January 1998

Dietary Fiber in Sow Gestation Diets — An Economic Analysis

Duane Reese
University of Nebraska - Lincoln, dreese1@unl.edu

Dietary Fiber in Sow Gestation Diets — An Economic Analysis

Duane E. Reese[1]

Summary and Implications

A previous research summary indicated sows fed high-fiber diets during gestation weaned an average of .3 more pigs/litter than sows fed lower-fiber, grain-based diets. Gestation diets containing 45 percent wheat midds, 20 percent soybean hulls, 25 percent alfalfa meal, 30 percent sugar beet pulp or 40 percent oats provide similar amounts of neutral detergent fiber (NDF), which should be sufficient to increase litter size weaned by .3 pigs per litter. An economic analysis suggests feeding a diet containing these sources of NDF would increase sow feed ingredient costs from 0 to $3.30/sow/period (110 days) compared to feeding a corn-soybean meal-based diet. However, income generated from the additional pigs weaned/litter would, more than likely, offset as much as a $6 increase in sow feed ingredient cost that could be associated with feeding sows high-fiber diets during gestation. Producers may be able to improve their operation's profitability and perhaps sow welfare by using fibrous feed ingredients in sow gestation diets.

Introduction

Gestating sows are well-suited to utilize high-fiber, low energy-dense diets. They utilize fiber better than growing pigs and they have a high feed intake capacity relative to their gestational energy requirement. Results from a review of 24 research studies on the effects of providing high-fiber diets to sows during gestation appeared in the 1997 Nebraska Swine Report. The most significant finding in that review: sows fed high-fiber diets during gestation weaned .3 more pigs/litter on the average than did sows fed low-fiber, con-

(Continued on next page)

trol diets. The most recent study included in that review showed feeding wheat straw during gestation resulted in .7 more pigs weaned per litter. It seems sows should consume 350 to 400 grams/day of neutral detergent fiber (NDF) during gestation to increase the number of pigs weaned/litter.

There may be situations which justify using fibrous feed ingredients in sow gestation diets. When making a decision to add fiber to gestation diets, it is important to conduct an economic analysis. The economic analysis presented in this paper does not include costs associated with ingredient storage, feed handling and manure disposal.

Procedures

Six gestation diets were formulated (Table 1). One diet was corn-soybean meal-based and the others contained either 45 percent wheat midds, 20 percent soybean hulls, 25 percent alfalfa meal, 30 percent sugar beet pulp or 40 percent oats. All diets were designed to provide sows with similar daily amounts of metabolizable energy, lysine, calcium and available phosphorus by altering ingredient composition and daily feed intake. The metabolizable energy values used for wheat midds, soybean hulls, alfalfa meal and beet pulp were obtained from research trials where sows were used as the experimental animal. Each of the high-fiber diets were formulated to provide about 350 grams/day of NDF when fed at 6.1 Mcal of metabolizable energy per sow per day. Total sow feed ingredient cost and the total amount of feed to be consumed were estimated for each diet. A standard feeding period of 110 days was assumed.

Table 1. Diets for gestation sows

Ingredient	Diet					
	Corn-soy	45% Wheat midds	20% Soybean hulls	25% Alfalfa meal	30% Beet pulp	40% Oats
Corn	1689	933	1352	1339	1194	943
Soybean meal, 46.5% CP	220	85	165	95	131	173
Wheat midds		900				
Soybean hulls			400			
Alfalfa meal				500		
Beet pulp					600	
Oats						800
Dicalcium phosphate, 18.5% P	55	35	52	43	51	48
Limestone	13	24	8		1	13
Salt	10	10	10	10	10	10
Vitamin/trace mineral mix	13	13	13	13	13	13
Daily intake						
Feed, lb	4.1	4.4	4.4	4.6	4.6	4.5
Metabolizable energy, Mcal[a]	6.1	6.1	6.1	6.1	6.1	6.1
Lysine, g	10.3	11.0	11.0	11.0	11.0	11.1
Calcium, g	16.9	18.5	17.2	17.8	16.6	17.2
Phosphorus, g	15.0	17.4	15.0	14.2	14.5	15.5
Phosphorus (available), g	10.4	10.5	10.5	10.4	10.5	10.6
Neutral detergent fiber, g	140	355	350	375	355	344
Calculated analysis						
Lysine, %	.55	.55	.55	.53	.53	.54
Calcium, %	.90	.93	.86	.86	.80	.85
Phosphorus, %	.80	.87	.75	.66	.70	.76

