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INFLUENCE OF SOYBEAN MEAL VARIETY AND PROCESSING TEMPERATURE ON THE GROWTH PERFORMANCE OF PIGS FROM 25 TO 45 LB [1]

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Summary

Three hundred ninety high-lean growth pigs were used in a 17 d growth assay from 25 to 45 lb. Treatments consisted of soybean meal (SBM) from either high-oleic or check-line soybean varieties processed under pilot-plant processing conditions at four temperature ranges (80-85, 85-90, 90-95, 100-105°C). Positive and negative controls were made using commercially obtained SBM (46.5% CP). Total dietary lysine was maintained at .95% except for the positive control (1.30%). Pigs fed commercial SBM with 1.30% dietary lysine had increased ADG and better F/G than pigs fed any other treatment. A SBM variety × processing temperature interaction was observed for ADG and F/G for each growth period. The interaction likely resulted from improvement in ADG and F/G with high-oleic SBM, but not the check-line SBM, as processing temperature increased. Pigs fed high-oleic SBM had improved ADG and F/G throughout all growth periods as processing temperature increased, so pigs fed high-oleic SBM processed at 80-85°C had poorer growth performance than pigs fed any other treatment. These results indicate that pigs fed high-oleic SBM processed above 80-85°C have similar performance to pigs fed SBM from other varieties.

(Key Words: High-Oleic Soybeans, Processing Temperature, Growth, Nursery Pigs.)

Introduction

Grains and oilseeds are being improved genetically to provide a specific trait or traits for quality or agronomic reasons. Changes in nutrient content and/or composition can provide direct improvements in diet cost and growth efficiency for the swine industry. Increasing the oleic acid content of soybeans may increase demand for soybean oil used in restaurant and home food preparation. As demand for high-oleic soybean oil increases, larger amounts of soybean meal (SBM) from high-oleic soybeans will be produced. However, potential differences in SBM processing conditions to maximize oil extraction from high-oleic soybeans also may affect growth performance of pigs. Additionally, it is unknown if SBM produced from high-oleic soybeans will provide similar levels of growth performance as SBM from other more traditional varieties. Therefore, our objective was to determine the growth performance of pigs fed either high-oleic soybean meal or a standard check-line SBM processed under pilot plant conditions using different temperature ranges.

Procedures

Three hundred and ninety high-lean growth pigs (Newsham Hybrids) were blocked by weight (initially 22.3 lb and 35 d of age) and allotted to one of 10 dietary treatments. There were four or five pigs per pen (equal number of pigs per pen by block) and

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eight replicate pens per treatment. The experimental diets consisted of a 2 × 4 factorial arrangement with main effects including SBM variety (high-oleic and check-line SBMs) and processing temperature (80-85, 85-90, 90-95, and 100-105°C) with positive and negative controls using commercially obtained SBM (46.5% CP).

The high-oleic and check-line SBMs were processed by Dupont using commercial pilot-plant processing conditions with standard hexane processing. Conditioning steam and top tray temperature were varied, resulting in the four different processing conditions. The commercial SBM was obtained through normal industry channels by the KSU Animal Sciences and Industry Feed Mill.

All diets were corn-SBM-based. Analyzed total amino acid values for the SBMs were used to formulate diets to .95% lysine, except the positive control diet, which was formulated to 1.30% lysine. All pigs were fed common SEW, transition, and phase 2 diets according to KSU recommendations until 21 d postweaning, when they were placed on their respective treatments. All experimental diets were corn-SBM-based (Table 1). The positive control (1.30% lysine) contained .15% lysine HCl to minimize the use of additional SBM to meet the higher lysine level, while maintaining all other amino acids at or above an ideal amino acid pattern relative to lysine. All diets in this experiment were fed in meal form from d 21 to 38 postweaning.

Pigs were housed in the KSU segregated early-weaning nursery in 4 × 4 ft pens. They were allowed ad libitum access to feed and water through a four-hole dry feeder and one nipple waterer per pen. The pigs were weighed and feed disappearance was measured at 7 d intervals and at the termination of the trial to determine ADG, ADFI, and F/G.

