

were observed. The results indicate that DDGS (20% inclusion) do not alter growth performance or carcass parameters in heavy market hogs. Furthermore, RAC and CLA can improve specific measures of growth performance and carcass fatness.

**Key Words:** pork, DDGS, CLA

**205 Assessment of protein quality in a corn co-product based on growth of young pigs.** J. R. Booth\*, J. L. Reichert, and T. D. Crenshaw, *University of Wisconsin, Madison.*

Increased ingredient prices have re-kindled interest in assessment of alternatives to economically meet pig requirements. Ethanol co-products offer new alternatives, but may be of limited value for swine. A new ingredient with potential value for swine is Hi-Pro Meal (HPM) produced by Badger State Ethanol (Monroe, WI). By analysis HPM contains 51.7% CP, 2.5% fat, 2.6% Lys and 0.43% Trp. The low fat is advantageous as fat content limits inclusion rate for some corn co-products. A 26-d growth assay was used to establish a maximum inclusion of HPM in corn-based diets for growing pigs and to determine if Lys and Trp were first and second limiting. A corn-SBM control diet (Ctl, diet 1) was formulated to meet 105% of Lys requirement. Diets 2, 3, and 4 were formulated with 10%, 20%, and 30% HPM respectively to supply 95% of Lys requirements. Diets 5 and 6 both included 30% HPM but additional Lys (diet 5 to supply 110% of required Lys) or Lys + Trp (diet 6 to supply 110% of required Lys and 130% of required Trp) added to assess the order of limiting amino acids. Crossbred (PIC Cambrough × Line 19) pigs (n=144) were randomly allotted to 1 of 6 diets within weight and sex blocks at approximately 45 d of age. Pigs were housed with 4 pigs in 1.52 × 0.91 m pens. Pigs were allowed continuous access to feed and water. Pigs fed the Ctl diet had higher ADG and improved feed efficiency compared with pigs fed HPM regardless of HPM level or amino acid supplementation. Growth was suppressed as HPM levels increased. Addition of Lys improved ADG and efficiency, but further addition of Trp failed to improve performance. In conclusion, protein quality of HPM can be improved by additional Lys, but Trp does not appear to be second limiting. Other factors affecting protein quality need to be evaluated.

**Table 1. Dietary treatments**

Trait	1	2	3	4	5	6	SEM
ADG, kg/d <sup>abc</sup>	0.70	0.62	0.52	0.44	0.53	0.53	0.02
FI, kg/d <sup>ab</sup>	1.20	1.16	1.04	0.98	1.04	1.05	0.04
Feed:Gain <sup>abc</sup>	1.70	1.86	2.01	2.22	1.97	1.99	0.04

<sup>a</sup>Ctl vs HPM,  $P < 0.01$ ; <sup>b</sup>HPM level linear,  $P < 0.01$ ; <sup>c</sup>4 vs 5,6,  $P < 0.01$ .

**Key Words:** bioassay, protein quality, co-products

**206 Concentrations of β-glucans and mannan oligosaccharides in corn dried distillers grains with solubles (DDGS) and its relationship to fiber components.** J. M. Pomeroy\*, L. W. O. Souza, and G. C. Shurson, *University of Minnesota, St. Paul.*

Typically, β-glucans (BG) and mannan oligosaccharides (MOS) can be found in the bran of cereal grains, yeast cell walls, plant cellulose, and in many types of fungi and bacteria. Furthermore, both BG and MOS are known to exhibit beneficial health properties. The objective

of this study was to determine the concentrations of BG and MOS in corn dried distillers grains with solubles (DDGS) containing varying levels of ADF and NDF, and to determine if any correlation between fiber content and BG content existed. Thirty-four samples of DDGS from various dry-grind ethanol plants in the Midwest were selected based on their varying concentrations of ADF and NDF. Both ADF and NDF concentrations were previously determined using wet chemistry procedures from commercial laboratories. Samples of DDGS contained between 7.21% to 17.27% ADF, while NDF content ranged from 20.13% to 32.94%. Average concentration of ADF and NDF was 10.68% and 25.35%, respectively. Samples were prepared in duplicates, and enzymatic kits (K-YBGL 04/2008 and K-MANGL 01/05) from Megazyme (Megazyme International Ireland Limited, Bray, Ireland) were used to determine BG and MOS content. Data were analyzed utilizing the Univariate and Corr procedures of SAS. The content of BG ranged from 5.51 g/100 g to 10.09 g/100g. Average BG content in DDGS samples was 7.61 g/100g. Concentration of BG and ADF were positively correlated ( $P < 0.006$ ) with a Pearson correlation coefficient of 0.46. Conversely, NDF and BG were not correlated ( $P > 0.5$ ). Unfortunately, MOS concentrations were below detectable levels. Overall, these results indicate that BG concentration in DDGS is positively correlated to the ADF fraction. Furthermore, the level of BG in DDGS is variable, yet is relatively higher in comparison to other feed ingredients such as oats or barley.

