and haematocrit. Four diets were fed to 48 pigs (initial BW 20 ±1.6) in 24 pens (6 pens per diet) for 4 wks in a completely randomized design. A control corn-wheat-soybean meal basal diet was formulated and 3 additional diets produced by replacing 33, 66 or 100% of soybean meal with EECM to achieve inclusion levels of 0, 10, 20 and 30%. Diets were formulated to be similar in NE and nutrient composition, and to meet NRC (1998) nutrient requirements. Pigs were allowed ad libitum access to feed and water for the duration of the Exp. Feed intake and BW of pigs were determined on a weekly basis; whereas organ weights and blood parameters were determined at the end of the study. ADFI was linearly decreased ($P$= 0.006) whereas ADG tended to decline linearly ($P$=0.084) with increasing levels of EECM in the diet, whereas G:F was not affected ($P$>0.05). Thyroid weight and serum T3 were linearly increased ($P$<0.05), whereas serum T4 was linearly reduced with higher inclusion of EECM. Other blood parameters and organ weights were not affected by increasing inclusion of EECM. The analyzed concentration of glucosinolate in the EECM used in this study was 9.27µmoles/g, with values in the diets ranging from 1.02 to 2.75µmoles/g for the lowest to highest inclusion levels, respectively. The increased thyroid weight and changes in thyroid hormones, indicates that higher glucosinolate concentrations in EECM may adversely affect performance in growing pigs.

**Key Words**: expeller extracted canola meal, performance, pigs

O086 **Feeding value of green canola seed fed to growing-finishing pigs.** T. A. Woyengo [1,*], J. Yáñez [1], M. Young [2], G. Lanz [2], E. Beltranena [1, 3], R. T. Zijlstra [1], *[1]University of Alberta, Edmonton, [2]Gowans Feed Consulting, Wainwright, [3]Alberta Agriculture and Rural Development, Edmonton, Canada.*

Green canola seed (GCS) is immature seed that is not used for production of human oil grade, but due to its oil content (20–40%) might be a good energy source in pig diets. In 2 studies, we determined the nutritive value of GCS for pigs. In Study 1, 6 ileal-cannulated barrows (46 kg) were fed 3 diets (wheat, wheat+GCS, and N-free) as a double 3 × 3 Latin square to calculate NE value and standardized ileal digestibility (SID) of AA for GCS. Nutrient digestibility in GCS was calculated by difference from the wheat diet. In Study 2, 1,100 pigs (32.9 kg) housed in 50 pens (22 pigs) by sex were fed 5 dietary regimens: 4 constant dietary levels of 0, 5, 10, and 15% GCS, and the fifth, declining amounts (15, 10, 5, 0, and 0%, respectively) of GCS over 5 growth phases to determine effects of GCS on performance and carcass traits. Phase diets were formulated to provide 4.0, 3.6, 3.25, 2.9 and 2.65 g SID Lys/Mcal NE for d 0 to 21, 22 to 42, 43 to 62, 63 to 74, and 75 to 123 kg market weight. The GCS contained (DM basis) 25% CP, 43% ether extract, 22% NDF, 9.97 µmol/g glucosinolates, and 3.50 Mcal/kg NE value. The SID of Lys, Met, Thr, and Trp was 86.9, 87.3, 76.9, and 84.3%, respectively. Increasing dietary GCS from 0 to 15% linearly decreased ($P$ < 0.05) overall G:F from 0.384 to 0.373 kg/kg, carcass dressing percent from 78.4 to 77.8%, and feed cost from 213 to 207 $/ton. Pigs fed declining amounts of GCS by growth phase compared with pigs fed 0% GCS had lower ($P$ = 0.015) overall G:F. Diet did not affect overall ADG and ADFI, carcass backfat thickness, loin depth, pork yield, and revenue minus feed cost. In conclusion, GCS fed was a rich source of dietary energy and AA, but increasing its dietary inclusion in diets for pigs reduced G:F and carcass dressing percentage due to increased dietary fiber. Thus, inclusion of GCS in swine diets should be based on targeted G:F and relative cost to other feed commodities.

