

- 7 The effect of dietary energy source (fat vs carbohydrate) on performance and carcass characteristics of growing swine. C.A. Bowie* and M.T. Coffey, North Carolina State University.

Two experiments (EXP) were conducted using pigs with a high capacity for growth (> 800 g/d). In EXP1, 18 pigs ($27.4 \pm .5$ kg) were individually-penned and fed diets prepared by the isocaloric substitution of 0, 3.8 or 7.8% poultry fat for corn starch in a base diet. Grower diets (12.2g ideal protein (IP)/MJ DE) were fed until pigs weighed 60 kg; and finisher diets (7.7g IP/MJ DE) were fed to a weight of $94.4 \pm .6$ kg. Diets were applied in amounts to approximate ad libitum intake yet maintain isoenergetic intakes on a metabolic body weight basis. Growth rate (781, 822 and 848g/d; TRTS1-3) and carcass characteristics (LEA:39.5, 41.2 and 7.8 cm²; BF:21.6, 24.9, and 23.6mm; TRT1-3) were not altered by dietary energy source at isoenergetic intakes. In EXP2, 72 pigs ($16.6 \pm .2$ kg) were penned according to sex and fed ad libitum diets that contained 1, 3.75 or 7.5% poultry fat (TRTS 1-3; 4 pigs/pen; 3 pens/TRT/sex). Diets contained 12.2 and 7.8 g IP/MJ DE during the grower and finisher (60-106.3 \pm .8kg) periods, respectively. Pigs fed TRT3 grew faster ($P < .01$) than pigs fed TRT1 or TRT2 during the grower period (825, 809 and 872g/d) and tended ($P < .09$) to grow faster during the finisher period (889, 891 and 940g/d). Over the entire study, pigs fed TRT3 grew faster ($P < .01$) than pigs fed TRT1 or TRT2 (862, 858 and 912g/d). Dietary fat addition reduced ($P < .06$) feed intake during the grower period (1.88, 1.73 and 1.77 kg/d) and over the entire study (3.10, 2.69 and 2.59 kg/d), and improved ($P < .05$) F/G during the grower (2.19, 2.14 and 2.03), finisher (3.61, 3.32 and 2.99) and over the entire study (3.07, 2.88 and 2.63). Neither loin eye area (43.3, 42.0 and 41.2 cm², TRTS1-3) nor backfat (27.7, 29.7 and 29.5 mm) were altered. Feeding fat-added diets ad libitum increased performance without adverse effects on carcass quality.

KEY WORDS: Swine, Energy source, Fat

- 428 Effect of energy restriction during the late development period on puberal onset in F-2 gilts. E.A. Newton*, D.C. Mahan and M.L. Day. The Ohio State University, Columbus.

An experiment was conducted to evaluate the effects of 3 energy intakes on puberal onset in non-boar exposed gilts. A total of 105 F-2 D \times L \times Y gilts were utilized in two replicates of a randomized complete block experiment. Replicate 1 was conducted from September 1989 to January 1990, whereas replicate 2 was from February to June 1990. Gilts were fed daily quantities of feed to achieve target weights of 100, 123, or 150 kg BW at 8 mo of age. Feed intakes averaged 1.6, 2.3 or 3.2 kg/d using a corn-soybean meal (C-SBM) mixture containing 1.15% lysine from 4 to 9 mo of age for the light (L), medium (M) or heavy (H) weight groups, respectively. The C-SBM diet was formulated to meet or exceed daily NRC recommendations for all nutrients except energy. Body weights achieved by 8 mo were 111, 131 and 154 kg for L, M and H weight groups, respectively ($P < .05$). Gilts were housed in an open fronted building. Both L and M weight groups were fed in individual crates twice per day, whereas the H group had access to a self-feeder. From 4.5 to 9 mo of age, blood samples were collected weekly with plasma assayed for progesterone (P4) and estradiol-17 β (E2) for detection and verification of initial ovulation (P4 > 1 ng/ml). Gilts were checked daily by the herdsman for visual signs of estrus 1 hr each day beginning at 4.5 mo of age. At no time were gilts exposed to boars. Although body weight and backfat increased ($P < .01$) as energy intake increased, dietary energy restriction did not affect age at first estrus or ovulation. Concentrations of E2 in plasma were similar between weight groups 1 wk prior to ovulation. During the week that ovulation occurred, H gilts had higher ($P < .05$) E2 concentrations than L or M weight gilts. Replicate differences were observed but attributable to season. Gilts in replicate 1 became puberal at an older age (~ 17 d) with H weight gilts less frequently detected in estrus in replicate 1 vs 2. Percentage ovulated was not affected by energy intake nor by replicate. These data suggest that energy restriction from 4.5 to 8 mo of age did not affect puberal onset in F-2 D \times L \times Y gilts.

KEY WORDS: Gilts, Energy, Restriction

- 429 Characterization of LH secretion in the lactating primiparous sow: Relation to return-to-estrus interval and blood metabolites. M. D. Tokach, J. E. Pettigrew, G. D. Dial, J. E. Wheaton, B. A. Crooker and L. J. Johnston. University of Minnesota, St. Paul.

