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Abstract

A 35-d growth trial was conducted to determine the influence of different soybean meal processing techniques on starter pig growth performance. From d 0 to 14 after weaning, all pigs were fed a common diet. Then pigs were fed six experimental diets from d 14 to 35 after weaning. Three treatment comparisons were made. Pigs fed a diet containing extruded-expelled soybean meal (SBM) without hulls (Insta-Pro) were compared to those fed solvent-extracted SBM (46.50/0 CP) and 3.21% soy oil. Pigs fed a diet containing extruded-expelled SBM with hulls (Insta-Pro) were compared to those fed a diet containing 44% CP SBM and 4.57% soy oil. Pigs fed a diet containing a second expelled SBM product with hulls (Soyplus) were compared to those fed a diet containing 44% CP SBM and 1.61% soy oil. Pigs fed either Insta-Pro extruded-expelled diet had similar growth performance to pigs fed diets containing conventionally processed soybean meal and added oil. Pigs fed diets containing Soyplus had numerically lower ADG and higher F/G than pigs fed any other treatment. These data suggest that Insta-Pro extruded-expelled SBM can replace conventionally processed SBM and added soy oil on a lysine and energy basis without affecting growth performance.; Swine Day, Manhattan, KS, November 19, 1998

Keywords

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EFFECTS OF DIFFERENT SOYBEAN MEAL PROCESSING TECHNIQUES ON GROWTH PERFORMANCE OF PIGS[1]

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Summary

A 35-d growth trial was conducted to determine the influence of different soybean meal processing techniques on starter pig growth performance. From d 0 to 14 after weaning, all pigs were fed a common diet. Then pigs were fed six experimental diets from d 14 to 35 after weaning. Three treatment comparisons were made. Pigs fed a diet containing extruded-expelled soybean meal (SBM) without hulls (Insta-Pro) were compared to those fed solvent-extracted SBM (46.5% CP) and 3.21% soy oil. Pigs fed a diet containing extruded-expelled SBM with hulls (Insta-Pro) were compared to those fed a diet containing 44% CP SBM and 4.57% soy oil. Pigs fed a diet containing a second expelled SBM product with hulls (Soyplus) were compared to those fed a diet containing 44% CP SBM and 1.61% soy oil. Pigs fed either Insta-Pro extruded-expelled diet had similar growth performance to pigs fed diets containing conventionally processed soybean meal and added oil. Pigs fed diets containing Soyplus had numerically lower ADG and higher F/G than pigs fed any other treatment. These data suggest that Insta-Pro extruded-expelled SBM can replace conventionally processed SBM and added soy oil on a lysine and energy basis without affecting growth performance.

(Key Words: Soybean Meal, Processing, Growth, Starter Pigs.)

Introduction

Extrusion processing has been shown to improve the feeding value of whole soybeans and soybean meal (SBM). The technology of extrusion followed by expelling has led to the development of an SBM product that has a higher fat content than solvent-extracted SBM (approximately 5 vs 1%, respectively). In previous experiments (pg. 49), apparent ileal digestibility of amino acids and DE and ME values were determined for two different dry-extruded-expelled SBM products produced by the Insta-Pro Express™ extruder/press system. Soyplus is another commercially available expelled SBM product. Relatively little information is available on the influence of Soyplus on pig performance. Therefore, the objective of this experiment was to compare the growth performance of pigs fed diets containing extruded-expelled SBM and those fed solvent-extracted SBM formulated to the same digestible lysine and ME concentrations.

Procedures

A total of 216 weanling pigs (initially 13.4 lb and 21 d of age) was used in a 35-d growth trial. Pigs (PIC L-326 × C-22) were weaned into pens and fed 1 lb of a segregated early-wean diet (1.6% lysine) per pig (Table 1). A transition diet (1.45% lysine) was fed for the remainder of the 14 d period (Table 1). On d 12, pigs were weighed and randomly allotted by sex, ancestry, and weight into six replications of six pens. Each pen

[1]The authors thank Insta-Pro International, a division of Triple "F", Des Moines, IA for partially funding this trial and for supplying the extruded, expelled soybean meals used.

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contained six pigs. On d 14, pigs averaged 23.3 lb and were 35 d of age.

