

and 88% trts, respectively. Subjecting gilts to dietary energy restriction from 122 d of age until three wk before the start of mating, followed by *ad libitum* feed during breeding period, reduced total feed consumed and had no measurable impact on reproductive performance through 46 d after end of breeding.

Key Words: Gilts, Growth, Reproductive Performance

126 Effects of intrauterine location on fetal growth and development in the pig: nutritional implications. R. L. McPherson^{*1}, F. Ji¹, G. Wu², and S. W. Kim¹, ¹Texas Tech University, ²Texas A&M University.

Three hundred and four fetuses from 25 primiparous sows were used in this study to determine fetal growth as related to fetal location within the uterine horn during gestation. All the sows were fed the same gestation diet at equal amounts (2.0 kg/d) and housed in crates during the trial. Sows were randomly assigned to slaughter groups representing days of gestation: 45 (6-sows), 60 (4-sows), 75 (3-sows), 90 (3-sows), 100 (5-sows), and 110 (4-sows). After slaughter, the reproductive tracts were obtained from all the sows and dissected to obtain the fetuses and the placentas. Before the dissection, the location of each fetus was recorded with the cranial extremity of each horn being location number one. The fetuses were further dissected to obtain individual organs: heart, liver, lung, gastrointestinal tract (GIT), spleen (75+ days), and kidneys. Overall, no relationship ($P > 0.05$) was found between fetal location and fetus weight on d 45, 75, 90 or 110 of gestation. However, there was a linear relationship between fetal location and fetus weight on d 60 and d 100 of gestation ($P < 0.01$), showing that the fetuses at the cranial extremities were proportionally larger than those at the caudal extremities of the uterine horn. When gestation day was not considered in analyzing the data, the weights of the fetus, fetal carcass, gastrointestinal tract (GIT), liver and kidney decreased linearly ($P < 0.01$), but the weights of the placenta, heart, lung and spleen decreased linearly ($P < 0.05$), as the location within the uterine horn proceeded cranial to caudal. These data suggest that the fetus at the cranial extremities of the uterine horn may receive more nutrient supplies than the fetus at the caudal extremities. In addition, the results suggest the availability of nutrients in sows on d 60 and d 100 of gestation may have a greater impact on fetal growth than at other gestational ages.

Key Words: Pigs, Intrauterine Location, Fetus

127 Changes of maternal tissues during gestation in primiparous sows: nutritional implications. F. Ji^{*1}, Y. G. Kim¹, G. Wu², and S. W. Kim¹, ¹Texas Tech University, Lubbock, ²Texas A&M University, College Station.

Thirty-five gilts (128.44±7.45 kg SE) were used to determine the weight changes of various body tissues of sows during gestation. Gilts were housed in individual gestation crates and were divided into two groups (heavy and light) based on BW. Three sows from each group were randomly selected and slaughtered to provide baseline information as day 0 of gestation. The remaining sows were bred and, within a group, randomly assigned to one of six slaughter groups: day 45 (6 sows), day 60 (4 sows), day 75 (5 sows), day 90 (4 sows), day 102 (5 sows) and day 112 (5 sows). All sows were fed 2 kg diet/d (3.115 Mcal ME/kg and 0.56% Lys) until the assigned slaughter d. Body weights of any remaining sows were measured on day 10, 25, 45, 60, 75, 90, 102, and 112 of gestation. The carcass, liver, stomach, small intestine, large intestine, spleen, pancreas, kidney, lung, heart, liver, uterus, mammary gland, and other remaining viscera were obtained, weighed, and ground for further analysis. The body weights and the weights of hot carcass, soft tissue (carcass without bone), bone, and the remaining viscera were increased linearly ($P < 0.05$) as gestation progressed. The proportion of hot carcass, soft tissue, bone, kidney, lung, and liver relative to the body weight was decreased linearly ($P < 0.0001$) as gestation progressed. The weights of stomach, small intestine, large intestine and pancreas, as well as the proportion of these organs relative to body weight were decreased linearly ($P < 0.001$) which might be due to restricted feeding during the gestation period. The weights of the reproductive tract (including fetuses) and average mammary glands were increased with gestation (quadratic, $P < 0.01$). Uterus weight and the proportion of the reproductive tract (including fetuses), fetus and uterus relative to body weight were increased linearly ($P < 0.01$). These data show that growth rates of maternal tissues in restrictedly fed sows vary greatly during gestation. Our findings

may have important implications for establishing a feeding strategy for gestating sows to improve reproductive performance.

Key Words: Sows, Gestation, Tissue Growth

128 Apparent digestibility of soluble and insoluble fiber in diets for gestating sows. J. A. Renteria^{*1}, L. J. Johnston², D. D. Gallaher¹, and G. C. Shurson¹, ¹University of Minnesota, St. Paul, ²University of Minnesota, Morris.

