 g/d) and G/F (0.36 vs. 0.29). In Exp. 3, the additional treatment was designed to minimize feed wastage by dropping feed closer to the floor in pigs fed 2 times per day. The goal was to determine whether the improvements in performance were due to improved efficiency or decreased feed wastage. Pigs fed 6 times per day had improved ($P < 0.05$) ADG (608, 518, 509 g/d for 6 times, 2 times, and 2 times modified, respectively) and G/F (0.37, 0.31, and 0.31) compared to

either 2 times per day treatment. There was no difference ($P > 0.10$) in performance for pigs fed 2 times per day when feed was dropped from the feed drop or by the modified method. Feeding a restricted diet 6 times per day appears to improve pig performance compared with feeding 2 times per day.

Key Words: feeding frequency, restricted intake, pigs

209 Energy digestibility and DE content of co-extruded flax and pea for grower pigs. J. K. Htoo^{*1}, X. Meng², J. F. Patience³, and R. T. Zijlstra¹, ¹University of Alberta, Edmonton, AB, ²Alberta Agriculture, Food and Rural Development, Brooks, AB, ³Prairie Swine Centre Inc. Saskatoon, SK, Canada.

Flax can increase pork omega-3 fatty acid content; however, energy digestibility and DE content of flax products, including a 50:50 combination of flax and pea, has not been well described. Five barrows (32 kg initial BW) fitted with a T-cannula at the distal ileum were fed five diets according to a 5x5 Latin square design: a wheat and soybean meal control diet and four diets containing 30% raw or co-extruded flax and pea plus 70% control diet and chromic oxide as an indigestible marker. The four extrusion treatments included: 1) E0, ground, non-extruded; 2) E1, single screw extruded; 3) E2, twin screw extruded with low intensity [screw speed 120 rpm; die temperature 110 °C; water input 4 kg/h]; and 4) E3, twin screw extruded with high intensity [300 rpm; 125 °C; 10 kg/h]. The ADF content was 14.9, 12.0, 12.8 and 15.8% DM in E0, E1, E2 and E4, respectively. After a 7-d acclimation at 3 times maintenance, feces were collected for 2 d and ileal digesta for 2 d. Energy digestibility in the test ingredients was calculated using the difference method. The apparent total tract digestibility (ATTD) of DM did not differ among the four ingredients and ranged from 89.0 to 94.9%. The ATTD of OM was higher in E2 than in E1 and E3 ($P < 0.05$). Energy ATTD was higher in E2 than E0 ($P < 0.05$) and did not differ among the three extruded samples, and ranged from 70.8 to 79.9%. The DE content of E2 was higher than E0 and E3 ($P < 0.05$). Ileal digested energy contents of E0, E1, E2 and E3 were 3.62, 3.67, 4.24, and 3.96 Mcal/kg DM, respectively. The DE content (Mcal/kg DM) of E0, E1, E2 and E3 were 3.76, 4.18, 4.39 and 4.06, respectively. Overall, energy digestibility was improved by extrusion but not maximized at the highest intensity, suggesting that co-extrusion of flax and pea should be carefully controlled. In conclusion, co-extrusion increased energy digestibility of flax and peas and should be considered optimize feeding programs for omega-3 enriched pork.

Key Words: extrusion, flax, pea

210 Inclusion of yellow, field peas in nursery pig diets to improve growth performance. K. R. Blubaugh^{*1}, A. L. Meteer¹, B. R. Wiegand¹, G. I. Peterson², J. D. Spencer², and J. R. Winter¹, ¹Illinois State University, Normal, ²JBS United, Inc., Sheridan, IN.

