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EFFECTS OF DIFFERING ENERGY SOURCES ON PERFORMANCE OF LACTATING SOWS

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ABSTRACT

The effects of dietary energy sources on lactational performance of sows were evaluated at two locations in North Dakota. Crossbred sows (n=200) were allotted at 109 d of gestation to four dietary treatments. Dietary treatments were: (1) corn-soybean meal (SBM), (2) barley-SBM, (3) barley-SBM + fat (sunflower oil) added to approximate metabolizable energy concentration in Diet 1, and (4) naked oat-SBM. Calculated metabolizable energy concentrations for the four diets were, respectively; 3.23, 3.08, 3.23, and 3.33 Mcal/kg. All diets were formulated to .95% lysine. Litters were adjusted to 10 pigs by day 2 postfarrowing. Sows were allowed ad libitum access to feed during lactation. Sow parity, number of pigs on day 2, and lactation length averaged 3.4, 10.9, and 19.7 days, respectively. Average daily feed intake during lactation was 5.83, 5.67, 5.71, and 5.73 kg (P>.40); thus, calculated metabolizable energy intakes for the four diets were 18.8, 17.5, 18.4, and 19.1 Mcal/d. Litter weaning weight (58.1, 54.5, 57.6, and 58.3 kg) and litter weight gain (39.6, 36.0, 39.2, and 39.8 kg) were lower (P<.10) for sows fed Diet 2 as compared with those fed corn or naked oats. Addition of fat to the barley-SBM diet increased (P<.10) litter weaning weight and weight gain. Survival to weaning (91.0, 91.4, 91.3, and 94.7%) and number of pigs weaned (9.9, 9.9, 9.9, and 10.3) were greater (P<.10) for sows fed naked oats as compared with the other energy sources. Sows fed barley-based diets tended (P<.12) to lose more weight during lactation than sows fed corn, but return-to-estrus interval was not affected (P>.10) by energy source. On day 14 of lactation, milk was collected from 20 sows/treatment. Milk dry matter (19.1, 18.3, 18.6, and 19.0%) and fat (8.28, 7.48, 7.89, and 8.30%) were increased

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(P<.10) for sows fed corn or naked oats as compared with those fed Diet 2. Adding fat to the barley-SBM diet numerically increased milk dry matter and fat. Milk crude protein (5.29, 4.90, 4.98, 4.92%) was greater (P<.02) for sows fed corn as compared with the other energy sources. These results suggest that naked oats and barley with added fat compare favorably to corn as energy sources for lactating sows.

INTRODUCTION

Lactating sows are seldom capable of consuming enough energy during lactation to meet their need for maximum milk production. Thus, some of the energy required for milk production will be supplied by body reserves. A deficiency of energy will lead to lower milk production, which in turn limits the growth potential of the litter. Also, sows that use body reserves to help meet their energy demands will often fail to have normal reproductive function following lactation.

One method to overcome this energy deficit is to provide the lactating sow with a high-energy diet. This can be achieved by ingredient selection, as differing grain sources contain differing amounts of metabolizable energy, or by the addition of animal or vegetable fat to the diet. The addition of fat (either of animal or vegetable origin) to lactating sow diets has been shown to increase energy intake, reduce sow weight and fat loss, and increase litter weight gains.

Energy sources available in North Dakota for use in swine rations include corn, wheat, barley, naked oats, and vegetable fat. Most of the corn fed in North Dakota is shipped in from out of state, thus transportation costs must be considered. Wheat is often too expensive to include in swine diets. Barley is a plentiful feed grain in North Dakota, but the energy content of barley limits its use in sow lactation diets. Naked oats are a relatively new crop that has not been investigated as an energy source for lactating sows.

While corn must be shipped into the state, corn is by far the grain source of choice in sow lactation diets due to its greater energy content as compared with barley. Barley could be used as a grain source if the energy content of the diet could be increased. One method to increase the energy content of barley-based diets is to add supplemental fat.

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"Paul" naked oats, developed at NDSU, is a fairly new crop that holds the promise of being an energy source in swine diets. Fat levels in naked oats are greater than that found in corn or barley. Recent results from NDSU suggest that the fat content of naked oats can be used effectively by young pigs (Landblom et al., 1997; Whitney et al., 1997). These results suggest that naked oats offer the potential as an energy source in lactating sows diets.

Therefore, the objective of this experiment was to determine the feeding value of barley, barley with added fat, and naked oats as an energy source in diets for lactating sows.

MATERIALS AND METHODS

A cooperative study utilizing two hundred primi- and multi-parous sows from two experiment stations (NDSU, Fargo and DREC, Dickinson) in North Dakota were utilized to determine the effects of energy source on lactational performance of sows.

