87 **Moist extrusion influences utilization of soybean products by the early-weaned pig.** K.G. Friesen*, J.L. Nelssen, K.C. Behnke, R.D. Goodband, and L.J. Kats, Kansas State University, Manhattan.

A trial was conducted to evaluate the effect of moist extruded soy proteins (SP) on starter pig growth performance and N digestibility. A total of 170 pigs (averaging 21 d of age and 5.8 kg) was utilized in a 2 x 3 factorial arrangement plus a positive control. Treatments included an all milk protein control diet (MP), and either soy flakes (SF), soy flour (FL), or soy protein concentrate (SPC) with or without moist extrusion (ESF, EFL, ESPC, respectively). Soy proteins were texturized in a Wenger, X-20 single screw extruder. Following a 15 minute drying period, the texturized SP was ground in a Fitz mill, through a 1.6 mm screen. Soy protein replaced MP in the diets on a protein percentage basis. Experimental diets fed from d 0-14 were formulated to contain 1.4% lysine, .9% Ca, and .8% P. A 1.25% lysine corn-soybean meal (10% dried whey) diet was fed to all pigs from d 14-35. Pig weights and feed disappearance were recorded weekly to calculate ADG, ADFI, and gain/feed (G/F). Fecal samples were collected on d 14 to determine apparent N digestibility. An extrusion by protein source interaction (P<.01) was detected for ADG, ADFI, and G/F d 0-14 post-weaning. Moist extruding SPC did not improve growth performance to the extent moist extrusion improved less refined soy products (SF and FL). By extruding SF and FL, trypsin inhibitor (TI) concentrations were reduced and protein utilization was improved as measured by improvements in N digestibility. An interaction between extrusion processing and protein source (P<.01) was detected for N digestibility. Pigs fed MP had higher N digestibility (P<.01) than pigs fed SP. For the 35 d trial, an extrusion by protein source interaction existed for ADG (P<.01), ADFI (P<.05), and G/F (P<.05). These data suggest that moist extrusion can improve protein utilization of less refined soy products (SF and FL) by decreasing TI concentrations and improving N digestibility. By utilizing moist extrusion, less refined soy products (SF and FL) can be utilized as efficiently as highly processed soy products (SPC) by the early weaned pig.

Item	MP	SF	ESF	FL	EFL	SPC	ESPC	CV
d 0-14 ADG	284	61	227	69	198	199	211	18.0
d 0-14 G/F[ab]	.95	.32	.85	.35	.75	.82	.84	30.8
d 0-35	410	294	374	296	384	367	357	6.7
d 0-35 G/F[ac]	.68	.62	.65	.62	.66	.68	.67	3.2
N Dig.,%[ac]	93.3	71.7	86.2	71.6	86.8	86.5	88.8	4.7
TI, mg/g	0	26.9	.4	31.6	.4	.8	.4	

[a] Milk vs SP (P<.01). [b] Extrusion * SP (P<.01). [c] Extrusion * SP (P<.06).

Key Words: Starter Pigs, Soybean Protein, Dried Skim Milk

88 **Effect of replacing milk proteins with wheat gluten and soybean products on digestibility of nutrients and growth performance in nursery pigs.** B.T. Richert*, J.D. Hancock, and J.L. Morrill, Kansas State University, Manhattan.

