parity 1 females x diet (14-15/diet and 178±4.7 kg post-farrow BW) was consistent with results for parity 2-4 females. This study failed to show an advantage in formulating a practical corn-soy diet to a valine:lysine ratio greater than .90:1.0.

Key Words: Sows, Lactation, Valine

109 Quantitation of body endogenous amino acid contribution in the lactating sow.

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Sixteen sows (Landrace x Yorkshire; parity 2 or 3; BW at postfarrowing = 219.0 ± 25.5 kg) were used to quantify endogenous amino acid contribution from body protein degradation (EAA) during lactation by plasma arterio-venous (A-V) differences of free plasma amino acids (AA) across the mammary gland. Each sow nursing 11 pigs was provided ad libitum access to 1 of 4 diets (4 sows/diet). All diets were isocaloric (3.4 Mcal ME/kg) with similar AA ratios, but contained different CP levels (7.8, 13.0, 18.2, and 23.5%). Sows were fitted with carotid arterial and main mammary venous catheters on d 4 or 5 of lactation. On d 10, 14, 18, and 22 of lactation, arterial and venous blood were collected simultaneously every 30 min for 6 h. Milk yield on d 11 and 21 was estimated by D_2O dilution method. During a 21-day lactation period, daily sow body weight loss, milk production, and litter weight gain were 1.18 ± .56 kg, 11.48 ± 2.19 kg, and 2.15 ± .34 kg, respectively. The relationship between log AA A-V difference and daily AA intake was linear and quadratic ($P < .05$). The best fitting regression model was $Y = aX^2 + bX + c$, with Y being the predicted log AA A-V difference, X the daily AA intake (g/d), and a, b and c the parameter estimates. When daily AA intake = 0, plasma AA A-V difference (t) = reverse log intercept c. When t is multiplied by mammary plasma flow rate, the product, i.e., AA uptake by the mammary glands, represents the difference between EAA and obligatory AA need for extra-mammary tissues. Daily mammary plasma flow rate was evaluated at 6440 L/d using the Fick principle where daily uptake of plasma lysine by the mammary glands was assumed equal to daily output of lysine in milk. During the 21-day lactation period, sow's body endogenous contribution of arginine, lysine, methionine, phenylalanine, threonine, and valine were 3.40, 11.13, 2.18, 5.79, 5.77, and 4.80 g/kg BW loss, respectively.

Key Words: Porcine mammary gland, Arterio-venous difference, Endogenous amino acid

110 Effects of litter size on nutrient mobilization in lactating sows.

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Twenty-eight primiparous sows were used to quantify the effect of litter size on mobilization of nutrients from different organs during lactation. Litter size was set from six to 12 pigs immediately after birth with four sows allotted to each litter size. Sows were provided a maximum of 13.6 Mcal ME and 46.3 g lysine per day during lactation. Sows were slaughtered on d 21 of lactation. Liver, gastrointestinal tract (GIT, composed of the empty stomach, empty small and large intestines, cecum and rectum), reproductive tract, and the other organs were separated from the carcass. The gastrointestinal tract was manually stripped of contents and flushed with water to remove digesta. The hot carcass was split longitudinally at the midline. Individual organs and carcass were weighed and ground for chemical analysis. Dry matter, protein, fat, amino acid, and ash contents were measured. Regression equations (variable = slope × litter size + intercept) were obtained. Changing litter size from six to 12 pigs resulted in 14.5, 3.5, 0.86 kg greater loss of carcass weight, carcass protein, carcass ash, respectively of sows on d 21 of lactation. The protein content of liver and GIT in sows decreased by 74 g and 4.1 kg as litter size increased from six to 12. There was no clear pattern in reproductive tract and the other organs. Sows with larger litter size clearly mobilized more protein from body, liver, and GIT, while fat changes did not show a clear pattern. Protein or amino acid requirements in lactating sows should consider number of pigs nursed during lactation. These data provide a basis for estimating nutrient supply available for milk production and mammary gland growth.

