

Evaluating High Oil Corn for Lactating Sows

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Introduction

Adding fat or increasing dietary energy to sow diets during lactation has been found to increase litter weight gains. High oil corn is a specialty hybrid of yellow corn that has a higher oil and protein content than normal yellow corn. High oil corn would be an effective way of increasing the energy density of swine diets. This study was conducted to determine the effects of feeding an elevated energy diet consisting of high oil corn or normal corn with added fat on lactating sow and litter performance.

Experimental Procedures

One hundred eighteen Yorkshire x Landrace sows (avg. parity of 2.8) were placed on one of three dietary treatments approximately 2 to 5 days prior to farrowing. The three dietary treatments (Table 1) were: 1) normal corn-soy diet formulated to .8% lysine with no supplemental fat (NC); 2) high oil corn on an equal weight replacement for normal corn in the NC diet (HOC); and 3) normal corn with supplemental fat and soybean meal to make it isocaloric and isolysinic to the HOC diet (NC+Fat). Litter sizes were adjusted two days after farrowing to average 10 pigs per litter. Cross-fostering was done within treatment or pigs came from extra, non-experimental sows farrowing at the same time. This study was conducted from June 1998 to February 1999, providing 3 seasons (summer, fall, and winter).

Sow weights, feed intake, and last and tenth rib backfat depths (determined with an Aloka 210 ultrasound) were recorded at days 0, 7, 21 and weaning (avg. of 28 days). Litter weights were recorded at days 2, 7, 21, and weaning. Blood samples were collected at day 21 \pm 1 to analyze serum urea nitrogen levels. Milk samples were collected at days 2 and 18 from approximately 12 sows per treatment. Milk samples were collected by injecting 10 IU of oxytocin into the sow's ear vein and hand milking the front two functional mammary glands on each side of the sow. Piglets were separated from the sow 30-45 minutes prior to milk sampling. Approximately 200 ml of milk was collected from each sow (50 ml/gland). Milk samples were freeze dried for analysis to determine dry matter, ash, nitrogen, lipid, and lactose content.

Data were statistically analyzed using the GLM procedure of SAS with initial sow body weight, backfat thickness, and adjusted litter size as covariates for the respective response criteria. Season of the year and parity were used as blocking factors.

Results and Discussion

Average adjusted initial litter size (day 2) was not different between treatments, with 10.2, 9.8, and 10.0 pigs per litter for NC, HOC, and NC+Fat, respectively. The number of pigs weaned per litter (avg. 9.4) was not affected by dietary treatment ($P < .50$). Sows fed the increased energy diets (HOC and NC+Fat) had greater litter weight gain ($P < .05$) over the whole lactation

period than sows fed the NC diet (Table 2). Average daily feed intake (ADFI) increased for sows fed HOC and NC+Fat diets for the first week of lactation ($P<.074$). Sows lost more body weight from days 7 to 21 when fed the HOC diet compared to those fed the NC+Fat diet ($P<.002$). Sows fed NC lost more tenth and last rib backfat from day 2 to weaning than sows fed HOC and NC+Fat diets ($P<.03$ and $P<.07$, respectively).

Splitting the data set to evaluate high producing sows only (weaning 10+ pigs) showed sows fed HOC and NC+Fat had greater litter weight gain during the first week and overall through the whole lactation period ($P<.05$ and $P<.01$, respectively; Table 3). Sows fed HOC and NC+Fat also had greater ADFI during the entire lactation period ($P<.03$) compared to sows consuming the NC diet. Sows fed HOC that weaned 10+ pigs had greater body weight loss than sows fed NC+Fat from days 7 to 21 and from day 0 to weaning ($P<.004$ and $P<.03$, respectively).

Dietary treatment did not significantly change dry matter, ash, or fat content of the milk. Day at which the milk was collected did significantly affect dry matter, ash, and fat content ($P<.0001$, $P<.0001$, and $P<.008$, respectively), with day 2 milk having greater fat and DM but less ash than day 18 milk (Table 4).

Implications

High oil corn is better than normal corn on a pound for pound basis and is equivalent to a normal corn diet supplemented with fat and protein for supporting litter weight gain and lactational performance of the sow. High oil corn offers producers the opportunity to add energy to diets without the expense of installing and maintaining supplemental fat equipment for feed processing. However, the producer needs to evaluate the overall cost of using high oil corn and maintaining identity of the grain versus adding fat and protein to normal corn sow diets.

Table 1. Diet formulation.