Two experiments were conducted to evaluate the nutritional value of differently processed wheat glutens for weanling pigs. In Exp. 1, 72 pigs (20 d of age and 4.2 kg avg wt) were used to determine N digestibility (ND), biological value (BV), and N retention (NR) of diets with the wheat glutens. Treatments were: 1) corn-casein-cornstarch-based control; 2,3,4,5, and 6) diet 1 with flash-dried (FDWG), spray-dried (SDWG), and two solubilized wheat glutens, and soybean meal (SBM) replacing casein and cornstarch. Daily feed allowance was calculated as .05 x $BW^{.9}$. Pigs were fed the diets at 6-h intervals during a 5-d adjustment period and 4-d collection of feces and urine. The diet with casein had the highest ND, BV, and NR (P < .01). Wheat gluten products had greater ND than SBM (P < .01). Solubilization of the wheat gluten decreased BV (P < .02) compared to FDWG and SDWG, and tended to decrease NR (P < .11). In Exp. 2, 180 weanling pigs (25 d of age and 5.6 kg avg wt) were used in a growth assay. Treatments for d 0 to 14 were: 1) corn-20% dried skim milk (DSM)-20% dried whey-based control (HNDD); 2,3,4, and 5) diet 1 DSM was replaced by lactose and FDWG, SDWG, solubilized-modified wheat gluten (SMWG), and soy protein isolate (SPI). All pigs were fed a common diet (corn-SBM-whey based) from d 14 to 35. For d 0 to 14, ADG and ADFI were not different (P > .15). Wheat gluten diets supported higher G/F than diets with SPI (P < .01). Pigs fed SDWG had improved G/F compared to pigs fed SMWG (P < .01). At d 14, the HNDD diet had greater apparent DM digestibility (P < .07) than all other diets, but apparent N digestibility was not affected. For d 14 to 35, pigs fed the HNDD diet had the poorest ADG and G/F (P < .03). Pigs fed the FDWG had reduced ADG (P < .04) and ADFI (P < .02) compared to pigs fed SDWG and SMWG. Spray-dried wheat gluten supported greater ADG (P < .08) and ADFI (P < .11) than SMWG. Overall (d 0 to 35), pigs fed SDWG and SMWG had greater ADG (P < .08) and ADFI (P < .02) than pigs fed FDWG. Pigs fed SDWG had 18% greater ADG than pigs fed DSM (d 0 to 35). Wheat gluten and lactose can effectively replace DSM in diets for early-weaned pigs.

Item	HNDD	FDWG	SDWG	SMWG	SPI	CV
d 0 to 14						
ADG, g	334	320	341	322	306	11.4
G/F	.952	.950	1.036	.925	.904	5.5
d 14 to 35						
ADG, g	408	431	517	461	446	11.4
G/F	.607	.657	.652	.641	.638	5.9
d 0 to 35						
ADG, g	379	387	447	406	390	10.9
G/F	.657	.678	.659	.653	.649	4.4
DM dig,%	89.1	87.8	87.5	88.3	88.6	1.4

Key Words: Piglets, Wheat Gluten, Digestibility

89 **Optimum particle size of corn and hard and soft sorghum for nursery pigs.** B.J. Healy*, J.D. Hancock, P.J. Bramel-Cox, K.C. Behnke, and G.A. Kennedy, Kansas State University, Manhattan.

A total of 240 weanling pigs (5.3 kg avg BW) was used to determine the effects of particle size of corn and two sorghum genotypes on growth performance. Milling characteristics (production rate and energy required for grinding) of the cereal grains were measured. Treatments were corn, hard endosperm sorghum (HS), and soft endosperm sorghum (SS), milled to particle sizes of 900, 700, 500 and 300 µm (geometric mean), in a 3 x 4 factorial arrangement. All diets were pelleted. As particle size was reduced, production rate (t/h) decreased and energy required to mill (kWh/t) increased. Corn required more energy to mill and had lower production rates than did either sorghum. For d 0 to 7, ADG and G/F increased linearly (P < .05 and P < .002, respectively) as particle size was decreased to 300 µm. This was most evident in the corn treatments with a 35% increase in ADG and a 32% increase in G/F as particle size was reduced from 900 to 300 µm. At 300 µm, ADGs were 267, 247 and 251 g/d for corn, HS and SS, respectively. For d 0 to 14, ADG and G/F increased linearly (P < .009 and P < .002, respectively) as particle size was decreased to 300 µm. At 300 µm, ADGs were 350, 322 and 305 g/d for corn, HS and SS, respectively. For d 0 to 35, G/F responded quadratically (P < .02) with maximum G/F at 500 µm for all grains. Pigs fed diets with corn grew 23% faster and were 7% more efficient (P < .001) than pigs fed diets with sorghum, but when compared at their optimum particle sizes, HS and SS supported ADGs that were 80 and 84% that of corn (438, 349 and 367 g/d for corn, HS and SS, respectively) and G/Fs that were 94% that of corn. These data suggest that response to reduction in particle size is greatest during the first 2 wk postweaning and that optimum particle size increases with age of pigs.