**Key Words**: green canola seed, nutritive value, pig

O087 **Effect of levan supplementation on the growth performance, nutrient digestibility, fecal microflora, and fecal noxious gas content in weaning pigs.** J. Li*, B. R. Lee, I. H. Kim, *Department of Animal Resource & Science, Dankook University, Cheonan, Republic of Korea.*

Levan is one type of fructans. Bio-Mos® contains mannanoligosaccharides and is a prebiotic. A total of 120 weanling pigs [(Yorkshire × Landrace) × Duroc] with an average BW of 7.22 ± 0.80 kg were used in a 35-d trial to determine the effects of levan inclusion on performance. Pigs were randomly allotted to 4 experimental diets by BW and sex (2 gilts and 3 barrows/pen; 6 pens/treatment). Dietary treatment groups were: CON, control diet; BM, CON + 0.1% bio-mos®; LE1, CON + 0.1% levan; LE2, CON + 0.2% levan. All data were subjected to the GLM procedures of SAS (1996) as a randomized complete block design, with pen as the experimental unit. Differences among dietary treatments were separated by Duncan's multiple range test, and $P$ < 0.05 was considered statistically significant. Pigs fed the BM and LE2 diet had greater ($P$<0.05) ADG than pigs fed the CON diets (512 or 504 vs. 479g), and G/F ratio was increased ($P$<0.05) in LE2 compared with CON (0.830 vs. 0.781). The apparent total tract digestibility (ATTD) of DM in pigs fed the LE1 and LE2 diets was greater ($P$<0.05) than pigs fed the CON diet (91.53 or 91.84 vs. 88.6%) at wk 2. The ATTD of N in LE2 treatment was greater ($P$<0.05) than that in CON treatment (93.74 vs. 88.80%) at wk 5. Pigs fed the LE1 and LE2 diet decreased (48.1%, 47.8%; $P$<0.05) fecal *E. coli* concentration compared with pigs fed the CON diet at the end of 2 wk. However, no difference ($P$>0.05) was observed on the fecal *Lactobacillus* concentration. Fecal score was highest ($P$<0.05) in CON compared with other treatments (3.8 vs. 3.2 or 3.2 or 3.0) at d 7. LE2 had lower ($P$<0.05) hydrogen sulfide concentration than CON (4.40 vs. 5.22 ppm) at d 5. Fecal total mercaptans emission in LE2 was decreased (28.7%, 29.0%, 25.5%; $P$<0.05) compared with CON at d 3, 5 and 7. Pigs fed the LE1 diets also had lower total mercaptans concentration compared with those fed the CON diet at d 5 and 7(7.33 vs. 9.53 ppm, 6.15 vs. 9.15 ppm). In conclusion, results indicated that dietary inclusion of 0.2% fructan improved ADG (5.2%), G/F ratio (6.3%), ATTD of DM (3.4%) and N (5.6%), decreased fecal *E. coli* concentration (47.8%), fecal score (21.1%), fecal Hydrogen sulfide emission (15.7%) and total mercaptans (28.7%) in weanling pigs.

**Key Words**: fructan, growth performance, weanling pigs

O088 **The effects of wheat and crystalline amino acids on nursery and finishing pig growth performance and carcass characteristics.** D. Goehring*, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, S. S. Dritz, J. L. Nelssen,*Kansas State University, Manhattan.*

Two experiments were conducted to evaluate the effects of wheat and crystalline amino acids on growth performance of nursery and finishing pigs. Treatments in both studies included: (1) corn-soybean meal diet, (2) diet 1 with wheat replacing 50% of the corn, (3) wheat replacing 100% of the corn in diet 1 with high amounts of crystalline amino acids, and (4) diet 3 with soybean meal (SBM) replacing a portion of the crystalline amino acids in diet 3 (5% in nursery; 2.5% in finisher). In Exp. 1, 192 pigs (12.1 kg BW) were used in a 21-d nursery study. Pigs were allotted to pens by initial BW and pens were randomly assigned to diets with 6 pigs/pen and 8 replicate pens. No growth differences were found when replacing 50% of corn with wheat ($P$>0.75*)*. There were tendencies for reduced ADG (linear, $P$<0.08) and improved (linear, $P$<0.07) caloric efficiency on an