	Carcass wt (kg)	Carcass protein (kg)	Carcass ash (kg)	Liver protein (g)	GIT protein (kg)
Slope	-2.424	-0.584	-0.144	-12.386	-0.678
Probability	0.0482	0.0121	0.0164	0.0607	0.0368
Intercept	148.49	27.01	5.18	572.38	23.38
Probability	0.0001	0.0001	0.0001	0.0001	0.0001
R-square	0.57	0.75	0.72	0.54	0.62

Key Words: Sow, Nutrient mobilization, Litter size

111 Effects of litter size on mammary gland and litter growth in lactating sows.

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Twenty-eight primiparous sows which farrowed at least eight live piglets were used to determine the effect of litter size on mammary gland growth during lactation. Litter size was set to six, seven, eight, nine, 10, 11, or 12 pigs immediately after birth by cross-fostering. Four sows were allotted to each litter size group. Sows were allowed to consume a maximum of 13.6 Mcal ME and 46.3 g lysine per day during lactation. Sows were slaughtered on d 21 of lactation. Mammary glands were collected at slaughter and trimmed of skin and the extraneous fat pad. Each gland was separated, weighed, and ground for chemical analysis. Dry matter content, dry-fat-free-tissue content (DFFT), protein content, amino acid composition, ash content, and DNA content were measured. Only glands known to have been suckled were included in the data set. Regression equations (variable = slope × litter size + intercept) were obtained. Total mammary wet and dry weight, DFFT, protein, DNA, fat, and ash amount in total suckled mammary gland were increased as litter size increased. Changing litter size from six to 12 pigs resulted in 2098, 432, 253, 227, 4.4, 178, and 20 g increases in the amounts of total mammary wet weight, dry weight, DFFT, protein, fat, and ash, respectively on day 21 of lactation. Litter weight gain (LWG) was about 18.1 kg greater in sows with 12 pigs compared to sows with 6 pigs. These data support a hypothesis that mammary gland growth during lactation varies according to litter size. Thus, sows with a larger litter size should require more nutrients to support mammary tissue expansion.

	Wet wt (g)	Dry wt (g)	DFFT (g)	Protein (g)	Fat (g)	DNA (mg)	LWG (g)
Slope	349.6	71.9	42.2	37.8	29.7	725.4	3022.8
Probability	0.0012	0.0003	0.0016	0.0016	0.0008	0.0049	0.0011
Intercept	1147.2	255.5	153.1	132.8	102.4	2180.4	835.4
Probability	0.0658	0.0187	0.0584	0.0650	0.0448	0.1779	0.8487
R-square	0.90	0.94	0.89	0.88	0.91	0.82	0.90

Key Words: Sow, Mammary gland, Litter size

112 Added dietary fat improved growth performance and feed efficiency in grow-finish pigs under commercial conditions.

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A total of 480 pigs (PIC), housed in a fully-slatted commercial research barn, were used to evaluate the effects of feeding added dietary fat (0, 2, 4, or 6% choice white grease) to corn-soybean meal-based diets. Pigs (initial BW = 36 kg) were randomly allotted to 24 pens (20 pigs/pen and 3 pens of barrows and 3 pens of gilts per fat level). Diets were fed in three phases with lysine:calorie ratio decreasing with each phase (3.67, 2.67, and 1.97 g lysine/Mcal ME, respectively). Diets were switched when the average BW for all pens within gender reached 59 and 93 kg. Diets did not contain any synthetic amino acids. From 36 to 59 kg, ADG and G/F improved linearly ($P < .05$; .81, .83, .86, .89 ± .01 kg and .44, .46, .47, .50 ± .01, respectively) with no effect on ADFI as fat level increased from 0 to 6%. From 59 to 93 kg, the response in ADG was not as great (linear, $P < .13$); however, the response in G/F (linear, $P < .05$) was similar to 36 to 59 kg (.33, .34, .36, .37 ± .01, respectively). From 93 to 120 kg, ADFI decreased and G/F increased linearly ($P < .05$; 2.56, 2.47, 2.49, 2.34 ± .06 kg and .27, .28, .30, .31 ± .005, respectively) with no effect on ADG as fat was added to the diet. For the cumulative study, increasing added fat increased ADG and G/F linearly ($P < .05$) with a trend for lower ADFI ($P < .13$). Therefore, the magnitude of response to added fat remained constant throughout the study

for G/F, but decreased for ADG as pigs became heavier. Lean percentage and premium per pig decreased linearly (P < .05) with increasing dietary fat. However, when adjusted to the same market weight, there were no differences in any of the carcass or sale price parameters, indicating the importance of the adjustment to examine the true treatment effects. Under these experimental conditions, up to 6% fat can be added to corn-soybean meal based-diets for grow-finish pigs without negatively influencing standard carcass parameters or premiums received.

