limited use if we are to include the plethora of new carbohydrate-based compounds and ingredients in swine diets of the future. The latest information on these compounds and the techniques used to measure them will be discussed.

Key Words: fiber, fiber analysis, swine

168 (Invited) Digestibility of dietary fiber in distillers co-products fed to growing pigs. H. H. Stein*, *University of Illinois, Urbana*.

The concentration of fiber in distiller co-products is approximately 3 times greater than in corn. The average concentration of crude fiber, ADF, and NDF in corn distillers dried grains with solubles (DDGS) is 6.6, 11.1, and 41.2%, respectively, whereas sorghum DDGS contains 9.8, 25.0, and 47.9% of these components. The majority of the fiber in both corn DDGS and in sorghum DDGS is insoluble dietary fiber (IDF), whereas less than 20% is soluble dietary fiber (SDF). The apparent ileal digestibility (AID) of total dietary fiber (TDF), IDF, and SDF in corn DDGS is 28.9, 20.0, and 64.4%, respectively, and the apparent total tract digestibility (ATTD) of TDF, IDF, and SDF are 48.8, 41.3, and 90.9%. For sorghum DDGS, the AID and ATTD of TDF, IDF, and SDF are 15.9 and 39.2, 4.8 and 28.6, and 63.4 and 90.6%, respectively. For corn distillers dried grains (DDG), the AID and ATTD of TDF are 0.7 and 43.8%, respectively. The relatively high concentration of dietary fiber in DDGS will result in an increase in the concentration of dietary fiber in diets containing DDGS. As an example, the concentration of TDF in a typical corn-soybean meal diet is approximately 12%, but if 30% corn DDGS is added to this diet, the concentration of TDF will increase to approximately 17%. However, the AID of TDF in the diet is not influenced by the addition of DDGS, but the ATTD of TDF is slightly reduced (from 66 to 55%). The total amount of energy that the pigs obtain from dietary fiber will, therefore, increase when DDGS is used in the diet. The relatively high AID of TDF that is observed in corn-soybean meal diets as well as in corn-soybean meal-DDGS diets indicate that there is a substantial fermentation taking place in the small intestine. A large proportion of the SDF disappears before the end of the small intestine, but there is also some disappearance of IDF in the small intestine. This observation demonstrates that a substantial microbial population resides in the upper gut. It is possible that the size of this population will increase if pigs are fed high fiber diets for a long period of time, but this aspect of fiber digestibility is poorly understood.

Key Words: dietary fiber, distillers co-products, pigs

169 (Invited) Digestion of carbohydrates and utilization of energy in pigs and sows fed diets with contrasting levels and physiochemical properties of dietary fiber. K. E. B. Knudsen* and H. Jørgensen, *Aarhus University, Department of Animal Health and Bioscience, Tjele, Denmark*.

Dietary fiber (DF) is an important component of all but a few feedstuffs used in the feeding of swine. DF is primarily found in the plant cell wall and consists of a series of polysaccharides often associated and/or substituted with proteins and phenolic compounds. The composition of the DF matrix (types and organization of the polysaccharides and the degree of lignification) has a significant influence on the physiochemical properties of the feed. Feedstuffs high in soluble DF generally have a higher swelling and water binding capacity than feedstuffs that are high in insoluble DF. In some cases, i.e. rye, high levels of soluble DF may also enhance the viscosity in the gut. DF polysaccharides are not degraded by the endogenous carbohydrases secreted to or present in the intestinal brush border in the small intestine but to a variable extent degraded by the microflora permanently colonizing the stomach and the small and large intestine. The large intestine is the main site for microbial degradation of DF polysaccharides of which the major part is broken down in cecum and proximal colon. Factors that limit the degradation of DF in the large intestine are the degree of lignification of the DF and the chemical structure of the DF polysaccharides. Sows have a higher capacity to degrade DF polysaccharides, which presumably is due to a longer retention time in the former. Nevertheless, DF has by far the largest negative impact on the digestibility of nutrients in the small and large intestine as well as it influences the proportion of energy absorbed as glucose or short-chain fatty acids (SCFA). A sizeable proportion of the energy is lost during the conversion from carbohydrates to SCFA in the gut, and since the utilization of energy absorbed as SCFA is lower than that of glucose, the overall energy utilization decreases in response to more energy being absorbed from the large intestine.

Key Words: carbohydrates, dietary fiber, growing pigs

170 (Invited) Factors to consider when using higher levels of fiber in diet formulation. J. F. Patience*, *Iowa State University, Ames*.