Crossbred (Duroc x Yorkshire x Hampshire) sows at the Fargo station and PIC (Line C-22) sows at the Dickinson Research Extension Center were randomly allotted at day 109 of gestation to four dietary treatments. Dietary treatments included: 1) corn-based diet, 2) barley-based diet, 3) barley-based diet plus added fat to approximate energy content of the corn-based diet, and 4) naked oat-based diet (Table 1). All diets were formulated to .95% lysine, and to meet or exceed NRC (1988) standards for minerals and vitamins. Diets were fed on an ad libitum basis during lactation. Sow feed intake was recorded on a weekly basis in order for determination of feed intake during the entire lactation period.

Within 24 hours of farrowing, number of pigs born and litter weight were recorded. All litters were adjusted to equal to or greater than 10 pigs by day 2 of lactation in order to equalize the energy needs of the litter across diet. On day 2 of lactation, new litter weight and number of pigs were recorded. Pigs were processed according to each station's standard practices.

Sows were weighed as they entered the farrowing house (d 109 of gestation), within 12 hours post-farrowing, and at weaning in order to determine sow weaning weight and lactation weight change. Additionally, backfat was measured by ultrasonography on each sow within 24 hours of farrowing and at weaning. Backfat change during lactation was

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then calculated. After weaning, sows were monitored for days to estrus.

All litters were weighed on day 2, 14, and at weaning. At weaning, the number of pigs weaned was recorded. These data allowed for the calculation of litter weaning weight, average pig weaning weight, litter gain, and survivability.

On day 14 of lactation, twenty sows per treatment were randomly chosen for milk collections. Sows were manually milked following injection of 20 IU of oxytocin. Approximately, 100 mL were collected and frozen. Milk samples were analyzed by standard procedures for dry matter, crude protein, and fat.

Data were analyzed as a completely randomized design using appropriate statistical procedures (SAS, 1996).

RESULTS

Parity and days of lactation for the four treatments averaged, respectively: 3.65, 3.46, 3.50, and 3.09 and 20.0, 19.6, 20.1, and 19.2 days. There were 48, 47, 48, and 46 sows per treatment, respectively.

Feed and Energy Intake

Sows fed corn tended to consume more feed throughout lactation than sows fed barley or naked oats; however, this numerical increase was not significant (P>.10; Table 2). The numerical decrease in feed intake in sows fed the barley-based diet is indicative of the higher fiber content of barley limiting intake. However, for sows fed naked oats, the increased fat content of the diet due to the relatively high fat content of naked oats most likely limited intake. Calculated metabolizable energy intakes for the four treatments averaged: 18.81, 17.51, 18.44, and 19.10 kcal/d. Although feed intake was not significantly affected by dietary treatment, calculated energy intakes were lower for sows fed the barley-based diet (Diet 2) as compared with the other diets. The decrease in energy intake in sows fed Diet 2 corresponded to poorer litter performance as described below.

Sow Performance

Sow weight post-farrowing averaged 472 pounds (P<.10; Table 2). Sow weight at weaning was lower (P<.05) for sows fed the barley-based diets (Diets 2 and 3) as compared with those fed corn. However, there was no difference

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(P>.10) in sow weaning weights among sows fed Diets 2, 3, and 4. The lower weaning weight of sows fed the barley-based diets was due to the greater (P<.10) weight loss in sows fed Diets 2 and 3. Lactation weight change in sows fed naked oats, although numerically lower, was not statistically different (P>.10) from those fed corn. Return-to-estrus interval was not affected (P>.10) by dietary treatment.

Litter Performance

Average number of pigs on day 2 of lactation was 10.82, 10.97, 10.96, and 10.82 pigs for the four treatments, respectively (Table 2). Sows fed naked oats weaned more (P<.10) pigs than sows fed the other energy sources. Likewise, piglet survival was higher (P<.10) for sows fed naked oats as compared with sows fed corn.

Litter weaning weight was lower (P<.10) for sows fed Diet 2 compared with those fed corn. However, a marked improvement (P<.10) in litter weaning weight was noted with the addition of fat to the barley-based diet. Sows fed corn and naked oats had comparable litter weaning weights. Litter weight gain during lactation followed a similar pattern. Sows fed the barley-based diet had lower (P<.10) litter weight gains than sows fed corn, barley+fat, or naked oats. Again, adding fat to the barley-based diet resulted (P<.10) in a marked improvement in litter weight gain.