The data were analyzed as a randomized complete block design in a 2 × 4 factorial arrangement. Pigs were blocked by initial weight with pen as the experimental unit. Analysis of variance was performed using general linear model procedures with linear and quadratic polynomial contrasts to determine the effects of increasing processing temperature within variety on pig performance. Nonorthogonal contrasts also were analyzed to determine if differences in performance existed between the means of individual Dupont varieties or between the Dupont varieties and the positive or negative control.

Results

Pigs fed the positive control diet formulated to 1.30% dietary lysine had increased ADG and better F/G than pigs fed any other treatment ($P<.05$; Table 2). A SBM variety × processing temperature interaction was observed for ADG and F/G during each growth period ($P<.05$). Average daily gain and F/G improved during each growth period, with the exception of d 0 to 7 ADG, as processing temperature increased (linear, $P<.02$; quadratic, $P<.01$). However, the improvements in ADG and F/G in Table 2 were primarily results of pigs fed diets containing high-oleic SBM having improved ADG and F/G throughout all growth periods as processing temperature increased (quadratic $P<.01$; Table 3). Thus, pigs fed diets containing high-oleic SBM processed at 80-85°C had poorer growth performance than pigs fed any other treatment. The difference between pigs fed diets containing high-oleic SBM processed at 80-85°C and pigs fed any other treatment at the same lysine level also would explain the observed interactions associated with the main effects of SBM variety and processing temperature. From d 0 to 7 and d 0 to 17, pigs fed diets containing check-line SBM had decreased performance compared to pigs fed the negative control diets (.95% lysine) containing commercial SBM ($P>.05$). In contrast, from d 7 to 14 and d 14 to 17 pigs fed diets containing check-line SBM had similar performance to pigs fed the negative control diet containing commercial SBM ($P>.17$).

Discussion

These results indicate that .95% total dietary lysine is insufficient to maximize growth performance of 25 to 50 lb lean-growth potential pigs. This is similar to results reported previously in the 1994 KSU Swine Day Report of Progress, which indicated that growth performance of 25 to 50 lb high health pigs was maximized between 1.05 and 1.15% apparent digestible lysine. These diets, except the positive control, were formulated to a lower lysine level so that any effect of amino acid availability related to soybean variety or processing temperature on growth performance would be readily apparent.

These results also indicate that pigs fed diets containing high-oleic SBM have similar performance when compared to pigs fed diets containing either commercial SBM or check-line SBM formulated to similar lysine levels, when the high-oleic SBM is processed above 80-85°C. It seems unlikely that pigs fed diets containing high-oleic SBM processed at 80-85°C should have dramatically different growth performance than pigs fed diets containing check-line SBM processed at 80-85°C. A previous experiment by Dupont with chickens designed similarly to this experiment observed no differences in growth performance with various processing temperatures. Thus, difficulties in control using pilot-plant processing conditions probably contributed to the decreased performance of pigs fed diets containing high-oleic SBM processed at 80-85°C when compared to other treatments at similar dietary lysine levels. The observed differences in growth performance between the negative control treatments containing commercial SBM and the check-line SBM treatments were inconsistent across growth periods and do not represent large numerical differences in performance.

Table 1. Diet Composition (As-Fed Basis)[a] %

Item	Commercial SBM		High-Oleic SBM	Check-Line SBM
Dietary lysine, %	1.30	.95	.95	.95
Corn	58.10	66.67	67.01	67.21
Soybean meal, 46.5% CP	34.55	26.10	---	---
High-oleic soybean meal	---	---	25.75	---
Check-line soybean meal	---	---	---	25.55
Soybean oil	3.00	3.00	3.00	3.00
Monocalcium phosphate	1.57	1.73	1.74	1.74
Limestone	.80	.75	.75	.75
Medication[b]	1.00	1.00	1.00	1.00
Salt	.35	.35	.35	.35
Vitamin premix	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15
Lysine HCl	.15	---	---	---

[a]All diets were formulated to contain .9% Ca and .8% P.
[b]Provided 50 g/ton carbadox.