NE basis when replacing 100% corn with wheat. Adding wheat to the diet did not influence G:F, but improved (linear, $P<0.05$) ME caloric efficiency. Increasing SBM in the wheat diets tended to improve ($P<0.07$) G:F and improved ($P<0.03$) NE caloric efficiency (Trt 3vs4). In Exp. 2, 288 pigs (72.5 kg BW) were used in a 61-d finishing study. Pens (8 pigs/pen) were randomly allotted by initial BW to diets with 9 replicate pens. Increasing wheat reduced ADG (linear, $P<0.04$) and worsened G:F (linear, $P<0.003$), but also reduced (linear, P<0.001) jowl fat iodine value. Replacing corn with wheat tended to improve (linear, $P<0.08$) caloric efficiency on an ME basis, but not on an NE basis. In summary, wheat can be used to replace 50% of corn in diets without negatively affecting growth performance. Use of high levels of crystalline amino acids in wheat-based diets did not significantly influence growth of nursery or finishing pigs.

| Exp. 1 Treatment: | 1 | 2 | 3 | 4 | SEM |
|---|---|---|---|---|---|
| ADG, kg | 0.550$^{ab}$ | 0.554$^{a}$ | 0.525$^{b}$ | 0.542$^{ab}$ | 0.009 |
| G:F | 0.636$^{a}$ | 0.636$^{a}$ | 0.629$^{a}$ | 0.648$^{a}$ | 0.007 |
| Exp. 2 | | | | | |
| ADG, kg | 0.833$^{a}$ | 0.824$^{ab}$ | 0.793$^{b}$ | 0.788$^{b}$ | 0.01 |
| G:F | 0.307$^{a}$ | 0.303$^{a}$ | 0.295$^{b}$ | 0.297$^{b}$ | 0.003 |
| Caloric efficiency, Mcal/kg | | | | | |
| ME | 10.92$^{a}$ | 10.77$^{ab}$ | 10.69$^{ab}$ | 10.66$^{b}$ | 0.09 |
| NE | 8.18$^{a}$ | 8.15$^{a}$ | 8.15$^{a}$ | 8.09$^{a}$ | 0.07 |
| Carcass yield, % | 73.4$^{a}$ | 73.6$^{a}$ | 73.4$^{a}$ | 73.1$^{a}$ | 0.2 |
| HCW, kg | 91.8$^{a}$ | 91.8$^{a}$ | 90.0$^{a}$ | 89.7$^{a}$ | 1.1 |
| Jowl fat iodine value | 68.9$^{a}$ | 67.7$^{b}$ | 67.1$^{b}$ | 67.5$^{b}$ | 0.2 |

**Key Words**: crystalline amino acids, nursery pig, wheat

# NONRUMINANT NUTRITION: NURSERY PIG NUTRITION AND MANAGEMENT

O089 **Effects of increasing wheat middlings (midds) and NE formulation on nursery pig growth performance.** J. A. De Jong*, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, S. S. Dritz, J. L. Nelssen, *Animal Science, Kansas State University, Manhattan.*

A total of 210 pigs (PIC 327 × 1050, 6.87 kg BW) were used in a 29-d trial to evaluate the effects of dietary midds and NE formulation on nursery pig performance. Pens of pigs were balanced by initial BW and randomly allotted to 1 of 5 dietary treatments (6 pens/treatment and 7 pigs/pen). Wheat midds (0, 10, or 20%) were added to the first 3 diets without balancing for energy. The last 2 diets contained 10 and 20% midds but were balanced to contain the same NE (INRA, 2004) as the positive control (0%) midds by adding soybean oil (1.4 and 2.8%). Overall (d 0 to 29), no midds × fat interactions were observed ($P>0.34$). Pigs fed increasing midds tended to have poorer (linear; $P<0.07$) G:F and ME caloric efficiency, but when balanced on NE, increasing midds had no effect on pig performance. Regardless of formulated energy value, caloric efficiency and G:F were poorer ($P<0.01$) on an ME basis as midds increased from 10 to 20% of the diet. However no differences were observed for energetic efficiency on an NE basis. This suggests that ME values slightly overestimated the energy value of the soybean oil or midds and that the NE values provided by IRNA (2004) are a closer approximation of the true energetic value of the feed ingredients. In summary, 10% midds can be added to nursery diets without influencing performance. Formulating on an equal NE basis did not improve growth; however, energetic efficiency values indicate that NE may value the energy content in midds more appropriately. (See table below.)

