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Extruded-Expelled Soybean Meal for Pigs

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Summary and Implications

A review of the value of extruded-expelled soybean meal (ESBM) for pigs was conducted. Results from two studies where the growth performance of weanling pig was evaluated suggested that the feeding value of ESBM relative to solvent-extracted soybean meal (SSBM) is not consistent. The economic value of ESBM relative to SSBM was estimated from pig performance data and the metabolizable energy content of corn, ESBM, and SSBM. When ESBM is used to replace 44% CP SSBM in growing-finishing pig diets, it is worth 0 to $36.29 per ton more than 44% CP SSBM, assuming 44% CP SSBM and corn cost $175/ton and $2/bushel, respectively. When ESBM is used to replace 46.5% CP SSBM in growing-finishing pig diets, it is worth 0 to $18.45 per ton more than 46.5% CP SSBM, assuming 46.5% CP SSBM and corn cost $175/ton and $2/bushel, respectively. Due to the higher fat content of ESBM, there is less dust generated when ESBM is handled compared to SSBM. Caution should be exercised when considering the purchase of ESBM due to the apparent quality variation until further evaluations on ESBM are completed.

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Introduction

Solvent-extracted soybean meal (SSBM) containing 44 to 46.6% CP and 1.5 to 3% fat is the most common source of supplemental protein used in pig diets. It is widely available and often produces the most economical gain when compared with other protein sources. Extruded-expelled soybean (ESBM), containing 43% CP and 7% fat, has become available in Nebraska recently. Previous research has shown that extruding raw soybeans makes them an acceptable source of supplemental protein for pigs. In addition, extrusion increases the dry matter and nitrogen digestibility of SSBM. The expeller reduces the oil content of extruded soybeans from about 18 to 7%. The objective of this study was to evaluate the economics of ESBM as a substitute for SSBM in swine diets. Because of limited research results available on ESBM, this is a progress report.

Nutrient Composition

A comparison of the nutrient composition of SSBM and ESBM is shown in Table 1. ESBM contains less total lysine than the SSBM, but similar concentrations of digestible lysine. Previous research at Kansas State University has shown that the digestibility of lysine in one source of ESBM is about two percentage points higher than the lysine in SSBM. The metabolizable energy (ME) level in ESBM is significantly higher than that in SSBM. The higher ME level in ESBM is due to two factors: the higher fat content of the meal and the extrusion process itself. Extrusion apparently increases the ME of ESBM because the ME of ESBM is higher than that predicted from its chemical composition. Diets made from ESBM contain 1 to 1.5% added fat (20 to 30 lb of added fat per ton of feed).

Performance Results

In the 1998 Nebraska Swine Report, the results of a study in which SSBM was compared to ESBM in the diet of segregated early weaned pigs were presented. In that study, diets containing ESBM and SSBM were formulated to contain the same concentration of ME and digestible lysine. In addition, the diets were formulated to contain the same lysine contribution from either ESBM or SSBM. Pigs fed the diet containing ESBM grew 22% slower and were 16% less efficient than pigs fed a diet containing SSBM during a 14-day study. In addition, energy, dry matter, and crude protein digestibilities were lower for the ESBM diet than the SSBM diet. The results of this study suggest that ESBM has a lower feeding value (84% if based on feed efficiency) than SSBM. In contrast, researchers at Kansas State University used a different source of ESBM and found the performance of weanling pigs fed diets containing ESBM was similar to that of those fed diets containing SSBM and added fat to equalize dietary energy density. They formulated the diets using the apparent ileal digestible amino acid coefficients and ME values for SSBM and ESBM obtained from a previous experiment. The results from these studies suggests there is significant variation in the feeding value of ESBM for pigs depending on the source of the ESBM.

Economic Considerations

We are not aware of any published research where the performance of pigs fed ESBM-based diets was compared to those fed SSBM-based diets that did not contain added fat to equalize dietary energy density. Nor are we aware of any economic analyses that producers who are not adding fat to SSBM-based diets can use to evaluate whether ESBM or SSBM is a better buy.

To calculate the economic value of ESBM as a replacement for either 44% CP or 46.5% CP SSBM in growing-finishing pig diets, 12 corn-based diets were formulated. All the diets were formulated using the ME and digestible lysine values for corn, SSBM and ESBM shown in Table 1. In addition, all diets were formulated to contain .81, .73, .65, and .55 % digestible lysine for pigs growing from 45 to 80, 80 to 130, 130 to 190, and 190 to 250 lb, respectively. Four diets were formulated with 43% CP ESBM and the level of ME was calculated for each diet. Four additional diets were made with 44% CP SSBM, but fat (3,616 kcal ME/lb) was added to match the ME level in the 43% CP ESBM diets. Likewise, four diets were made with 46.5% CP SSBM, but fat was added to match the ME level in the 43% CP ESBM diets. The percent of fat that was added to the 44% CP and 46.5% CP SSBM-based diets was 3.3 and 2.3, respectively. It was necessary to calculate the amount of added fat it would require to equalize energy density in the SSBM-based diets to the ESBM-based diets so we could estimate the improvement in feed efficiency of ESBM fed pigs. Based on previous research,

Table 1. Average nutrient composition of solvent extracted soybean meal (SSBM) and extruded-expelled soybean meal (ESBM).