**Key Words:** dried distillers grains with solubles, β-glucans, mannan-oligosaccharides

**207 Effect of a commercial enzyme (Nutrase) on growth performance of growing pigs fed diets containing dried distillers grains with solubles (DDGS).** J. Y. Jacela\*, S. S. Dritz, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, and J. L. Nelssen, *Kansas State University, Manhattan.*

A total of 1,076 pigs (PIC BW=39.7 kg), were used to determine the effect of a commercial enzyme containing bacterial endo-1,4-beta-xylanase (Nutrase; Nutrex, Lille, Belgium) on the growth performance of pigs fed diets with DDGS. Pigs were randomly allotted to 1 of 3 treatments (13 pens/trt) balanced by initial BW within gender. Treatments were: 1) diet with 3% added fat (Control); 2) diet supplemented with enzyme (Nutrase) with 1.9% added fat but formulated to have an energy content equal to that of the control diet based on calculated increased ME from the enzyme; and 3) diet with 1.9% added fat without enzyme formulated using the same energy values for the control diet (Low energy). Diets were corn-SBM-based containing DDGS fed in 3 phases from 39 to 95 kg BW. Corn and SBM ME values were based on NRC (1998) while ME used for DDGS was equal to corn. Diets contained 30% DDGS in phases 1 & 2 (39 to 59kg and 59 to 84 kg, respectively) and 15% DDGS in phase 3 (84 to 95kg). Within each phase, all diets had the same lysine levels. Thus, Control and Nutrase diets had lys:ME ratios of 2.69, 2.29, and 1.97 g/Mcal ME for phases 1, 2, and 3; respectively, while the low energy treatment had lys:ME ratios of 2.73, 2.32, and 2.00 g/Mcal ME for phases 1, 2, and 3, respectively. There was no treatment × gender interactions ( $P > 0.25$ ) observed for any response criteria. Barrows had greater ( $P < 0.01$ ) ADG (844 vs 795 g), ADFI (2.21 vs 2.01 kg), and final BW (97.0 vs 92.9 kg) but poorer G:F ( $P < 0.01$ ; 0.38 vs 0.40) compared to gilts. Overall, there were no differences between Low energy, Control, and Nutrase treatments for ADG ( $P = 0.86$ ; 825, 817, and 817g), ADFI ( $P = 0.93$ ; 2.12, 2.10, and 2.11 kg), G:F ( $P = 0.65$ ; 0.39, 0.39, and 0.39)

and final BW ( $P = 0.88$ ; 95.1; 95.4; and 94.4 kg). In conclusion, under the conditions of this experiment, the commercial enzyme used at the manufacturer's recommended level did not affect growth performance of growing pigs fed diets containing DDGS.

**Key Words:** DDGS, enzyme, pig

**208 Solid state fermentation-derived enzymes improve energy and nutrient digestibility in pigs under good management.** B. Bucher<sup>1</sup>, R. Messikommer<sup>1</sup>, K. Samarasinghe<sup>1</sup>, C. Wenk<sup>1</sup>, and K. Jacques<sup>\*2</sup>, <sup>1</sup>*Institute of Animal Sciences, Zurich, Switzerland*, <sup>2</sup>*Alltech Inc., Nicholasville, KY*.

The effect of solid state fermentation enzymes (SSF) on energy and nutrient digestibility in pigs under good management conditions was investigated in the grow-finish phase. Twelve weaned castrates were assigned to a wheat and barley-based control diet and to a SSF (Allzyme SSF, Alltech Inc.)-supplemented test diet (200 ppm SSF) in a Latin Square Design and fed restricted over 14 wks. Both diets were extruded before supplementation to inactivate natural phytase then pelleted after SSF addition. Phytase activity of feeds was determined before and after extrusion and pelleting. Digestibility of dietary energy, protein, phosphorus and total minerals were evaluated by an indicator method at four collection periods, evenly distributed in growing and finishing periods. Natural phytase activity of the feed (0.742 PU/g) was reduced by 50% due to extrusion (90°C, 5 bars) while pelleting (55–60°C) reduced the activity of supplemental phytase by 22%. Phytase activity of the control and test feeds after pelleting were 0.308 and 0.368 PU/g, respectively. Apparent total-tract digestibility of energy, protein and phosphorus with the control feed for the whole trial period were 0.83, 0.80, and 0.34, respectively. SSF supplementation increased the total-tract digestibility of dietary energy by 5%, protein by 9.3%, phosphorus by 53.6% and total minerals by 28.1% ( $P \leq 0.001$ ) during the growing phase. However, none of the parameters were improved by SSF during the finishing phase. Therefore, when the digestibility values were calculated for the entire fattening period, the improvements (relative to the control) were rather low (1.3%, 3.4%, 11.8% and 8.3%, respectively). The digestibility of energy and protein were improved by 3.7 and 9.0% ( $P \leq 0.05$ ), respectively, with pig age irrespective of diet. Phosphorus and total mineral digestibilities were also generally improved by 2.8 and 5.6%, respectively, with age. It is concluded that SSF enzymes improve the digestibility of dietary energy, protein, phosphorus and total minerals in growing pigs even under good management conditions. Phytase in SSF tolerates pelleting temperatures from 55–60°C.