Key Words: Pigs, Finishing, Dietary Fat

113 Nutritional modification of late finishing swine diets in a controlled heat stress environment.

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Nutritional modifications were made to finishing swine diets to determine the effect on growth recovery and body composition of maternal line barrows (PIC C-22) subjected to a controlled environmental heat stress (HS). A total of 60 pigs (81-91 kg) that were within 7 d of age, and 5 mm backfat were selected. Twelve pigs were used for initial body composition. Forty-eight pigs were randomly assigned to treatments (trts) and individual pens in four environmental chambers containing 12 pens/room. One chamber was set to a thermoneutral temperature and contained 12 pigs fed a control diet (TN-C). The other 3 chambers (HS, 35°C) each contained 4 dietary trts: (1) control diet, (2) diet with added fat to reduce heat increment, (3) diet with added fat and amino acids (AA) to the same true digestible lysine:ME ratio as the control, (4) as trt 3 plus AA to fully compensate for the expected decrease in ADFI with HS and fat addition. Pigs were killed at 116 kg BW for determination of body composition. Pigs fed the TN-C displayed a higher ADFI (P<.05) than HS. For ADG, pigs fed diets 1 and 2 grew slower than pigs fed the TN-C (P<.05). Pigs fed diet 1 grew slower than all other HS treatments (P<.05). Pigs fed diets 3 and 4 showed improved feed efficiency (G:F) over pigs fed the TN-C and diet 1 (P<.05). Treatment 1 had a lower G:F than all other HS trts (P<.05). Pigs fed diet 3 had an improved carcass fat:protein ratio and accretion rate (g/day) compared to HS trts with added fat and AA. These results suggest that lowering the dietary heat increment during HS improves G:F by allowing pigs to grow faster. It also suggests that for maximum performance under HS, the lysine level of the diet should be balanced to the ME concentration of the diet.

Environment Diet	TN Control	HS 1	HS 2	HS 3	HS 4	SEM	P value
ADG (kg)	1.21	.86	1.05	1.14	1.14	.05	.02
G:F	.30	.28	.34	.38	.37	.02	.04
Fat:protein	1.77	1.67	1.85	1.75	1.91	.07	.20
CarcPro (g/d)	146	140	130	141	131	9.8	.78
CarcFat (g/d)	397	323	396	355	428	24.4	.06

Key Words: Growing Pigs, Heat Stress, Body Composition

114 Effects of genotype and dietary fat on pork quality and carcass composition.

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A study of pork quality and carcass composition of two genotypes that have different rates of fat and lean growth was conducted. Gilts (n = 120) were randomly assigned to a 2 × 5 factorial arrangement of genotype and diet. Pigs were selected at 45 kg live weight and fed conventional corn-soybean meal diets with or without 5% added fat until slaughter at 115 kg live weight. The dietary treatments included no fat supplement (**NF**), high quality poultry fat (**HQ**; low in polyunsaturated and free fatty acids), and low quality poultry fat (**LQ**; high in polyunsaturated and free fatty acids). Two additional dietary treatments were identical to HQ and LQ except that poultry fat was replaced with 5% beef tallow at 80 kg live weight (**HQT** and **LQT**, respectively). Diets were formulated to have equivalent lysine:calorie ratios and offered on an *ad libitum* basis. High-lean genotype gilts had larger loin eye areas (46.45 vs 42.52 ± .71 cm ^{2}, P ≤ .01), less 10^{th} rib backfat (1.42 vs 2.16 ± .08 cm, P ≤ .01), thinner bellies (4.24 vs 4.65 ± .08 cm, P ≤ .01), less drip loss (3.90 vs 5.69 ± .40%, P ≤ .01), lower belly firmness scores (1 = very soft; 3 = very firm; 2.56 vs 2.83 ± .09, P ≤ .05) than average-lean gilts. Genotype did not affect loin color scores or 45-minute pH. Dietary fat had a significant effect on marbling scores (NF: 1.68, HQ: 1.66, LQ: 1.42, HQT: 1.83, LQT: 1.50 ± .10, P ≤ .05). The dietary treatments did not affect loin firmness, backfat thickness, belly thickness, belly firmness, 45-minute pH, drip loss or loin eye area. In conclusion, feeding poultry fat, with or without finishing with beef tallow, appears to have minimal impact on pork quality, and does not affect carcass composition.