[a]Metabolizable energy values (Mcal/lb) for corn, soybean meal, wheat midds, soybean hulls, alfalfa meal, beet pulp, and oats were 1.55, 1.54, 1.35, 1.07, .9, 1.05, and 1.24, respectively.

Table 2. Feed ingredient costs and feed usage estimates for various gestation feeding programs

Item	Diet					
	Corn-soy	Wheat midds	Soybean hulls	Alfalfa meal	Beet pulp	Oats
Feed cost/ton, $[a]	122.00	116.00	118.00	124.00	122.00	112.00
Feed cost/sow/period, $[a,b]	27.61	27.94	28.27	30.91	30.36	27.61
Gestation feed usage, lb/sow/period[b]	450	485	485	505	505	495

[a] Ingredient prices used were corn $2.50/bu; soybean meal $225/ton; wheat midds $102/ton; soybean hulls $88/ton; alfalfa meal $135/ton; beet pulp $110/ton; oats $1.40/bu; dicalcium phosphate $275/ton; and limestone $100/ton.
[b]Period = 110 days; Daily metabolizable energy intake = 6.1 Mcal.

Table 3. Increase in number of pigs weaned/litter to offset extra sow feed ingredient expense

Extra sow feed expense, $/sow/period[a]	Value of a pig at weaning, $/pig				
	20	25	30	35	40
2	.11	.09	.07	.06	.06
4	.23	.18	.15	.13	.11
6	.34	.27	.23	.19	.17

[a]Period = 110 days.

Results and Conclusions

As expected, there was cost variation of the complete diets ($/ton) and in the total sow feed ingredient expense ($/sow/110-day period) among the six feeding programs (Table 2). The total feed cost per-sow per-period for the diets with various sources of additional fiber was up to $3.30/sow higher than that for the corn-soybean meal diet. The cost of feeding the 40 percent oat diet was the same as for the corn-soybean meal-based diet. Expense incurred from feeding the 45 percent wheat midds or 20 percent soybean hulls diet was slightly higher ($.33 and .66/sow, respectively) than that for the corn-soybean meal diet. The 25 percent alfalfa meal and 30 percent beet pulp feeding programs were $3.30 and 2.75/sow more expensive than the

corn-soybean meal-based program.

When lower energy, fibrous feedstuffs are added to the diet, sows must be provided more feed to meet their daily metabolizable energy requirement (estimated at 6.1 Mcal of metabolizable energy per day for this analysis). Feeding a gestation diet containing 45 percent wheat midds or 20 percent soybean hulls will result in a 8 percent increase in feed usage compared to feeding a corn-soybean meal diet (Table 2). Feeding a diet with 25 percent alfalfa meal, 30 percent beet pulp or 40 percent oats will increase feed usage by 12, 12 and 10 percent compared to feeding a corn-soybean diet. Therefore, it is important to compare total feed ingredient cost/sow/period rather than ingredient cost/ton of feed when evaluating the economics of feeding high-fiber diets to gestating sows.

The amount of manure solids produced from feeding these high-fiber diets would probably proportionally increase as well which could be a problem in some manure disposal systems. Some producers report the undigested portion of the hull from oats is particularly a nuisance to remove from manure storage devices.

