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EFFECT OF LYSINE LEVEL AND SUPPLEMENTAL SOYBEAN OIL FED DURING LACTATION ON SOW AND LITTER PERFORMANCE THROUGH TWO PARITIES

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Summary

A total of 158 gilts were fed ad libitum one of the following four diets during lactation: .65% lysine, .75% lysine, .65% lysine + 3% soybean oil, and .75% lysine + 3% soybean oil. These same sows were carried through a second parity on the same lactation diet treatments. In parity 1, lysine level had no effect on feed intake or interval from weaning to estrus. Addition of 3% soybean oil increased the weaning to estrus interval and decreased feed intake, although caloric intake was not different. In parity 2, there was no effect on feed intake from 3% supplemental soybean oil; however, the weaning to estrus interval was still delayed by 2.5 d. Overall, there were no interaction effects from increasing the lysine level and adding 3% soybean oil. Increasing lysine to .75% and adding 3% soybean oil had no effect on sow weight loss, sow backfat loss, pig survivability, litter size at weaning, litter weight at weaning, or average pig weight at weaning. Based on the results of this experiment, it appears that a .65% lysine diet without supplemental fat is adequate during lactation.

(Key Words: Sow, Lactation, Lysine, Soybean Oil.)

Introduction

With the use of highly productive sows, the problem of delayed return to estrus in first parity sows has become more apparent in many swine operations. Experiments have shown that intake of low levels of either energy or protein in lactation diets results in delayed return to estrus. In many cases, first parity sows do not consume enough energy to raise a large litter and rebreed quickly, especially in the summer months when heat stress reduces feed intake. To combat this problem, nutritionally high levels of supplemental fat have been used to increase caloric intake and high crude protein levels have been used to supply more protein when feed intake is reduced. Drip cooling has been used to reduce heat stress and increase feed intake.

Most studies of fat addition to sow lactation diets have used 5 to 10% supplementation rates. In this experiment, a more practical level of fat addition, 3% soybean oil, was used in combination with two lysine levels (.65 and .75%). These lysine levels are at or above KSU's recommendations for lactation diets and correspond, respectively, to 14 and 16% crude protein levels. The objective of this experiment was to evaluate these practical dietary protein and energy levels, with all diets at or above KSU recommendations, and determine if there was any benefit to sow and litter performance when energy and lysine levels were increased during lactation.

Experimental Procedures

A total of 158 crossbred gilts (Hampshire × Yorkshire × Chester White × Duroc) were fed 4.5 lb per d of a 14% crude protein diet during gestation. Gilts were bred and housed indoors in stalls for the first 30 d following breeding and were housed outdoors for the remainder of gestation. On d 110 of gestation, gilts were assigned randomly to lactation treatments and backfat measurements were taken.

On the day of farrowing, gilts were given their dietary treatments and fed ad libitum from d 1 to weaning (d 21 of lactation). Lactation treatments consisted of corn-soybean meal diets containing either .65% lysine, .75% lysine, .65% lysine + 3% soybean oil, or .75% lysine + 3% soybean oil (Table 1). Lysine levels were altered by changing the amount of soybean

Table 1. Diet Composition

Item	.65% Lysine		.75% Lysine	
	0% Soybean oil	3% Soybean oil	0% Soybean oil	3% Soybean oil
Corn	81.39	78.05	78.06	74.74
Soybean meal (48%)	14.29	14.59	17.69	17.99
Soybean oil	--	3.00	--	3.00
Monocalcium phosphate	2.30	2.38	2.25	2.29
Limestone	1.02	.98	1.00	.98
Salt	.50	.50	.50	.50
Biotin	.10	.10	.10	.10
Vitamin premix[a]	.25	.25	.25	.25
Trace mineral mix[b]	.10	.10	.10	.10
Selenium premix[c]	.05	.05	.05	.05
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
Metabolizable energy, Kcal/lb	1482	1534	1482	1534
Crude protein, %	14.00	14.00	16.00	16.00
Lysine, %	.65	.65	.75	.75

[a]Each lb of vitamin premix contains 1,000,000 IU vitamin A, 100,000 IU vitamin D_3, 4,000 IU vitamin E, 400 mg vitamin K, 1000 mg riboflavin, 2500 mg pantothenic acid, 5,500 mg niacin, 100,000 mg choline and 5 mg vitamin B_{12}.

[b]Contains 5% calcium, 10% iron, 10% zinc, 10% manganese, 1% copper, .3% iodine, and .1% cobalt.

[c]Each lb of selenium premix contains 272.4 mg of selenium.

meal and corn. All diets were equally fortified with vitamins and minerals. In this way, lysine was assured of being the most limiting amino acid. This was verified by diet analysis. At farrowing, sow weight, pig birth weight, and litter size were recorded. Within 48 h after farrowing, litters were equalized among sows, and initial litter size was recorded to determine pig survivability. Sows were fed ad libitum, with feed intakes measured throughout lactation. All sows were drip cooled when temperatures rose above 85°F in the farrowing house. No creep feed was available to pigs.

On d 21 of lactation, sow weight, sow backfat measurements, pig weight, litter size, and 21-d litter weight were recorded. Sows were moved to the gestation barn after weaning and checked for estrus for 28 d. Only sows that had returned to estrus by d 15 were rebred and utilized for parity 2. Parity 2 sow and litter management was the same as parity 1, except litter size at farrowing was recorded, and litters were equalized within dietary treatments.