Ingredients, %	NC Diet	HOC Diet	NC+Fat Diet
Normal Corn	75.61	0	70.79
High Oil Corn	0	75.61	0
SBM, 48%	20.30	20.30	21.70
Swine Grease	0	0	3.43
Dical. Phosphate	2.26	2.26	2.28
Limestone	.66	.66	.63
Salt	.50	.50	.50
Swine Vitamin Premix ^a	.25	.25	.25
Sow Vitamin Premix ^b	.25	.25	.25
Swine Trace Mineral Premix ^c	.125	.125	.125
Selenium Premix ^d	.05	.05	.05
Formulated			
Lysine, %	.80	.84	.83
Fat, %	2.9	6.38	6.17
Analyzed			
Lysine, %	.80	.82	.85
Fat, %	2.6	4.16	5.14
GE, Mcal/lb	8.47	8.84	8.95

^a Supplied the following per pound of diet: 2750 IU Vitamin A, 275 IU Vitamin D₃, 20 IU Vitamin E, .016 mg Vitamin B₁₂, 2.77 mg Vitamin K, .91 mg Menadione, 3.2 mg Riboflavin, 10 mg d-Pantothenic Acid, 15 mg Niacin.

^b Supplied the following per pound of diet: 10 IU Vitamin E, 250 mg Choline, .75 mg Folic Acid, .10 mg Biotin.

^c Supplied the following per pound of diet: 11.25 ppm Cu, .42 ppm I, 121 ppm Fe, 15 ppm Manganese, 121 ppm Zn.

^d Supplied .3 ppm Se per pound of diet.

Table 2. Effect of replacing normal corn with high oil corn or normal corn with added fat and protein on sow and litter performance.

	NC Diet	HOC Diet	NC+Fat Diet	CV	Significance
Number of sows/treatment	40	41	37	-	
Average Parity	2.93	2.80	2.54	62.64	
Average Lactation Length, d	26.35	29.95	26.70	13.63	Diet (P<.0001)
Initial					
Day 2 adjusted litter size	10.15	9.78	10.05	9.88	
Day 2 litter weight, lb	38.77	36.86	36.40	17.58	
Sow body weight, lb	501.03	517.95	510.62	15.18	
Tenth rib backfat, in.	.991	1.040	1.009	20.36	
Last rib backfat, in.	.956	1.011	.976	19.24	
Litter weight gain ^{ab} , lb/day					
Days 2-7 ^f	20.43	22.87	23.44	33.71	
Days 7-21	63.99	65.07	70.50	25.29	
Days 21-wean	20.83	27.97	24.19	74.46	
Days 2-wean ^g	104.98	116.27	117.94	21.74	Diet (P<.055)
ADFI ^c , lb/day					
Days 0-7 ^h	7.16	8.29	8.45	31.92	Diet (P<.074)
Days 7-21 ⁱ	9.98	10.12	11.03	23.90	
Days 21-wean ^j	9.84	10.65	11.24	32.77	
Days 0-wean ^k	9.28	9.80	10.31	20.56	Diet (P<.12)
Sow weight loss ^{ac} , lb/d					
Days 0-7	18.84	17.57	21.54	125.21	
Days 7-21 ^l	24.62	35.20	15.85	100.21	Diet (P<.0061)
Days 21-wean	10.18	8.92	16.93	218.61	
Days 0-wean	54.79	60.03	55.06	48.62	
Tenth rib backfat loss ^{ad} , in.					
Days 0-7 ^m	.076	.040	.032	176.85	
Days 7-21	.093	.106	.064	96.39	
Days 21-wean	.026	.028	.032	193.54	
Days 0-wean ⁿ	.203	.166	.131	52.70	Diet (P<.0314)
Last rib backfat loss ^{ae} , in.					
Days 0-7	.029	.001	.017	307.14	
Days 7-21	.118	.120	.093	103.55	
Days 21-wean ^o	.037	.040	.016	172.75	
Days 0-wean ^p	.187	.157	.127	56.95	Diet (P<.07)

^a Adjusted day 2 litter size used as a covariate.

^b Litter weight at day 2 used as a covariate.

^c Sow body weight at day 2 used as a covariate.

^d Initial tenth rib backfat depth used as a covariate.

^e Initial last rib backfat depth used as a covariate.

^{f-p} Treatment contrasts:

^f NC vs. HOC and NC+Fat (P<.071).

^g C vs. HOC and NC+Fat (P<.018).