The main objective of this study was to determine if yellow, short-season field peas could partially replace corn and soybean meal in the mid- and late- nursery pig diets (6.5 to 6.6 kg BW and 9.9 to 11.2 kg BW, respectively), and to evaluate the efficacy of a mixed enzyme (alpha-galactosidase, galactomannanase, xylanase, beta-glucanase) in diets with and without field peas to improve nursery pig growth

performance. All pigs were fed a two phase program (P1 and P2) provided for two wk each. The combination enzyme was supplemented at the rate of 0.1% and 0.05% for P1 and P2, respectively. This 2 x 2 factorial arrangement resulted in four treatments, consisting of 1) Control (Corn-Soy); 2) Control + enzyme; 3) 20% Field Peas; and 4) , 20% Field Peas + enzyme. Diets were balanced on SID lysine and met or exceeded NRC requirements. Nursery pigs (n=240), 25 d of age and 6.5-6.6 kg bodyweight, were randomly assigned within sire group to pen (six pigs per pen) with equal weights across replications (n = 10). Pigs were provided 0.21 m² pen space per pig. Pen was the experimental unit. A one wk acclimation period initiated the trial in which all pigs received the control diet (corn-soybean meal). Feed and water were provided ad libitum for the entire trial period. Pigs and feed were weighed weekly for calculation of ADG, ADFI, and G:F. Significant increases in ADG ($P = 0.02$), 847 vs 918 g/d for control and peas, respectively; ADFI ($P = 0.01$), 1233 vs 1390 g/d for control and peas, respectively; but decreases in G:F ($P = 0.01$), 685 g/kg vs 658 g/kg for control and peas, respectively were observed with field pea inclusion from 0-28 d. Pigs fed diets containing field peas combined with enzyme supplementation tended to increase ADG (Pea x enzyme; $P = 0.10$) from 0-28 d and feed intake ($P = 0.09$) from 21-28 d. The inclusion of yellow field peas (20%) in the mid- and late- nursery periods provided significant improvements in nursery pig growth performance compared to corn-soybean meal based diets. Additionally, the supplementation of exogenous cellulase enzymes tended to improve nursery pig performance when diets contained 20% field peas

Key Words: field peas, enzyme, pigs

211 Response of pigs in the weight range 34 to 61 kg to Threonine:Lysine ratio in the diet. M. K. O'Connell^{*1}, P. B. Lynch¹, and M. Overend², ¹Pig Production Development Unit, Teagasc Moorepark, Fermoy, Co. Cork, Ireland, ²Forum Products Ltd., Redhill Surrey, England.

The objective of this study was to determine the optimum threonine:lysine ratio (THR:LYS) for pigs in the weight range 34 to 61 kg. Seventy-two pairs of pigs (36 pairs entire male, 36 pairs female) were assigned to one of five THR:LYS ratios: A-0.55, B-0.60, C-0.65, D-0.70 and E-0.75 in a randomised block design. Diets were composed of barley, wheat and soybean, with added oil, amino acids, and vitamins and minerals. Crude protein concentration was 155 g/kg for entire males and 140 g/kg for female pigs. Amino acids (except threonine) were kept at constant ratios of 0.35:0.66:0.20:1 for methionine:methionine+cysteine:tryptophan:lysine. THR:LYS ratio was increased by addition of L-threonine in 0.5 kg and 0.45 kg increments for males and female, respectively, at the expense of wheat. Digestible energy was 13.5 MJ/kg for all diets. Trial period was 38±3.3 days. Entire male pigs had higher ADG (751 v 659 g/d; $P < 0.001$; sem 16.5) and better FCR (2.38 v 2.72 kg/kg; $P < 0.001$; sem 0.054) than female pigs, resulting in higher finishing weights (62.9 v 60.0 kg; $P < 0.01$; sem 0.73). Quadratic regression equations were applied to the data which predicted the THR:LYS ratio that would result in the maximum ADG and DFI or the minimum FCR for entire male and female pigs. Those values are presented in Table 1. The optimum THR:LYS ratio for entire males was between 0.66 and 0.72, and was lower for females at between 0.60 to 0.65, depending of criteria of interest.