The objective of this experiment was to evaluate differences in LH and blood metabolite concentrations during lactation in sows with an early (< 9 d; n=14) or late (> 15 d; n=9) return-to-estrus postweaning. Lactating primiparous Landrace \times Yorkshire sows were provided a matrix of lysine (15 to 45 g/d) and energy (6.5 to 16.5 Mcal ME/d) intakes to achieve a range in metabolite concentrations and return-to-estrus intervals. Blood samples for LH analysis were collected every 15 min for 6 h (1700 to 2300) on d 0, 7, 14, 21 and 28. The d 28 sampling was continued for an additional 6 h after weaning (PW). Circulating levels of

glucose, amino acids, insulin, triglycerides, urea N, nonesterified fatty acids (NEFA), and ATP also were measured on d 7 and 21. Mean LH concentrations (ng/ml) were high at farrowing but decreased substantially ($P < .01$) by d 7 in both groups. Mean LH and n of LH peaks/6 h increased linearly ($P < .01$) from d 7 to 28 for early sows. Early sows had higher LH means and more LH peaks/6 h on d 14, 21 and 28 than late sows ($P < .05$). Early sows had higher serum insulin ($P < .05$) on d 7 (24.5 vs 17.1 $\mu\text{IU/ml}$) and d 21 (15.1 vs 10.6 $\mu\text{IU/ml}$) than late sows. No other metabolites were different ($P > .10$) between early and late sows. Insulin levels on d 7 were correlated ($P < .05$) with n of LH peaks on d 14 ($r = .50$), d 21 ($r = .43$) and d 28 ($r = .43$). Weaker correlations ($P < .1$) also were found when n of LH peaks on d 21 were related ($r = .4$) to d 21 insulin and d 7 and 21 glucose and NEFA. These results demonstrate that aberrations in LH profiles as early as d 14 of lactation are associated with a delayed return-to-estrus following weaning. Also, insulin levels during early lactation may be associated with subsequent reproductive function.

Item	Day of lactation				
	0	7	14	21	28
Mean LH					
Early	.27	.12	.16	.22	.23
Late	.41	.12	.12	.15	.16
LH Peaks/6 h					
Early	0	0	.57	.93	.86
Late	0	0	0	.22	.11

KEY WORDS: Lactating sow, LH, Insulin

430 The relationship between the caloric density of the diet and energy intake by pigs from weaning to 50 kg. D. A. Cook¹, R. A. Easter and M. D. Harrison¹. University of Illinois, Urbana and ¹ Heartland Lysine, Inc., Chicago, IL.

A total of 48 pigs [(Landrace x Duroc) x Hampshire] (Ave. init. wt. = 6.47 ± 0.16 kg) individually housed in a thermoneutral environment were used to characterize the effect of energy density on feed intake and growth. Treatments consisted of four digestible energy (DE) levels (2900, 3200, 3500 or 3800 kcal DE/kg). Diets were formulated to have a constant digestible Lys:DE ratio (3.28 g/Mcal DE). This was accomplished by maintaining a constant ratio of the major ingredients (corn, soybean meal and dried skim milk) to the DE content of the diet. The level of soy oil, corn starch and a diluent (wood cellulose) was altered to arrive at the desired DE level. Diets were formulated to exceed the NRC (1988) requirements for essential amino acids relative to energy. Increasing DE content of the diet from 2900 to 3800 kcal/kg resulted in a significant quadratic response ($P < .01$) for average daily gain (ADG) and gain/feed (GF) and a significant cubic response ($P < .05$) for average daily feed intake (ADFI) and daily DE intake (DDEI). Although ADFI is increased at 2900 kcal/kg DDEI is decreased. This may suggest a physical limitation of the digestive tract at a DE level of 2900 kcal/kg and below. Both ADFI and DDEI were higher at DE levels of 3500 and 3800 kcal/kg than at 3200 kcal/kg. This may be due to a lower heat increment of the diets containing a higher concentration of soy oil.

	DE Content (kcal/kg)				
	2900	3200	3500	3800	SE
ADG, kg/d	0.51	0.55	0.63	0.61	0.01
ADFI, kg/d	1.34	1.17	1.23	1.19	0.03
GF	.377	.469	.518	.512	.013
DDEI, Mcal/d	3.90	3.74	4.31	4.52	0.01

KEY WORDS: Pigs, Energy density, Feed intake

431 Reconstitution of body reserves in multiparous sows during pregnancy. Effects of energy intake. Etienne, J. Y., Dourmad, A., Barrios and J. Noblet. I.N.R.A., Station de Recherches Porcines, 35590 Gilles-France

Effects of energy intake during pregnancy on the reconstitution of body reserves were investigated on 21 Lar White sows. They were allocated to three groups at mating (mean parity number, 4.9; mean BW, 208 kg) following a 26-d lactation during which they lost 37 kg BW. They received the same amount of proteins (3 g/d) and amino acids, but different DE levels: 7.4, 8.8 and 10.4 Mcal/d in groups L, M and H, respectively. Nitrogen balance (Nr) was measured 5 times during 7-d periods at 11 (P1), 32 (P2), 53 (P3), 82 (P4) and 117 (P5) days of gestation. BW and backfat depth were measured every two weeks. Sows were slaughtered at 1 d of gestation and the uterus and carcass were dissected. Additional 24 control sows were dissected after weaning in order to predict the initial composition of the experimental sows. Animals were housed at 22°C.

Net weight gain of pregnancy and Nr increased with energy level (26, 47 and 59 kg, $P < .001$, for net weight gain and 9.9, 11.3 and 14.5 g/d, $P < .001$, for Nr in groups L, M and H, respectively). Nr varied according pregnancy stage ($P < .001$): 9.2, 12.2, 8.6, 13.0 and 17.2 g/d at P1 to P5, respectively. The first raise at P2 was influenced by energy intake ($P < .001$): 9.0, 11.0 and 16.1 g/d in groups L, M and H, respectively. A second o