^h NC vs. HOC and NC+Fat (P<.024).

ⁱ HOC vs. NC+Fat (P<.143).

^j NC vs. HOC and NC+Fat (P<.14).

^k NC vs. HOC and NC+Fat (P<.08).

^l HOC vs. NC+Fat (P<.0015).

^m NC vs. HOC and NC+Fat (P<.089).

ⁿ NC vs. HOC and NC+Fat (P<.032).

^o HOC vs. NC+Fat (P<.14).

^p NC vs. HOC and NC+Fat (P<.064).

Table 3. Effect of replacing normal corn with high oil corn or normal corn with added fat and protein on sow and litter performance: Sows weaning 10+ pigs.

	NC Diet	HOC Diet	NC+Fat Diet	CV	Significance
Number of sows/treatment	22	22	21	-	
Average Parity	2.82	2.68	2.33	35.0	
Average Lactation Length, d	26.95	29.68	26.14	14.1	Diet (P<.01)
Initial					
Day 2 adjusted litter size	10.55	10.32	10.43	7.03	
Day 2 litter weight, lb	40.10	40.19	37.0	17.3	
Sow body weight, lb	489.64	530.23	499.81	14.5	
Tenth rib backfat, in.	.941	1.106	1.005	19.6	Diet (P<.042)
Last rib backfat, in.	.912	1.075	.956	18.4	Diet (P<.020)
Litter weight gain, lb/day					
Days 2-7 ^a	22.19	25.37	26.38	28.2	Diet (P<.134)
Days 7-21	66.36	69.17	76.55	24.2	
Days 21-wean ^b	22.42	35.36	25.58	66.1	Diet (P<.117)
Days 2-wean ^c	110.4	131.1	127.5	19.7	Diet (P<.022)
ADFI, lb/day					
Days 0-7	7.81	8.15	8.93	24.8	
Days 7-21	10.05	10.54	11.39	21.1	
Days 21-wean ^d	9.95	12.8	12.4	25.3	Diet (P<.012)
Days 0-wean ^e	9.54	10.57	10.95	16.9	Diet (P<.062)
Sow weight loss, lb/day					
Days 0-7	20.87	15.97	15.88	129.5	
Days 7-21 ^f	31.36	37.03	14.37	84.0	Diet (P<.011)
Days 21-wean	8.48	17.81	13.75	161.6	
Days 0-wean ^g	61.83	67.72	45.58	45.6	Diet (P<.066)
Tenth rib backfat loss, in.					
Days 0-7 ^h	.079	.046	.066	150.7	
Days 7-21 ^h	.115	.115	.053	77.0	Diet (P<.063)
Days 21-wean	.006	.016	.018	215.3	
Days 0-wean	.202	.180	.139	51.2	
Last rib backfat loss, in.					
Days 0-7	.045	.016	.021	247.8	
Days 7-21 ⁱ	.125	.135	.083	86.8	
Days 21-wean	.019	.029	.014	185.3	
Days 0-wean ^j	.191	.146	.119	54.60	

^{a-j} Treatment contrasts:

^a NC vs. HOC and NC+Fat (P<.051).

^b NC vs. HOC and NC+Fat (P<.006).

^c NC vs. HOC and NC+Fat (P<.006).

^d NC vs. HOC and NC+Fat (P<.0031).

^e NC vs. HOC and NC+Fat (P<.03).

^f HOC vs. NC+Fat (P<.0043).

^g HOC vs. NC+Fat (P<.03).

^h HOC vs. NC+Fat (P<.04).

ⁱ HOC vs. NC+Fat (P<.14).

^j NC vs. HOC and NC+Fat (P<.089).

Table 4. Milk composition on a dry matter basis.

	NC Diet	HOC Diet	NC+Fat Diet	CV	Significance
Day 2 ^a					
Dry Matter, %	21.7	21.6	21.6	15.72	Day (P<.0001)
Ash, %	3.89	3.51	3.53	17.88	Day (P<.0001)
Fat, %	43.1	44.4	42.1	16.81	Day (P<.0081)
Day 18 ^b					
Dry Matter, %	18.7	18.1	17.3	11.93	Day (P<.0001)
Ash, %	4.48	4.52	4.51	11.87	Day (P<.0001)
Fat, %	38.5	37.7	35.5	15.57	Day (P<.0081)

^a Day 2 data is from approximately 6 sows per treatment.

^b Day 18 data is from approximately 12 sows per treatment.