The majority of the US pig herd has moved to, and probably will continue to move to, higher dietary fiber levels. Concurrently, other changes in diet composition are occurring as well, including the use of more co-products of the ethanol and human food sectors. With so many changes taking place in practical diet formulation, nutritionists are faced with a growing number of formulation issues, from inconsistency of ingredient nutrient composition to often conflicting research results. The increase in dietary fiber is troubling for a number of reasons. Higher fiber leads to lower dietary energy density, or an increase in higher energy ingredients, such as fats and oils. Changes in dietary fiber may affect the health and function of the gastrointestinal tract, with different sections being affected differently. Fiber is not an inert entity, and even the selection of chemical descriptions of dietary fiber remain controversial. Another issue is the interpretation of research results, when dietary fiber levels are increased. This presentation will address these and other issues associated with the increased use of dietary fiber in practical diets.

Key Words: swine, fiber

171 Effects of dietary astaxanthin on the growth and carcass characteristics of finishing pigs. J. R. Bergstrom*, J. L. Nelssen, T. A. Houser, J. A. Gunderson, A. N. Gipe, J. Y. Jacela, J. M. Benz, R. C. Sulabo, M. D. Tokach, R. D. Goodband, J. M. DeRouchey, and S. S. Dritz, *Kansas State University, Manhattan*.

A total of 48 barrows (initially 97.6 kg) were used to evaluate the effects of increasing dietary astaxanthin (0, 5, 10, and 20 ppm) on late-finishing pig performance and carcass characteristics. Pigs were blocked by BW and randomly allotted to 1 of 4 diets in a 26-d experiment. There were 2 pigs/pen and 6 pens/treatment. Pigs were fed simple corn-soybean meal-based diets with 0, 5, 10, or 20 ppm added astaxanthin. Increasing astaxanthin did not influence ($P > 0.25$) ADG (956, 1010, 923, and 905 g/d) or G/F (0.32, 0.33, 0.33, and 0.32). However, ADFI (3027, 3071, 2832, and 2813 g/d) tended (linear; $P < 0.10$) to decrease with increasing astaxanthin. Pigs fed astaxanthin had decreased ($P < 0.03$

and $P < 0.06$, respectively) average (25, 22, 22, and 22 mm) and 10th rib (21, 17, 17, and 18 mm) backfat depth compared with control pigs. Pigs fed astaxanthin tended ($P < 0.10$) to have an increased percentage of fat-free lean (53.2, 55.6, 55.5, and 54.5%), and pigs fed 5 or 10 ppm were the leanest (quadratic, ($P < 0.10$). At 24 h postmortem, pigs fed astaxanthin tended ($P < 0.06$ and $P < 0.08$, respectively) to have lower L* (60.3, 55.3, 58.9, and 56.2) and b* (15.8, 14.8, 14.4, and 15.1) for the cut surface of the 10th rib loin muscle, indicating a darker color. At the time of the study, the improved carcass characteristics of pigs fed astaxanthin resulted in a numeric increase in the net profit per pig of $2.44 and $1.95 for those fed 5 and 10 ppm astaxanthin, respectively. In conclusion, growth performance of pigs fed 5, 10, or 20 ppm astaxanthin was not different from that of pigs fed the control diet. However, the improved carcass characteristics observed could be economically beneficial to pork producers. Additionally, the potential for improvements in pork color could result in improved consumer acceptance of fresh pork. These results warrant further research.

Key Words: astaxanthin, carcass characteristics, pork color

172 Effects of feeder design and changing the availability of water from a wet-dry feeder at 4 and 8 weeks prior to market on growth and carcass characteristics of finishing pigs. J. R. Bergstrom*, M. D. Tokach, S. S. Dritz, J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband, *Kansas State University*, *Manhattan*.

A total of 1,296 pigs (PIC, 337 × 1050; initially 19 kg) were used to evaluate effects of conventional dry (CD) or wet-dry (WD) feeder designs and changing availability of water from a WD feeder at 4 and 8 wk prior to market on growth and carcass characteristics. There were 27 pigs per pen (14 barrows and 13 gilts) and 24 pens per feeder-type. Pigs were fed identical corn-soybean meal diets with 15% DDGS. Pens with a WD had a separate cup waterer, but the WD provided the sole water source until d 69. The water supply to the WD was shut off in 8 pens on d 69 (WD8) and another 8 pens on d 97 (WD4) and the cup waterer was turned on. For the remaining 8 WD, the WD provided the sole water source for the entire experiment (WD0). From d 0 to 69, pigs using the WD had improved ($P < 0.05$) ADG (824 vs. 787 g/d), ADFI (1.86 vs. 1.80 kg/d), G/F (0.45 vs. 0.44), and d 69 BW (76.7 vs. 74.1 kg). Overall (d 0 to 124), pigs using WD0 had greater ($P < 0.05$) ADG, ADFI, final BW, and HCW than all other treatments. Pigs using WD4 had greater ($P < 0.05$) ADG than CD, and WD8 was intermediate. Pigs using WD4 had greater ($P < 0.05$) ADFI than WD8, and CD was intermediate. Pigs using WD0 had poorer ($P < 0.05$) G/F than WD8, and CD and WD4 were intermediate. Backfat depth of pigs using WD8 was reduced ($P < 0.05$) compared to all other treatments, and their loin depth was greater ($P < 0.05$) than CD and WD4. Loin depth of pigs using WD0 was also greater ($P < 0.05$) than CD. Margin-over-feed cost was numerically greatest for pigs using WD8. In conclusion, pigs using WD0 had better growth rates than pigs using CD, WD4, or WD8. Although measures of carcass leanness were improved with WD8, the reduction in growth for this treatment during the last 8 wk indicates that further research is necessary to improve this technique of modifying growth.