Item	44% CP SSBM[a]	46.5% CP SSBM[b]	43% CP ESBM[c]
Dry matter, %	89	90	94
Lysine, %	2.83	3.00	2.70
Digestible lysine, %	2.41	2.55	2.45
Metabolizable energy, kcal/lb	1,445	1,535	1,741
Fat, %	1.5	3.0	7.0
NDF, %[d]	13.3	8.9	
Phosphorus, %	.65	.69	
Available phosphorus, %	.20	.16	

[a]National Research Council (1998).
[b]Adapted from NRC (1998).
[c]Dry matter, lysine, and fat values from Bruning Grain, Bruning, NE and metabolizable energy value from Kansas State University research.
[d]Neutral detergent fiber.

Table 2. Estimated added value ($/ton) of extruded-expelled soybean meal compared to 44% CP solvent-extracted soybean meal (SSBM) at various corn and SSBM prices.[a]

	Corn, $/bushel		
44% SSBM, $/ton	1.50	2.00	2.50
125	0 to 27.55	0 to 31.66	0 to 35.77
175	0 to 32.18	0 to 36.29	0 to 40.40
225	0 to 36.81	0 to 40.92	0 to 45.04

[a]A range is presented to compensate for quality variation.

Table 3. Estimated added value ($/ton) of extruded-expelled soybean meal compared to 46.5% CP solvent-extracted soybean meal (SSBM) at various corn and SSBM prices.[a]

	Corn, $/bushel		
46.5% SSBM, $/ton	1.50	2.00	2.50
125	0 to 14.38	0 to 18.25	0 to 22.12
175	0 to 14.59	0 to 18.45	0 to 22.32
225	0 to 14.79	0 to 18.66	0 to 22.53

[a]A range is presented to compensate for quality variation.

we assumed that feed efficiency is improved by 2 % for each 1% increment of added fat to the diet. Thus, growing-finishing pigs fed diets containing 43% CP ESBM should have a 6.6 % (3.3% x 2) and 4.6 % (2.3% x 2) better feed efficiency than pigs fed 44% CP and 46.5% CP SSBM-based diets without fat, respectively. An overall feed efficiency rate of 3.0 lb feed per lb of gain and an average daily gain of 1.8 lb was assumed for pigs fed the diets made from SSBM. The price of corn and SSBM were varied, whereas the price of other ingredients were at current market prices. The cost savings realized from improved feed efficiency were attributed to ESBM. No credit was given for better dust control or for any improvement in daily gain that may occur. To reflect results from the trial where ESBM in the diet reduced daily gain and feed efficiency, we assumed ESBM had no additional value compared to SSBM.

The estimated value of ESBM compared to 44% CP and 46.5 % CP SSBM in swine diets is presented in Tables 2 and 3, respectively. The estimated value of ESBM is represented as a range for each corn and SSBM price combination to reflect possible quality variation in ESBM. We intend for the range in prices to reflect the minimum and maximum value of ESBM compared to SSBM.

To use the tables locate the on-farm price of corn and SSBM. For example, assume the on-farm value of corn is $2/bushel and the on-farm cost of 46.5% CP soybean meal is $175/ton (Table 3). The table indicates that you could afford to pay up to $18.45 more for one ton of ESBM.

The premium you can pay for ESBM increases as corn and SSBM prices increase. The premiums are larger and they increase more rapidly for each $50 per ton increase in the price of 44% CP SSBM than for 46.5% CP SSBM, because we expect a larger improvement in feed efficiency (6.6 vs 4.6%) when ESBM is substituted for 44% CP SSBM than when 46.5% CP SSBM is replaced in the diet. Also, there is a significant range in the added value of ESBM for each corn and SSBM price combination. This variation is driven by an apparent difference in the feeding value of ESBM for pigs. These results show the need for additional research to determine if the extent of the quality variation used to calculate the premiums in this paper is representative of ESBM that is available to pork producers.

Dust Control and Flowability

Due to the higher fat content of ESBM, there is less dust generated when ESBM is handled compared to SSBM. In general, aerial dust concentration may be reduced 40 to 55% when ESBM is used to manufacture swine diets compared to SSBM. However, after the ESBM is included in the diet, it would be expected to reduce aerial dust by 10 to 15%. Reducing dust levels may improve the health status of people who work in feed mills and confinement buildings. Extruded-expelled soybean meal also flows from bulk bins easier than SSBM. The economic benefit of reduced dust level and better flowability may be significant in some situations. These attributes were not considered in our economic analyses.

Conclusion

Based on the limited amount of published data, it appears there is significant variation in the quality of ESBM for pigs. Therefore, it is difficult to provide accurate guidelines on what the value of ESBM is relative to SSBM. Producers are advised to use caution when buying ESBM. Efforts to more fully understand the value of ESBM in swine diets will be the focus of future research at the University of Nebraska.

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