Key Words: Pigs, Pork Quality, Dietary Fat

115 Hydrogenated dietary fat improves pork quality of pigs from two lean genotypes.

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Pork quality is influenced by nutrition, genetics, management, and pork-processing procedures. Lean genotype pigs fed diets high in unsaturated fat may result in thinner, lower quality bellies with a soft fat composition. Therefore, we investigated the effects of supplementing 5% choice white grease that had been chemically hydrogenated to iodine values (IV) of 80, 60, 40, or 20. Diets were fed to barrows and gilts (n=240) from one of two genotypes (designated A and B) in a 4 x 2 x 2 factorial design. Pigs were blocked by initial weight (76.5 kg) and fed dietary treatments for 52 days. Genotype A had a greater feed conversion ratio (F/G=2.94 vs 2.82 .04; $P < .05$), backfat depth (26.2 vs 23.9 .5 mm; $P < .01$), and loin depth (58.9 vs 55.1 .8 mm; $P < .01$) compared to genotype B. Decreasing IV of fat fed to pigs increased belly thickness linearly on both dorsal and ventral sides ($P < .01$) and linearly decreased belly length on ham ($P < .05$) and shoulder ($P < .01$) ends. Increased belly thickness was associated with a progressive decrease in belly IV from 77.1 to 70.3 .6 (linear and quadratic effect; $P < .05$), and a decrease (linear and quadratic effect; $P < .01$) in C18:2 concentration in belly fat (20.5, 17.7, 16.7, 16.2 .3 %) as diet IV declined from 80 to 20 IV, respectively. The belly mono/polyunsaturated fat ratio increased 30% as diet IV declined from 80 to 20 (linear and quadratic effect; $P < .01$). Further, there was a linear increase ($P < .05$) in saturated fatty acids (C14 - 18) as fat IV level declined. Increasing linear and quadratic ($P < .01$) effects were detected in the level of C18:1*trans* as IV value decreased from 80 to 20. IV had no effect on fat digestibility, ADFI, or F/G ($P > .1$). Pork belly quality was improved as defined by reduced IV, C18:2 content, increased saturated fatty acid content, increased thickness and decreased length. Results indicate that reduction of dietary fat IV by chemical hydrogenation has the desirable effect of improving pork quality and does not alter growth performance.

Key Words: Pigs, Dietary Fat, Pork Quality

116 The effects of modified tall oil and vitamin E on growth performance and carcass characteristics of finishing pigs.

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Seventy-two crossbred barrows (initially 45.5 kg BW) were used to investigate the effects of modified tall oil (MTO) and increasing vitamin E on growth performance and carcass characteristics of finishing pigs. Pigs were blocked by initial weight and ancestry and randomly allotted to one of the six dietary treatments which were arranged as a 2 x 3 factorial with main effects of MTO (0 or .5% of the diet) and added vitamin E (0, 22, or 110 IU/kg of diet). The vitamin premix did not contain any alpha-tocopherol. The corn-soybean meal diets were fed in meal form in two phases: 45.5 to 81.6 (1.00% lysine) and 81.6 to 114.6 (.75% lysine) kg BW. Diets did not contain added fat. From 45.5 to 81.6 kg, pigs fed MTO had increased ADG (P = .03) and G/F (P = .09) regardless of added vitamin E when compared to pigs not fed MTO; otherwise dietary treatment did not affect (P > .15) growth performance. Pigs fed MTO had reduced average backfat (P = .004) regardless of vitamin E level. Interactions of MTO and vitamin E (P ≤ .07) were observed for marbling, firmness, and drip loss percentage of the longissimus muscle. Increasing vitamin E in diets containing MTO resulted in firmer longissimus muscle that had more marbling and reduced drip loss. Conversely, increasing vitamin E in diets not containing MTO resulted in higher drip loss and longissimus muscle that were less firm and had less marbling. Dietary combinations had no effect (P > .10) on visual color of the longissimus muscle 24-h postmortem. Pigs fed MTO had firmer bellies (P ≤ .04) initially, and after one and five minutes when centrally