Table 2. Effects of Soybean Meal Variety with 1.30 or .95% Lysine and Four Processing Temperatures (°C) on 25 to 45 lb Pig Performance[a]

	Commercial		High-Oleic (.95%)				Check-Line (.95%)					Probability[b]		
Item	1.30	.95	80-85	85-90	90-95	100-105	80-85	85-90	90-95	100-105	CV	linear	quadratic	SBM × Temp.[c]
Day 0 to 7														
ADG, lb[d]	1.23	.99	.70	.95	.84	.92	1.00	.87	.91	.87	9.68	.44	.37	.01
ADFI, lb	1.76	1.69	1.67	1.61	1.54	1.63	1.74	1.64	1.66	1.68	6.75	.40	.01	.68
F/G[d]	1.44	1.71	2.38	1.72	1.84	1.79	1.75	1.92	1.82	1.95	8.83	.02	.01	.01
Day 7 to 14														
ADG, lb[d]	1.43	1.21	.84	1.11	1.15	1.09	1.15	1.16	1.13	1.19	9.06	.01	.01	.01
ADFI, lb	2.13	2.11	2.00	2.03	2.00	2.01	2.14	2.05	2.05	2.13	5.57	.89	.13	.38
F/G[d]	1.49	1.74	2.42	1.84	1.74	1.86	1.86	1.79	1.82	1.80	8.86	.01	.01	.01
Day 14 to 17														
ADG, lb[d]	1.53	1.31	.70	1.33	1.29	1.32	1.23	1.35	1.35	1.12	21.9	.07	.01	.01
ADFI, lb	2.52	2.45	2.18	2.51	2.33	2.41	2.43	2.47	2.40	2.41	8.60	.44	.31	.23
F/G[d]	1.69	1.92	3.56	1.96	1.83	1.86	2.03	1.86	1.87	2.28	26.7	.01	.01	.02
Day 0 to 17														
ADG, lb[d]	1.36	1.13	.76	1.08	1.04	1.05	1.10	1.06	1.07	1.04	7.33	.01	.01	.01
ADFI, lb	2.02	1.98	1.89	1.92	1.85	1.91	2.02	1.94	1.94	1.98	5.27	.93	.11	.44
F/G[d]	1.50	1.75	2.49	1.80	1.78	1.83	1.84	1.83	1.81	1.91	5.45	.01	.01	.01

[a]A total of 390 pigs was weaned at 14 d of age, and weight average was 9.3 lb. They were fed a common three-stage diet series until being placed on test at d 21 postweaning. At trial initiation, the average pig weight was 22.3 lb. The average ending weight was 39.8 lb.

[b]The linear and quadratic probabilities on this table are for the main effect of processing temperature, without regard for variety.

[c]Main effects of Dupont soybean meal variety by processing temperature.

[d]Contrast of 1.30% dietary lysine SBM treatment vs. all other treatments (P<.05).

Table 3. Orthogonal Contrasts of Linear and Quadratic Effects within Soybean Meal Variety and Nonorthogonal Contrasts of Commercial Soybean Meal vs. High-Oleic Soybean Meal[b] and Check-Line Soybean Meal[c]

	Probability (P<)							
	HOSBM		HOSBM vs. .95% Lysine	HOSBM vs.	CLSBM		CLSBM vs. 95% Lysine	1.13% Lysine SBM vs. .95% Lysine
Item	linear	quadratic	SBM	CLSBM	linear	quadratic	SBM	SMB
D 0 to 7								
ADG, lb	.02	.01	.01	.01	.06	.25	.03	.01
ADFI, lb	.53	.02	.10	.02	.61	.22	.87	.17
F/G	.01	.01	.01	.08	.11	.74	.02	.01
D 7 to 14								
ADG, lb	.01	.01	.01	.01	.51	.54	.17	.01
ADFI, lb	.95	.98	.02	.01	.90	.03	.67	.36
F/G	.01	.01	.01	.01	.48	.61	.26	.01
D 14 to 17								
ADG, lb	.01	.01	.18	.16	.29	.13	.66	.14
ADFI, lb	.15	.14	.27	.16	.76	.99	.83	.31
F/G	.01	.01	.09	.04	.13	.07	.70	.52
D 0 to 17								
ADG, lb	.01	.01	.01	.01	.27	.89	.04	.01
ADFI, lb	.79	.55	.03	.01	.76	.15	.72	.16
F/G	.01	.01	.01	.01	.18	.22	.02	.01

[a]Commercial soybean meal is abbreviated as SBM.
[b]High-oleic soybean meal is abbreviated as HOSBM.
[c]Check-line soybean meal is abbreviated as CLSBM.