Twenty-four gestating sows (12 nulliparous, NULL; 12 multiparous, MULT) were fed four experimental diets to assess the apparent digestibility of soluble fiber (S) and insoluble fiber (IS). Experimental diets included corn-soybean meal control (C; 1.59% S, 7.67% IS), corn-soybean meal-34% oat bran high in S (HS; 3.19% S, 8.95% IS); corn-soybean meal-12% wheat straw high in IS (HIS; 1.46% S, 15.36% IS); and corn-soybean meal-16% sugar beet pulp (HS+HIS; 3.20% S, 15.31% IS). Sows were assigned randomly to diets within parity group, and individually fed to meet their energy requirements according to the NRC (1998) assuming 10 pigs per litter and 40-kg gestation gain. Total collections of feces and urine were conducted in 5-d periods at Wk 5, 10, and 14 of gestation. There were no parity group by diet interactions for any response criteria. Apparent digestibility of dietary S (83.8 vs 82.8%; $P > 0.20$) was similar between MULT and NULL sows, while IS digestibility was greater for MULT vs NULL sows (54.5 vs 51.6%; $P < 0.06$). Apparent S fiber digestibility was different among experimental diets (HS, 89.5%; C, 85.8%; HS+HIS, 80.3%; HIS, 77.7%; $P < 0.01$; SE= .84). Apparent IS digestibility was similar between HS+HIS and HS (61.9 and 58.4%), but greater than C (53.5%), while IS digestibility of HIS (38.3%) was lowest ($P < 0.01$; SE = 1.47). There was a time by treatment interaction ($P < 0.01$) for IS digestibility. Generally, digestibility of S improved ($P < 0.01$) as gestation progressed for sows fed C (82.6, 86.7, and 88.2%), HS (89.6, 89.9, and 89.1%), HS+HIS (74.8, 83.5, and 82.5%), and HIS (73.7, 76.9, and 82.5%). Digestibility of IS decreased as gestation progressed for sows fed C (57.6, 52.7, and 50.1%) and HS (67.5, 51.7, and 56.1%), but increased for sows fed HS+HIS (58.3, 64.3, and 63.0%), with no linear trend for sows fed HIS (40.5, 32.9, and 41.6%). In conclusion MULT had greater ability to digest IS than NULL. As gestation progressed, S digestibility improved. Digestibility of IS appeared to improve in the presence of S.

Key Words: Sows, Fiber, Digestibility

129 Comparison of three methods of feeding sows in gestation. M. G. Young^{*1}, M. D. Tokach¹, F. X. Aherne², R. G. Main¹, S. S. Dritz¹, R. D. Goodband¹, and J. L. Nelssen¹, ¹Kansas State University, Manhattan, ²Alberta Pig Company, Canada.

A total of 689 sows were used to compare 3 methods of feeding during gestation. Control gilts and sows were fed according to body condition, based on a scale of 1 to 5 (1 = thin, 5 = fat). Feed allowance was arbitrarily set by the farm manager to achieve a body condition score of 3 at farrowing. For method 2, feeding level was based on backfat and weight (at weaning for sows or service for gilts). Feed allowance was modeled from calculations of weight and backfat gain to achieve a target backfat of 19 mm at farrowing with a constant feed allowance from d 0 to 101. Method 3 was similar to method 2, except feeding pattern was altered for thin sows and gilts (< 15 mm backfat at service) in an attempt to reach 19.0 mm backfat by d 36 of gestation. Sows were weighed at weaning (gilts at service) and at entry to the farrowing house (d 112 to 114 of gestation). Backfat was measured between d 0 to 5 and d 108 to 113 of gestation. Sows fed by methods 2 and 3 had achieved backfat of 19.0 and 19.1 mm at farrowing, respectively, while control fed sows numerically tended to have greater ($P < 0.11$) backfat at farrowing (19.9 mm). Control sows had greater backfat gain in gestation (3.6 mm, $P < 0.05$), than those fed using method 2 (2.6 mm), while sows fed with method 3 had intermediate backfat gain (3.0 mm). Control sows had greater weight gain in gestation (49.6 kg, $P < 0.05$) than sows fed with method 2 and 3 (42.3 kg). Sows targeted to gain 6 and 9 mm of backfat in gestation failed to achieve target gains regardless of feeding method. Feeding sows in gestation based on backfat resulted in a higher proportion of sows in the target backfat range (17 to 21 mm) at farrowing and a lower percentage of fat sows (> 21 mm backfat), but no difference in the percentage of thin sows (< 16 mm backfat) compared to the standard method of feeding based on body

condition. The higher proportion of sows in the optimum backfat category demonstrates that feeding based on backfat and body weight has the potential for facilitating more precise gestation feeding.