Key Words: feeders, growth, pigs

173 Comparison of several dietary fats for finishing pigs. Y. Liu*, D. Y. Kil, V. G. Perez-Mendoza, and J. E. Pettigrew, *University of Illinois*, *Urbana*.

A recent report showed higher swine NE for choice white grease (CWG) than for soybean oil (SBO). The present study was conducted to determine whether practical responses confirm that difference and to extend the observations to other fat sources. Pigs (n = 144, 73.0 ± 4.0 kg BW) were randomly assigned to 6 dietary treatments: 1) a corn-soybean meal diet without added fat (C), 2) C + 6% SBO, 3) C + 6% CWG, 4) C + 6% palm oil (PO), 5) C + 6% animal-vegetable blend (AVB), and 6) C + 6% tallow (TA). The pigs were in 8 replications with 3 pigs/pen. There were 2 diet phases, d 1-19 for phase I and d 19-47 for phase II. Dietary treatments within each phase were formulated to contain equivalent standardized ileal digestible lysine/Mcal of ME. The ADG, ADFI and G:F were measured during each phase and overall. At the beginning and end of this experiment, ultrasound was used to measure backfat depth at the last rib (BFLR) and 10th rib (BFTR), and muscle depth at the last rib (MDLR) and 10th rib (MDTR). The changes of BFLR, BFTR, MDLR, and MDTR between initial and final measurements were calculated. The results showed that pigs fed fats (SBO, PO, AVB, CWG, and TA) had higher ($P < 0.01$) G:F in each phase and overall, higher ($P < 0.01$) ADG in phase I, and lower ($P < 0.01$) ADFI in phase II and overall than pigs fed the control diet. Pigs fed CWG had greater ($P < 0.05$) ADG than these fed SBO in phase I. In phase II and overall, pigs fed SBO had lower ($P < 0.05$) ADFI than pigs fed PO. The addition of fats had no effect on carcass measurements compared with the control diet, but pigs fed PO had greater ($P < 0.05$) increase in BFTR compared with SBO and AVB. In conclusion, different fats produced different practical results, consistent with different energy values. It is not clear from these data whether CWG has greater energy than SBO.

Key Words: dietary fats, growth performance, growing-finishing pigs

174 (National Pork Board Research Award) Soybean meal level modifies the impact of high immune stress on growth and feed efficiency in pigs. M. E. Johnston[1], R. D. Boyd*[1], C. E. Zier-Rush[1], and C. E. Fralick[2], [1]*The Hanor Company*, *Franklin, KY*, [2]*Swine-Tek Research*, *Van Wert, OH*.

This study was conducted to verify the SID lysine requirement of pigs fed Paylean (PLN) for 21 d, using carcass growth and G:F ratio as primary criteria. A second objective was to verify previous work from our lab that whole-body growth (WB) was promoted equally by low and high dietary SBM levels while carcass growth (Carc) was constrained by high SBM content. A total of 420 Camborough x TR-4 castrates (98.3 ± 3.8 kg) were allotted to diet in a 4 × 2 factorial arrangement (48 pens, 6 pens/diet). Four SID lysine levels were prepared (0.65, 0.75, 0.85, 0.95% SID) by summit blend; each having 5 PPM PLN. Diets were formulated with only (a) SBM (H-SBM) or (b) reduced SBM (L-SBM) plus lysine, threonine. Pigs were unexpectedly infected with diseases that trigger systemic inflammation. Diagnostic results confirmed pigs as PRRS and PCV2 (circovirus) positive; PCV2 tissue lesions were present. Mortality and morbidity was 6 times normal (12.7%) for 16 weeks. The inflammatory nature of these viruses is evident from the presence of circulating pro-inflammatory cytokines. The main effect of SID lysine was not significant ($P > 0.25$) for WB ADG or G:F, however, the effect of SBM level was ($P < 0.05$). H-SBM pigs grew faster (.99 vs