Sow Body and Milk Composition

Although numerical differences in backfat and backfat change existed among the four treatments, these differences were not significant (P>.10; Table 3). Milk dry matter, crude protein, and fat percentages were affected by dietary treatments. The percentages of dry matter and fat were greater (P<.10) for sows fed corn as compared with those fed Diet 2 (Table 3). Adding fat to the barley-based diet tended to increase milk dry matter and fat. Sows fed naked oats had percentages of milk dry matter and fat that were very similar (P>.10) to those fed corn. The percentage of crude protein in milk was greater (P<.10) for sows fed corn compared with sows fed the other energy sources.

The responses in litter weaning weight, litter gain, and milk fat percentage were well correlated with the dietary energy intake associated with each diet (Figure 1). Sows fed corn and naked oats consumed the greatest quantity of energy and weaned the heaviest litters. Sows fed barley without added fat weaned the lightest litters most likely

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due to inadequate energy intake. Adding fat to the barley-based diet increased energy intake and improved litter weaning weights and gain.

CONCLUSIONS

Results of this study suggest producers of North Dakota can effectively use naked oats as an energy source in lactating sow diets without compromising sow and litter performance. Additionally, barley diets with added fat can improve sow and litter performance above that for sows fed barley alone. Producers that utilize barley as an energy source for lactating sows should seriously consider adding fat to the diet in order to capitalize on the increased sow and litter performance reported in this experiment.

Table 1. Composition of diets, as-fed basis

Diet:	1	2	3	4
Energy Source:	Corn	Barley	Barley+Fat	Naked Oats
Ingredients, %				
Corn	68.60			
Barley, Hazen		75.64	71.39	
Naked oats				77.25
Soybean meal (48% CP)	27.31	20.59	21.30	18.96
Soybean oil			3.50	
Dicalcium Phosphate	2.44	1.84	1.92	1.86
Limestone	0.60	0.88	0.84	0.88
Salt, iodized	0.50	0.50	0.50	0.50
Trace Mineral & Vitamin[a]	0.30	0.30	0.30	0.30
Sow-Add Pak[b]	0.25	0.25	0.25	0.25
Calculated Analysis				

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Metabolizable energy, kcal/lb	1463	1401	1465	1512
Crude Protein, %	17.85	17.59	17.43	19.12
Lysine, %	0.96	0.96	0.96	0.96
Threonine, %	0.71	0.69	0.68	0.76
Methionine + Cystine, %	0.60	0.52	0.52	0.54
Tryptophan, %	0.24	0.25	0.24	0.27
Isoleucine, %	0.79	0.77	0.77	0.94
Valine, %	0.88	0.82	0.82	0.90
Calcium, %	0.94	0.94	0.94	0.94
Phosphorus, %	0.80	0.80	0.80	0.80
Available P, %	0.52	0.45	0.46	0.46

[a]Supplied per pound of diet: Zn, 68 mg; Fe, 68 mg; Mn, 11.3 mg; Cu, 8.25 mg; I, .15 mg; Se, .14 mg; vitamin A,

Table 2. Effect of energy source on sow and litter performance

Diet:	**1**	**2**	**3**	**4**	
Energy Source:	**Corn**	**Barley**	**Barley + fat**	**Naked oats**	**CV**
No. sows	48	47	48	46	
Parity	3.65	3.46	3.50	3.09	
Lactation days	20.0	19.6	20.1	19.2	
Daily feed intake, lb/d	12.86	12.50	12.59	12.63	13.63
Sow Performance					
Sow wt post-farrowing, lb	469.1	475.8	473.3	469.7	13.08
Sow weaning wt, lb	478.5[a]	470.8[ab]	467.3[b]	437.5[ab]	4.94

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Sow wt change, lb	6.46[a]	-1.25[ab]	-4.73[b]	1.43[ab]	4100
R-to-E, d	8.96	10.48	7.45	10.07	98
Litter Performance					
No. pigs, d2	10.82	10.97	10.96	10.82	13.38
Pig wt-d2, lb	39.38	41.13	41.74	40.90	17.91
No. weaned	9.85[a]	9.91[a]	9.90[a]	10.31[b]	11.25
Weaning wt, lb	128.1[a]	120.2[b]	127.1[a]	128.5[a]	16.01
Avg. pig wt, lb	13.00[a]	12.19[b]	12.96[a]	12.52[ab]	23.6
Litter gain, lb	87.33[a]	79.42[b]	86.41[a]	87.77[a]	16.99
Survival, %	91.0[a]	91.4[ab]	91.3[ab]	94.7[b]	10.85
[ab]Means within a row lacking a common superscript differ (P<.10).					