**Key Words:** enzyme, phytase, digestibility

**209 Alternative strategies in providing digestible protein to young piglets: yeast-derived protein (NuPro) plus enzymes from solid state fermentation (Allzyme SSF).** M. A. Naldo<sup>1</sup>, B. Quilat<sup>2</sup>, B. Catbagan<sup>2</sup>, D. Garcia<sup>3</sup>, and A. Frio<sup>\*3</sup>, <sup>1</sup>*Silliman University College of Agriculture, Dumaguete City, Philippines*, <sup>2</sup>*Camille Farm, Gen Santos City, Philippines*, <sup>3</sup>*Alltech Biotechnology Corp., Muntinlupa City, Philippines*.

Soybean meal (SBM) combined with dried whey and plasma protein are typically used protein sources in post-weaning diets. This experiment investigated whether yeast protein with added enzyme can replace plasma and dried whey in diets for newly weaned pigs. A total

of 630 piglets (6.8 kg BW) were randomly allotted to 18 equal groups (35 pigs/pen). Six pens were randomly assigned to each of 3 dietary treatments in a 2-phase feeding program (0 to 21 days: Phase 1, 22 to 49 days: Phase 2). Trt 1 in both phases contained low levels of SBM (18%), and high levels of dried whey (15 and 10% in phases 1 and 2), and plasma protein (5%). Trt 2 contained 25% SBM, moderate levels of dried whey (5 and 2.5% in phases 1 and 2), no plasma protein, and moderate levels of yeast-derived protein (NuPro, Alltech Inc., 3 and 2% in phases 1 and 2). Trt 3 in both phases contained high levels of SBM (25%), no dried whey, no plasma, and high levels of NuPro (4 and 3% in phases 1 and 2). Trts 2 and 3 were supplemented with a solid state fermentation product (Allzyme SSF, Alltech Inc., 0.02%). Feed intake (FI), BW gain, average daily gain (ADG), feed conversion ratio, and survival rate were recorded. Fecal consistency was measured at 7, 14 and 21d. Intestinal samples were taken from one pig per pen at 7 and 28d to measure duodenal villus height and crypt depth using light microscopy. Data were subjected to ANOVA. Phase 1 FI was highest for Trt 1 compared with Trt 2 (NS) or 3 (406, 378, 339 g/d;  $P = 0.02$ ). Phase 1 survival rate was lower for Trt 3 compared with Trts 1 or 2 (0.0, 0.1 and 2.9% for Trts 1, 2 and 3;  $P < 0.03$ ). Fecal score (1–4: 1 = solid, 4 = loose) was highest at 7d (phase 1) for pigs in Trt 3 (2.4, 2.4, 3.0;  $P = 0.03$ ). No differences in the other growth and scouring parameters were noted in phase 2 or overall. Crypt depth at 7d was numerically higher for Trt 1 and highest for Trt 3 at 28 d. This study demonstrates that the combination of NuPro and Allzyme SSF can successfully replace plasma and whey powder for newly weaned pigs, which offers opportunities for cost savings.

**Key Words:** digestible protein, morphology, yeast

**210 Effects of supplementation mannanase and xylanase of low energy density diet on growth performance, nutrient digestibility, blood profiles and meat quality in finishing pigs.** S. M. Hong<sup>\*1</sup>, S. H. Oh<sup>2</sup>, R. C. Noble<sup>2</sup>, and I. H. Kim<sup>1</sup>, <sup>1</sup>*Department of Animal Resource & Science, Dankook University, Choeran, Choongnam, Korea*, <sup>2</sup>*Department of Animal Science, North Carolina A&T State University, Greensboro*.

This study was conducted to investigate the effects of supplementation mannanase and xylanase on growth performance, nutrient digestibility, blood profiles and meat quality in finishing pigs. A total of 96 pigs (69.12 kg, average initial body weight) were used during 8 weeks. Dietary treatments included: 1) CON (basal diet), 2) LC (–150kcal/kg low energy density diet), 3) LM (LC + 0.05% mannanase), and 4) LMX (LC + 0.05% mannanase and xylanase complex). Each treatment had 6 replicates of 4 pigs per pen in a randomized complete block design. ADG was higher ( $P < 0.05$ ) in LMX treatment than LC and LM treatments when the entire period was evaluated. LM treatment was higher than LMX treatment in ADFI ( $P < 0.05$ ), with gain/feed was highest in LMX treatment ( $P < 0.05$ ). Energy digestibility in week 4 and N digestibility in week 8 were higher ( $P < 0.05$ ) in LMX treatment than LC treatment. Glucose concentration in blood in week 8 was higher in LMX treatment than LC treatment ( $P < 0.05$ ). In meat color, brightness (L\*) was significantly lower in LMX treatment than CON treatment while yellowness (b\*) was significantly lowest in CON treatment ( $P < 0.05$ ). Color, marbling and firmness score were improved in LMX treatment compared with LC treatments. In conclusion, dietary mannanase and xylanase supplementation improved growth performance, nutrient digestibility, glucose concentration in blood and meat quality.

**Key Words:** enzyme, nutrient digestibility, finishing pigs