**Key Words**: net energy, nursery pig, wheat middlings

O090 **Effects of dietary oxidized lipid on the growth performance and metabolic oxidative status of nursery pigs.** A. R. Hanson[1,*], L. J. Johnston[2], S. K. Baidoo[3], J. L. Torrison[4], C. Chen[5], G. C. Shurson[1], *[1]Animal Science, University of Minnesota, St Paul, [2]West Central Research and Outreach Center, University of Minnesota, Morris, [3]Southern Research and Outreach Center, University of Minnesota, Waseca, [4]Veterinary Diagnostic Laboratory, [5]Department of Food Science and Nutrition, University of Minnesota, St Paul.*

Dietary inclusion of oxidized lipids (Ox-L) can reduce ADFI and ADG, and reduce antioxidant status of pigs. Levels of Ox-L in dried distillers grains with solubles (DDGS) vary, but some sources have higher levels than corn as measured by the thiobarbituric acid reactive substances (TBARS) and peroxide value (PV) assays. This experiment evaluated if dietary inclusion of DDGS high in Ox-L (Ox-DDGS) compromised vitamin E (VE) and Se status (as measured by serum and liver concentrations) and increased incidence of Mulberry Heart Disease (MHD). Sows (n = 12) were fed corn-soybean meal diets (0% DDGS) or diets with DDGS (40 and 20% in gestation and lactation, respectively) for 3 parities. In the third parity, 108 weaned pigs were penned (2 littermates/pen) and fed 1 of 3 nursery diets (ND): 1) 0% DDGS, 2) 30% Ox-DDGS, and 3) 30% Ox-DDGS with 5x NRC (1998) level of VE for 7 wks, in a 2 x 3 factorial arrangement (n = 9 pens/treatment). Diets were formulated to contain similar SID Lys:ME. Concentrations of TBARS and PV in the Ox-DDGS source used were 25 and 27 times greater, respectively, than corn. Data were analyzed using the MIXED procedure of SAS for a split plot design with repeated measures in time when appropriate. Several 2-way and 3-way interactions were observed. No evidence of MHD was found. Inclusion of DDGS in sow diets reduced ($P < 0.01$) VE in pig serum at weaning (5.6 vs. 6.7 ± 0.1 μg/mL) compared with 0% DDGS. Glutathione peroxidase activity and TBARS concentration of pig serum were not affected by ND ($P > 0.05$). The concentration of sulfur amino acids (SAA) in serum from pigs fed ND 2 or ND 3

**O089 Table**

| Treatment: | 1 | 2 | 3 | 4 | 5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Midds, %: | 0 | 10 | 20 | 10 | 20 | | | | Midds | |
| Item, Fat, %: | 0 | 0 | 0 | 1.4 | 2.8 | SEM | Midds x Fat | Lin | Quad | 10 vs 20% |
| ADG, g | 442 | 440 | 425 | 454 | 440 | 9.30 | 0.95 | 0.41 | 0.25 | 0.12 |
| ADFI, g | 690 | 683 | 698 | 705 | 701 | 14.6 | 0.54 | 0.60 | 0.96 | 0.71 |
| G:F | 0.641 | 0.645 | 0.610 | 0.644 | 0.627 | 0.01 | 0.34 | 0.06 | 0.11 | 0.01 |
| Caloric efficiency, mcal/kg | | | | | | | | | | |
| ME | 5.17 | 5.09 | 5.33 | 5.20 | 5.40 | 0.08 | 0.82 | 0.06 | 0.11 | 0.01 |
| NE | 3.74 | 3.62 | 3.74 | 3.73 | 3.81 | 0.06 | 0.76 | 0.64 | 0.17 | 0.11 |