Key Words: Sows, Feed Intake, Backfat

130 Effect of gestation feeding method on sow performance in lactation. M. G. Young^{*1}, M. D. Tokach¹, F. X. Aherne², R. G. Main¹, S. S. Dritz¹, R. D. Goodband¹, and J. L. Nelssen¹, ¹Kansas State University, Manhattan, ²Alberta Pig Company, Canada.

A total of 562 sows were used to examine the effect of 3 gestating feeding methods on lactation performance. Control gilts and sows were fed according to a standard 5-point visual body condition score (1 = thin, 5 = fat). Feed allowance was arbitrarily set by the farm manager to achieve a body condition score of 3 at farrowing. For method 2, feeding level was based on backfat and weight (at weaning for sows or service for gilts). Feed allowance was modeled from calculations of weight and backfat gain to achieve 19.0 mm backfat at farrowing with a constant feed allowance from d 0 to 101. Method 3 was similar to method 2, except feeding was altered for thin sows and gilts (< 15 mm backfat at service) in an attempt to reach a target of 19.0 mm backfat by d 36 of gestation. Sow weight and backfat was recorded at entry into the farrowing house (d 108 to 113 of gestation) and at weaning. Lactation feed intake, total number of pigs born, born alive, born dead, mummified, fostered, and weaned were recorded. Dates of weaning and estrus were recorded to calculate wean-to-estrus interval. Performance in lactation and wean-to-estrus interval were not affected ($P > 0.10$) by gestation feeding method. Sow weight at farrowing, weaning, and lactation weight loss were not different ($P > 0.20$) among the three feeding methods. Lactation ADFI was not affected by gestation feeding method. The relationship between weight gain in gestation and lactation feed intake was highly variable with weight gain only explaining 9% of the differences in lactation feed intake. However, when comparing lactation ADFI for the high backfat sows (> 23 mm) to the rest of the population (≤ 23 mm), a tendency ($P < 0.06$) was observed for high backfat sows to have lower ADFI in lactation (5.6 vs 5.9 kg). Total number of pigs born, born alive, born dead, mummified, and fostered pigs were not affected by gestation feeding method. The results indicate that the gestation feeding methods used in this trial had no effect on performance in lactation.

Key Words: Sows, Feeding Method, Lactation

131 Effect of dietary levels of soluble and insoluble fiber on litter size and sow performance. J. A. Renteria^{*1}, L. J. Johnston¹, S. K. Webel², and R. L. Moser², ¹University of Minnesota, St. Paul., ²United Feeds, Sheridan, IN.

Three concurrent experiments involving 716 sows were conducted to evaluate the effects of soluble (S) and insoluble (IS) dietary fiber during gestation on litter size and sow performance. Sows were assigned randomly to a common control diet or a high fiber diet within each experiment. In Exp. 1, diets included a corn-soybean meal control (C; 1.54% S, 7.97% IS; n = 122) or corn-soybean meal-30% oat bran high in S fiber (HS; 3.18% S, 8.03% IS; n = 124). In Exp. 2, diets included C (n = 97) or corn-soybean meal-13% wheat straw high in IS fiber (HIS; 1.41% S, 15.63% IS; n = 119), and in Exp. 3, sows received C (n = 123) or corn-soybean meal-21% soy hulls (HS+HIS; 2.99% S, 20.80% IS; n = 131). Experimental diets were offered to sows to supply similar daily amounts of ME (6172 kcal), protein (250 g), and lysine (12 g) beginning two d post-mating. All sows, regardless of treatment, had ad libitum access to a standard lactation diet. The HS diet compared with C supported more sow wt gain during gestation (26.7 vs 16.1 kg; $P < 0.01$), but had no effect ($P > 0.30$) on total litter size born (11.15 vs 11.37 pigs), litter weaning wt (48.39 vs 49.09 kg), or ADFI of lactating sows (5.26 vs 5.45 kg). The HIS diet compared with C had no effect ($P > 0.20$) on sow wt gain during gestation (16.9 vs 13.4 kg), total litter size born (11.44 vs 11.32 pigs), litter weaning wt (54.8 vs 55.2 kg), or ADFI of lactating sows (6.01 vs 6.02 kg). The HS+HIS diet compared with C supported less sow wt gain during gestation (18.5 vs 28.6 kg, $P < 0.01$), and greater ADFI of lactating sows (6.20 vs 5.66 kg, $P < 0.01$), but had no effect ($P > 0.30$) on total litter size born (11.94 vs 12.27 pigs) or litter weaning wt (51.8 vs 53.2 kg). Post-weaning interval to estrus averaged 6.4 d and was not affected ($P > 0.15$) by dietary treatments. In conclusion, gestation diets high in soluble and/or insoluble fiber can be

fed at recommended energy and nutrient intakes without compromising sow or litter performance.