Starting on d 14 after weaning, six experimental diets (Table 2) were fed for 21 days. All diets were fed in meal form. Using the apparent ileal digestible amino acid coefficients and ME values determined in previous experiments, diets were formulated to .95% apparent digestible lysine using extruded-expelled SBM with and without hulls. Pigs fed these diets were compared with those fed corresponding corn-46.5% CP (without hulls) or 44% CP (with hulls) solvent-extracted SBM diets with added soy oil. Soy oil was added to equalize ME across comparative treatments. These extruded-expelled SBM products were processed by the Insta-Pro Express™ extruder/press system, using the Model 2500 Insta-Pro Dry extruder and Model 1500 Continuous Horizontal Press. Extruder temperatures and production rates for extruded-expelled SBM with and without hulls were 312 and 316°F and 1,875 and 1,925 lb/hr, respectively. Extruded-expelled SBM products originated from the same batches used in the digestibility and energy determination experiments previously conducted at Kansas State University. A fifth diet containing an alternative expelled SBM source (Soyplus) was formulated to a similar total lysine content (1.10% total lysine). Pigs fed this diet were compared with those fed a 44% CP SBM diet formulated to the same lysine, methionine, Ca, P, and crude fat concentrations. The last two diets were formulated on a calculated total nutrient basis using values obtained from NRC (1998) or chemical analysis, because digestibility values were not available for the alternative expelled SBM product.

Pigs were housed in an environmentally controlled nursery at the Kansas State University Swine Teaching and Research Center. Each pen was 4 × 5 ft and contained one nipple waterer and one four-hole self-feeder to provide ad libitum access to water and feed. Pigs were weighed and feed disappearance was determined weekly to calculate ADG, ADFI, and F/G.

Data were analyzed as a randomized complete block design with pen as the experimental unit. Contrast statements were used to compare the growth performance of pigs fed the different extruded-expelled SBM sources with their respective solvent-extracted SBM and added soy oil diets formulated to the same ME concentration or crude fat level.

Results and Discussion

From d 0 to 14 after weaning when pigs were fed a common diet, ADG, ADFI, and F/G were .70 lb, .88 lb, and 1.25, respectively. For any time period or the cumulative study, pigs fed either extruded-expelled SBM source with or without hulls (Insta-Pro) had similar ($P > .14$) ADG, ADFI, and F/G as those fed either 46.5 or 44% CP SBM diets. From d 0 to 7, 14 to 21, or 0 to 21, pigs fed the alternative expelled soybean meal (Soyplus) had decreased ($P < .05$) ADG and poorer ($P < .004$) F/G than pigs fed 44% CP and soy oil.

Because no differences occurred in growth performance of pigs fed the Insta-Pro extruded-expelled SBM products and the conventionally processed SBM products, the extruded-expelled products can replace conventionally processed SBM and added soy oil in pig diets, based on economic feasibility. Price matrices (Tables 4, 5, 6, 7, 8, and 9) were calculated to determine the price that can be paid for the extruded-expelled products based on conventionally processed SBM and fat prices. Tables 4, 6, and 8 demonstrate the prices on an as-fed basis, and Tables 5, 7, and 9 indicate price relationships on an equal dry matter (88%) basis. Understanding the dry matter content of the products used is very important in the price relationship. The extruded-expelled SBMs contained 95 to 96% dry matter in this experiment compared to 88% dry matter for the conventionally processed SBM. If the products had a similar dry matter content, the value of the extruded-expelled SBM would be lower than when compared on an as-fed basis; however, the value is still greater than that of conventionally processed SBM. Because of its importance in establishing the

price relationship, the dry matter content of solvent-extracted or extruded-expelled soy products should be analyzed.

In conclusion, pigs fed diets containing Insta-Pro Express™ extruded-expelled SBM had similar growth performance to pigs fed diets formulated to similar lysine and ME values using soybean oil and conventionally processed SBM. Pigs fed diets containing Soyplus had lower ADG and higher F/G than pigs on any of the other treatments. These data illustrate the importance of proper processing when using an extruded SBM. The Insta-Pro extruded-expelled SBM products can replace conventionally processed SBM and soybean oil on an equal energy and lysine basis without influencing pig performance. Economics and availability of the products will dictate which SBM source should be used.

Table 1. Diet Composition of Common Diets (As-Fed Basis)[a]

Ingredient, %	SEW	Transition
Corn	39.08	42.43
Dried whey	25.00	20.00
Soybean meal (46.5%)	20.76	26.70
Spray-dried animal plasma	3.50	1.00
Soy oil	3.00	3.00
Select menhaden fish meal	2.50	-
Spray-dried blood meal	2.00	2.00
Monocalcium phosphate	1.14	1.61
Medication	1.00	1.00
Limestone	.72	.91
Zinc oxide	.38	.38
Salt	.25	.30
Vitamin premix	.25	.25
L-Lysine HCl	.15	.15
Trace mineral premix	.15	.15
DL-Methionine	.12	.12
Calculated analysis, %		
Crude protein	22.60	21.51
Lysine	1.60	1.45
Methionine	.45	.43
Ca	.90	.90
P	.80	.80

[a]One lb per head of SEW diet was fed, then pigs were fed the Transition diet for the remainder of the 14 d period.