Table 3. Effect of energy source on sow body and milk composition					
Diet:	**1**	**2**	**3**	**4**	
Energy Source:	**Corn**	**Barley**	**Barley + fat**	**Naked oats**	**CV**
Body Composition					
No. Sows	48	47	47	46	
Backfat @ farrowing, in	14.12	13.71	13.59	12.84	32.6
Backfat @ weaning, in	12.65	13.48	13.47	13.23	22.3
Backfat change, in	-.93	-.09	-.11	-.35	787
Milk Composition					
No. Sows	20	20	20	19	

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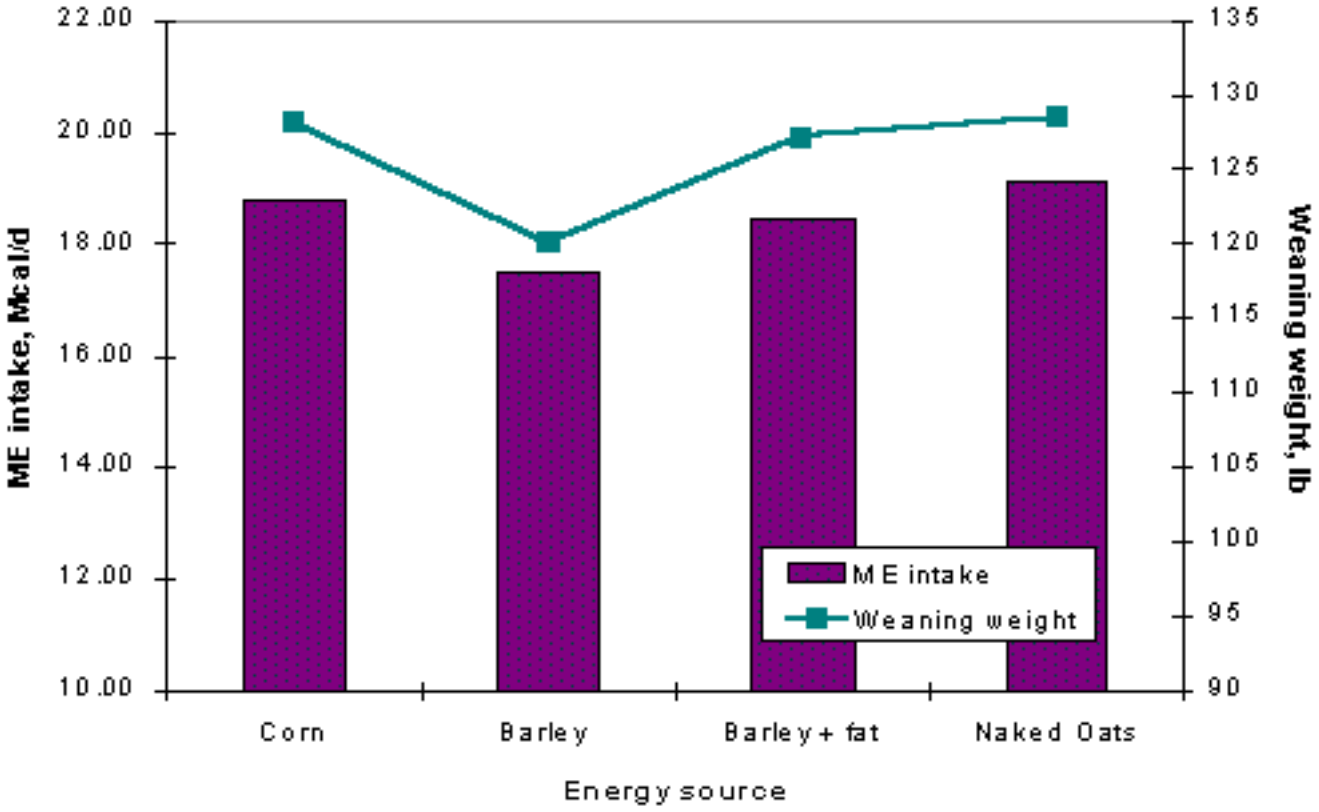
Milk DM, %	19.14[a]	18.27[b]	18.61[bc]	18.97[ac]	5.21
Milk CP, %	5.29[a]	4.90[b]	4.98[b]	4.92[b]	7.52
Milk Fat, %	8.28[a]	7.48[b]	7.89[b]	8.30[a]	13.17
[abc]Means within a row lacking a common superscript differ (P<.10).					

Figure 1. Relationship between metabolizable energy (ME) intake and litter weaning weight for sows fed the four dietary treatments



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