Key Words: Sows, Fiber, Litter Size

132 Full-Fat canola seed as an energy substitute for vegetable oil in late gestation and lactation diets. B. S. Zimprich^{*1}, R. L. Harrold¹, T. E. Socha¹, and D. Landblom², ¹North Dakota State University, Fargo, ²Dickinson State University, Dickinson, ND.

A total of 143 litters from 94 mixed parity sows were used to evaluate litter performance, sow body condition change, days to estrus, milk composition, and litter weights, when sunflower oil (SA) or full-fat canola seed (CA) were added to the control (C) diet of corn-soybean meal. Sows were randomly assigned to diets at day 100 of gestation. Sows were weighed and measured for body condition change using realtime ultrasound on day 100 of gestation, farrowing, day 7 and weaning. Milk samples were taken from three randomly selected sows per treatment per farrowing. Milk samples were analyzed for solids, protein, and fat at d 0 and 14. Litter weights were taken on d 0, 1, 7, and at weaning. SA sows returned to estrus earlier than C sows (4.60 vs. 5.25; $P < 0.07$). Sows on SA and CA diets weaned heavier litters than C sows (55.14, 53.37 vs. 49.44 kg; $P < 0.02$). The C and SA sows consumed more feed from d 100 to 0 than CA sows (39.25, 39.94 vs. 37.33 kg; $P < 0.03$). From d 0 to 7 SA sows ate more than sows on C and CA treatments (36.65 vs. 33.46, 32.78 kg; $P < 0.05$). Sows on SA and CA diets consumed more feed than sows on diet C between d 7 and weaning (58.12, 59.51 vs. 51.77 kg; $P < 0.02$). Overall feed intake showed SA sows consumed more feed than C sows (135.3 vs. 124.5 kg; $P < 0.03$). Milk collections taken on d 0 showed no differences between treatments, however, sows on SA diet had a higher butterfat content than sows on diets C and CA at d 14 (9.06 vs. 7.55, 7.86; $P < 0.03$). Sows on the SA diet also had a higher milk solids content on d 14 than sows on diets C and CA (19.61 vs. 18.24, 18.56; $P < 0.02$). Differences in survival rate of nursing piglets among treatments were not observed (88.96, 92.55, and 90.14%). There are benefits of increasing the fat content of late gestation and lactation diets for increased litter performance, and a quicker return to estrus. However, the cost of fat sources must be considered in determining the potential for these inclusions.

Key Words: Full-Fat Canola, Sow Performance, Milk Composition

133 Threonine is more limiting than valine in diets of lactating sows with high body protein loss. K. T. Soltwedel, R. A. Easter, and J. E. Pettigrew, University of Illinois, Urbana.

The objective of this study was to determine whether threonine or valine is more limiting in corn-soybean meal diets fed to lactating sows mobilizing a high amount of body protein, using plasma urea nitrogen concentration (PUN) as an indicator of amino acid limitation. The study was conducted as a replicated 4 X 4 Latin Square with three squares. Initial sow BW averaged 241 kg and initial litter size averaged 9 pigs. A diet containing corn and soybean meal as the only protein sources formulated to 0.90% lysine was diluted with starch, sucrose and soybean oil to lower the protein concentration and induce a high rate of body protein loss. L-lysine-HCl and D,L-methionine were added at 0.112 and 0.016% of the diet, respectively, to ensure that lysine and methionine were not limiting. From this basal diet, each of the following dietary treatments was formulated: 1) the negative control (NC) basal diet, 2) the NC diet supplemented with 0.139% L-threonine (NC+T), 3) the NC diet supplemented with 0.174% L-valine (NC+V), 4) the NC diet supplemented with 0.139% L-threonine and 0.174% L-valine (NC+T+V). Dietary treatments were made isonitrogenous by glycine supplementation. The study was initiated on either d 3, 4, or 5 of lactation for each sow. Feed intake was standardized to 4.8 kg/d, an amount of feed that did not exceed sow appetite, yet provided sufficient energy intake (18 Mcal ME/d). Each diet was fed to each sow for a period of four days. At the end of each period, blood samples were collected 5 to 6 h post-prandial for analysis of PUN. The PUN was lower ($P < 0.01$) for the threonine-supplemented treatments, and was not affected ($P < 0.10$) by supplemental valine intake (see Table). Total sow BW loss and litter gain averaged 19.58 and 35.05 kg, respectively, for the entire 16-d study. This study demonstrates that threonine is more limiting than valine in corn-soybean meal diets fed to lactating sows with a high rate of body protein loss in lactation, when PUN is used as an indicator.