Table 2. Diet Composition of Experimental Diets (As-Fed Basis) for Six Treatments (T1-T6)

	Soybean Meal Source					
Ingredent, %	Extruded, expelled SBM without hulls[a] T1	46.5% CP SBM T2	Extruded, expelled SBM with hulls[a] T3	44% CP SBM T4	Soyplus[b] T5	44% CP SBM T6
Corn	66.01	60.18	64.37	55.66	57.24	58.79
Extruded-expelled SBM						
Without hulls	29.60	-	-	-	-	-
With hulls	-	-	31.25	-	-	-
46.5% CP SBM	-	32.23	-	-	-	-
44% CP SBM	-	-	-	35.49	-	35.34
Soyplus	-	-	-	-	38.50	-
Soy oil	-	3.21	-	4.57	-	1.61
Monocalcium phosphate	1.54	1.55	1.54	1.49	1.39	1.46
Limestone	1.10	1.08	1.09	1.04	1.12	1.05
Medication	1.00	1.00	1.00	1.00	1.00	1.00
Salt	.35	.35	.35	.35	.35	.35
Vitamin premix	.25	.25	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15	.15	.15
Calculated analysis						
CP, %	20.42	20.19	20.19	20.73	20.98	20.92
Crude fat, %	4.31	5.92	4.04	7.17	4.32	4.32
ME, Mcal/lb	1.56	1.56	1.55	1.55	-	-
Lysine, total, %	1.09	1.11	1.09	1.10	1.10	1.10
Lysine, available, %	.95	.95	.95	.95	-	-
Methionine, %	.32	.32	.31	.31	.33	.32
Ca, %	.80	.80	.80	.80	.80	.80
P, %	.70	.70	.70	.70	.70	.70

[a]Extruded-expelled, soybean meal products were processed using the Insta-Pro Express™ extruder press system.

[b]Soyplus is a commercially available, expelled, soybean meal product.

Table 3. Influence of Different Soybean Meal Processing Techniques on Growth Performance of the Weanling Pig[a,b]

	Soybean Meal Source									
	Extruded-expelled SBM with no hulls	46.5% CP SBM	Extruded-expelled SBM with hulls	44% CP SBM	Soyplus	44% CP SBM		Contrasts		
Item	T1	T2	T3	T4	T5	T6	CV	1 vs 2	3 vs 4	5 vs 6
Day 0 to 7										
ADG, lb	.88	.94	.92	.94	.83	1.00	7.89	.17	.65	.0003
ADFI, lb	1.54	1.54	1.53	1.57	1.56	1.62	7.72	.96	.56	.41
F/G	1.75	1.66	1.66	1.67	1.89	1.62	6.84	.17	.84	.0006
Day 7 to 14										
ADG, lb	1.24	1.22	1.20	1.14	1.17	1.25	9.67	.83	.40	.25
ADFI, lb	2.07	2.05	2.04	2.00	2.11	2.13	7.93	.83	.66	.84
F/G	1.67	1.68	1.71	1.80	1.81	1.71	8.83	.94	.35	.26
Day 14 to 21										
ADG, lb	1.53	1.51	1.56	1.51	1.39	1.53	7.54	.83	.46	.05
ADFI, lb	2.76	2.70	2.71	2.80	2.84	2.71	7.38	.63	.46	.26
F/G	1.82	1.78	1.74	1.87	2.06	1.78	8.10	.71	.14	.004
Day 0 to 21										
ADG, lb	1.21	1.22	1.22	1.20	1.13	1.25	3.62	.71	.36	.0001
ADFI, lb	2.11	2.09	2.08	2.12	2.16	2.13	4.61	.69	.55	.65
F/G	1.74	1.71	1.71	1.78	1.92	1.71	5.08	.53	.19	.0004

[a]A total of 216 pigs 14 d after weaning (initially 23.25 lb and 35 d of age), six pigs per pen, and six pens per treatment (T1-T6).
[b]Pigs were fed a common diet for the first 14 d after weaning with overall ADG=.70 lb, ADFI=.88 lb, and F/G=1.25.