In Table 3 the increase in litter size at weaning needed to offset a range of additional feed ingredient expenses is presented. The calculations are based on pig values at weaning of $20, 25, 30, 35 and 40/pig. These results indicate a relatively small improvement in the number of pigs weaned/litter is necessary to offset even a $6 increase in sow feed ingredient cost/110-day period.

Based on the results of the original review presented in the 1997 Nebraska Swine Report, the probability of an increase in litter size weaned of the magnitudes shown in Table 3 is high. Of the 24 studies evaluated in the original review, eight showed a sow response to feeding fiber that was either negative (sows fed high-fiber diets weaned fewer pigs than those fed a control diet) or zero. The litters in these eight studies represented only 19 percent of all the litters evaluated in the original review. Of the remaining 16 studies, there was an increase in litter size that ranged from .1 to 1.2 pigs/litter.

Feeding fiber to gestating sows also reduces the incidence of stereotypic behavior, such as bar-biting, floor licking or sham-chewing. The presence of fiber in the diet seems to result in a more "satisfied" sow. The same situation has been observed in breeding boars. The financial and production consequences of having more satisfied or docile breeding animals have not been examined.

Diets containing fibrous feedstuffs will have a lower bulk density (lb/ft^3) than simple grain-soybean meal-based diets. Therefore, it is necessary to increase not only the weight but also the volume of feed offered for the sow to consume a sufficient amount of nutrients. Producers who use automated feed delivery systems with "feed boxes" must adjust the box settings when a high-fiber diet is used. Otherwise, sows will not be able to consume enough energy and other nutrients to gain an adequate amount of weight and condition during gestation. In some cases, it will not be possible to feed the high-fiber diets in shown in Table 1 once daily through feed delivery systems with "feed boxes," because the boxes are too small. In that case, divide the sows' daily allotment into two daily feedings. In feeding systems where scoops and buckets are used to handle feed, a greater volume of feed is also required. In addition, pelleting high-fiber ingredients and diets facilitates easier handling, including removal from bulk bins.

Wheat midds may be contaminated with vomitoxin, a mycotoxin that causes reduced feed intake in pigs. When feeding a diet containing 900 pounds of wheat midds/ton, such as the one shown in Table 1, it is important to have an excellent quality control program to monitor for possible vomitoxin contamination in the midds. Otherwise, consider including 400 to 450 pounds of wheat midds/ton of feed to minimize the impact of any vomitoxin contamination that may be undetected.

The high fiber diets in Table 1 are designed to provide sows with about 350 grams/day of NDF, which is about 210 grams more than that provided by a corn-soybean meal-based diet. It is important to note that definitive research results are not available to adequately describe the relationship between each gram of additional NDF consumed by the sow and possible changes in reproductive performance. Thus, sows may not need to consume 350 to 400 grams/day of NDF to wean an extra .3 pigs/litter. A recent cooperative study completed at several American universities indicated that when sows consumed a diet providing them with 368 grams/day of NDF, they weaned .7 more pigs/litter than did those fed about 140 grams/day of NDF from corn-soybean meal. Thus, if practical problems preclude the preparation, handling and feeding of the high-fiber diets in Table 1, consider reformulating the diets to provide sows with about 100 grams/day of additional NDF (total of 240 to 250 grams/day of NDF). In that case, diets would contain about 23 percent wheat midds, 10 percent soybean hulls, 12 percent alfalfa meal, 15 percent sugar beet pulp, or 20 percent oats.

The diets shown Table 1 are made using a vitamin and trace mineral premix which provides maximum flexibility for adding fibrous feedstuffs to the diet. A supplement or base mix designed for use with grain and soybean meal should not be used with any fibrous ingredient without first checking with the manufacturer of the product or a nutritionist. The nutrients found in many fibrous feedstuffs vary considerably in amount and digestibility from those found in grain and soybean meal. These differences should be considered in diet formulation.

---

[1]Duane E. Reese is Extension swine specialist and associate professor in the Animal Science Department.