Table 2. Effect of Lysine Level and Supplemental Fat on Sow Performance during Lactation in Parity 1

Item	.65% Lysine		.75% Lysine	
	0% Soybean oil	3% Soybean oil	0% Soybean oil	3% Soybean oil
Parity 1				
No. of litters	40	40	40	38
Post farrowing weight, lb	365.1	364.3	366.3	369.4
Weight loss, lb	23.9	25.0	18.3	24.3
Backfat loss, in.	.12	.09	.12	.10
Feed intake, lb/d				
Week 1	10.3	9.8	10.1	9.7
Week 2	10.6	9.9	10.8	9.7
Week 3	10.1	9.6	10.2	9.5
Overall[a]	10.1	9.8	10.4	9.7
ME intake, Mcal/d	15.1	15.1	15.3	15.0
Percentage returned to estrus				
By d 7	58.5	45.2	53.7	42.1
By d 14[a]	85.4	76.2	90.2	63.2
By d 28[a,b]	95.1	83.3	90.2	71.1
Avg d to estrus[c]	8.0	9.7	6.8	8.1

[a]Addition of 3% soybean oil reduced % sows in estrus by d 14 and d 28 postweaning (P<.05).
[b]Increasing lysine level to .75% reduced the number of sows showing estrus (P<.08).
[c]Includes only the sows that returned to estrus by d 28, no treatment effect (P>.2).

Results and Discussion

The effect of lysine level and fat supplementation on sow performance in parity 1 is shown in Table 2. There was no additive effect from the combination of increased dietary lysine and fat supplementation on sow or litter performance. Only statistical differences for main effects of lysine level and fat supplementation will be reported, because there were no interactions between lysine level and fat additions, nor were there any season by diet interactions.

In parity 1, all sows lost weight and backfat, regardless of treatment. Increasing dietary lysine from .65 to .75% had no effect on sow weight loss, sow backfat loss, daily feed intake, or percentage of sows returning to estrus by d 7 or d 14. However, there was a trend for fewer sows to return to estrus on the .75% lysine diet by d 28 postweaning ($P<.08$) compared to .65% dietary lysine. Supplementation with 3% soybean oil reduced feed intake by .5 lb/d ($P<.03$). Calculated metabolizable energy intakes were similar with all sows consuming at least 15 Mcal/d. Soybean oil addition had no effect on sow weight loss or backfat loss; however, at d 14 and d 28 postweaning, fewer sows that received the 3% fat supplementation ($P<.05$) had returned to estrus.

Table 3. Effect of Lysine Level and Supplemental Fat on Sow Performance During Lactation in Parity 2

	.65% Lysine		.75% Lysine	
Item	0% Soybean oil	3% Soybean oil	0% Soybean oil	3% Soybean oil
Parity 2				
No. of litters	28	23	19	17
Post farrowing weight, lb	404.4	406.7	412.2	413.2
Weight change, lb	-3.5	+2.5	-10.9	-0.8
Backfat change, in.	-.02	+0.02	-0.02	-0.03
Feed intake, lb/d				
Week 1	11.1	11.4	11.2	11.2
Week 2	12.2	12.6	12.3	11.2
Week 3	11.8	12.0	11.9	12.3
Overall	11.7	12.0	11.8	11.5
ME intake, Mcal/d	17.3	18.2	18.0	17.1
Percentage returned to estrus				
By d 7	85.7	56.5	84.2	76.5
By d 14	92.9	74.9	94.7	88.2
Avg days to estrus[a]	5.4	7.2	5.3	8.6

[a]Soybean oil delayed return to estrus ($P<.05$).

In parity 2 (Table 3), lysine level had no effect on lactation weight change, backfat change, daily feed intake, or the weaning to estrus interval. Addition of 3% fat had no effect on daily feed intake, sow weight change, backfat change, or the percentage of sows returning to estrus by d 7, d 14 or d 28 postweaning. Daily caloric intakes of all sows, regardless of dietary treatment, were at least 17 Mcal ME/d in parity 2. Fat-supplemented sows tended to take 2 to 3 d longer to return to estrus ($P<.05$).

The effect of lysine level and supplemental fat on litter performance is shown in Table 4. No differences were observed in litter weaning weight, average pig weight, litter size, or survivability because of dietary treatment levels of lysine or fat in either parity 1 or 2. Previous studies have shown increased litter weaning weight with increasing lactation protein intake during 4 or 5 wk lactations; however, increases in litter gain from increased protein occurred late in lactation (wk 4 or 5).

Table 4. Effect of Lysine Level and Fat Supplementation during Lactation on Litter Performance

Item	.65% Lysine		.75% Lysine	
	0% Soybean oil	3% Soybean oil	0% Soybean oil	3% Soybean oil
Parity 1				
No. of litters	40	40	40	38
No. pigs (equalized on d 2)	10.0	10.0	9.7	10.0
No. of pigs weaned	9.2	9.0	9.2	9.2
Pig survival, %	92.0	90.1	92.3	91.8
Pig performance, lb				
21-d avg pig wt	11.5	12.0	11.8	11.7
21-d litter wt	105.9	107.1	108.5	107.1
Parity 2				
No. of litters	28	23	19	17
No. pigs born alive	7.3	7.4	7.7	7.9
No. pigs weaned	6.8	6.8	7.5	7.3
Pig survival, %	93.4	91.9	98.4	94.6
Pig performance, lb				
21-d avg pig wt	14.3	14.3	14.4	13.6
21-d litter wt	94.6	95.4	104.9	99.2

Based on results of this experiment, we conclude that a corn-soybean meal diet formulated to contain .65% lysine and no supplemental fat is adequate for sow and litter performance, when fed during a 21 d lactation. Our sows were fed a gestation diet that contained 14% crude protein and were drip cooled during lactation. The .65% lysine with no supplemental fat is also the most economical diet and will result in substantial savings in feed costs when compared to any of the other three diets.

KSU swine science graduate students (left to right), Gary Fitzner, Bret Healy, Terry Weeden, Dan Jones, Jeff Swanson, Mike Johnston, Rhonda Nicholson, and Defa Li.