Table 4. Price Matrix for Extruded-Expelled Soybean Meal without Hulls Compared to Soybean Meal on an As-Fed Basis[ab]

Fat Price	Soybean Meal (46.5% CP) Price ($/ton)										
($/lb)	150	160	170	180	190	200	210	220	230	240	250
.15	181	192	202	213	224	235	246	257	268	279	290
.20	192	202	213	224	235	246	257	268	279	289	300
.25	202	213	224	235	246	257	268	279	289	300	311
.30	213	224	235	246	257	268	279	289	300	311	322
.35	224	235	246	257	268	279	289	300	311	322	333

[a]Assuming corn price is $2.15/bu. Values represent the highest price that can be paid for extruded-expelled soybean meal without hulls to be economically feasible, compared to given soybean meal and fat prices.
[b]Dry matter contents of soybean meal and extruded-expelled soybean meal in this study were 88 and 96%, respectively.

Table 5. Price Matrix for Extruded-Expelled Soybean Meal without Hulls Compared to Soybean Meal on an Equal Dry Matter Basis (88%)[a]

Fat Price	Soybean Meal (46.5% CP) Price, ($/ton)										
($/lb)	150	160	170	180	190	200	210	220	230	240	250
.15	166	176	186	196	206	216	226	236	246	256	266
.20	176	186	196	206	216	226	236	246	255	265	275
.25	186	196	206	216	226	235	245	255	265	275	285
.30	196	206	215	225	235	245	255	265	275	285	295
.35	205	215	225	235	245	255	265	275	285	295	305

[a]Assuming corn price is $2.15/bu. Values represent the highest price that can be paid for extruded-expelled soybean meal without hulls to be economically feasible, compared to given soybean meal and fat prices.

Table 6. Price Matrix for Extruded-Expelled Soybean Meal with Hulls Compared to Soybean Meal on an As-Fed Basis[ab]

Fat Price	Soybean Meal (44% CP) Price ($/ton)										
($/lb)	150	160	170	180	190	200	210	220	230	240	250
.15	192	204	215	226	238	249	260	272	283	294	306
.20	207	218	230	241	252	264	275	286	298	309	320
.25	221	233	244	255	267	278	289	301	312	323	335
.30	236	247	259	270	281	293	304	315	327	338	349
.35	251	262	273	285	296	307	319	330	341	353	364

[a]Assuming corn price is $2.15/bu. Values represent the highest price that can be paid for extruded-expelled soybean meal with hulls to be economically feasible, compared to given soybean meal and fat prices.
[b]Dry matter content of soybean meal and extruded-expelled soybean meal in this study was 88 and 94.6%, respectively.

Table 7. Price Matrix for Extruded-Expelled Soybean Meal with Hulls Compared to Soybean Meal on an Equal Dry Matter Basis (88%)[a]

Fat Price	Soybean Meal (44% CP) Price ($/ton)										
($/lb)	150	160	170	180	190	200	210	220	230	240	250
.15	179	189	200	211	221	232	242	253	263	274	284
.20	192	203	214	224	235	245	256	266	277	287	298
.25	206	217	227	238	248	259	269	280	290	301	311
.30	220	230	241	251	262	272	283	293	304	314	325
.35	233	244	254	265	275	286	296	307	318	328	339

[a]Assuming corn price is $2.15/bu. Values represent the highest price that can be paid for extruded-expelled soybean meal without hulls to be economically feasible, compared to given soybean meal and fat prices.

Table 8. Price Matrix for Extruded-Expelled Soybean Meal with Hulls Compared to Soybean Meal on an As-Fed Basis[ab]

Fat Price	Soybean Meal (46.5%) Price ($/ton)							
($/lb)	150	160	170	180	190	200	210	220
.15	175	186	196	206	216	227	237	247
.20	186	196	206	216	227	237	247	258
.25	196	206	216	227	237	247	258	268
.30	206	216	227	237	247	258	268	278
.35	216	227	237	247	258	268	278	289

[a]Assuming corn price is $2.15/bu. Values represent the highest price that can be paid for extruded-expelled soybean meal without hulls to be economically feasible, compared to given soybean meal and fat prices.
[b]Dry matter contents of soybean meal and extruded-expelled soybean meal in this study were 88 and 96%, respectively.

Table 9. Price Matrix for Extruded-Expelled Soybean Meal with Hulls to Soybean Meal on an Equal Dry Matter Basis (88%)[a]

Fat Price	Soybean Meal (46.5%) Price ($/ton)							
($/lb)	150	160	170	180	190	200	210	220
.15	163	173	182	192	201	211	221	230
.20	173	182	192	201	211	221	230	240
.25	182	192	201	211	221	230	240	249
.30	192	201	211	220	230	240	249	259
.35	201	211	220	230	240	249	259	268

[a]Assuming corn price is $2.15/bu. Values represent the highest price that can be paid for extruded-expelled soybean meal without hulls to be economically feasible, compared to given soybean meal and fat prices.