			Gain/feed		
Trt	t/h	kWh/t	0-7	0-14	0-35
Corn					
900	1.76	5.3	.81	.80	.67
700	.97	9.2	.86	.82	.69
500	.63	15.7	.96	.95	.72
300	.65	24.5	1.07	.94	.70
Hard sorghum					
900	5.95	1.7	1.04	.84	.64
700	4.12	2.4	.95	.81	.64
500	2.37	3.8	.94	.85	.67
300	.74	20.1	1.11	.88	.62
Soft sorghum					
900	4.48	1.9	.88	.83	.63
700	3.43	2.5	.92	.82	.65
500	1.89	4.3	.99	.88	.67
300	1.17	15.3	.97	.86	.65
CV	-	-	10.6	7.7	4.5

Key Words: Particle Size, Sorghum, Piglets

90 **Effects of a grind and mix high nutrient density diet on starter pig performance.** J.A. Hansen*, J.L. Nelssen, M.D. Tokach, R.D. Goodband, L.J. Kats, and K.G. Friesen. Kansas State University, Manhattan.

A 28-d growth trial involving 520 crossbred weanling pigs (22±2 d of age, initial wt 6.7 kg) was conducted to determine the influence of pelleting on the growth response of pigs fed a high nutrient density diet (HNDD). Pigs were allotted by weight and sex to 10 replicates with 13 pigs/pen. The experimental design consisted of a 2×2 factorial arrangement with two HNDD diets (HNDD1 or HNDD2) fed in a meal or pelleted form. HNDD1 was a corn-soybean meal based diet containing 20% dried whey, 10% lactose, and 10% porcine plasma protein while HNDD2 was a corn-extruded soy protein concentrate based diet containing 10% plasma protein, 10% lactose, and 10% dried whey. HNDD1 and HNDD2 were formulated to have different flowability. The trial consisted of two phases, with Phase I being d 0 to 9 postweaning and Phase II being d 9 to 28 postweaning. Experimental diets were formulated to 1.5% lysine, .90% Ca, and .80% P and were fed only during Phase I. All pigs were fed a common diet (meal form) during Phase II formulated to 1.25% lysine and containing 10% dried whey and 5% fish meal. During the grower phase (28 to 56 d postweaning), all pigs were fed a common 1.1% lysine, milo-soybean meal diet. There was an interaction (P<.05) between diet form and composition for ADG during Phase I. Pigs fed meal-form HNDD1 had a slightly higher ADG compared to pigs fed the same diet in a pelleted form. However, pigs fed pelleted HNDD2 grew slightly faster than pigs fed the meal-form of the same diet during Phase I. There were no interactions (P>.18) between diet form and composition for G/F or ADFI during Phase I or during the overall experiment. During Phase I, there was no difference in G/F between pigs fed HNDD1 or HNDD2. However, pigs fed pelleted diets were 20% more efficient (P<.01) than meal-fed pigs. Overall (d 0 to 28), pigs fed pelleted diets during Phase I, regardless of composition, were more efficient (P<.01) than pigs fed meal diets during Phase I. Starter diet did not affect ADG in the grower phase. Therefore, the interaction (P<.08) between diet form and composition for d 56 wt was entirely due to differences in performance during the starter phase. In summary, the response in G/F between pigs fed a meal or pelleted HNDD can be used to determine the economic feasibility of either diet form.

		HNDD1		HNDD2		
Item		Pellet	Meal	Pellet	Meal	CV
0-9 d	ADG, g	209	222	227	204	12.6
	G/F	.92	.78	.94	.76	9.9
0-28 d	ADG, g	281	295	304	291	9.0
	G/F	.65	.62	.66	.63	4.3
d 56 wt, kg		31.8	32.6	32.8	32.2	3.9

Key Words: Starter Pigs, Performance, Pelleting