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Abstract

One hundred and forty-three lactating primiparous sows were used in a study to determine the influence of four different litter sizes on the dietary lysine requirement as measured by sow and litter performance. At farrowing, sows were randomly assigned to one of three corn soybean meal diets (.67, .94, or 1.22 % lysine) and one of four litter sizes (8, 9, 10, or 11 pigs). Sows were fed 7.7, 9.9, and 12.1 lbld of their respective diet for the first, second, and third week of lactation. This provided an average daily lysine intake of 30.1, 42.2, or 54.8 gld throughout the 21-day lactation period. Ratio of other amino acids relative to lysine were kept constant to ensure that lysine was first limiting, and all diets contained 5% soybean oil to increase the energy density. Sows were fed twice daily, and feed disappearance was recorded each day. Litters were adjusted to their treatment size within 72 h after farrowing. If a pig died during the lactation period, a pig of similar age and weight was used as a replacement. Sows and litters were weighed weekly, and average backfat was measured at farrowing and weaning (d 21). There were no interactions between litter size and lysine intake for litter weight gain. Utter weight gain was increased by increasing litter size. Increasing dietary lysine tended to improve litter weight gain. A dietary lysine x litter size interaction was observed for sow weight loss. Sow weight loss was increased as litter size increased. However, increased dietary lysine reduced sow weight loss. Sow backfat loss was not affected by litter size or dietary lysine. In conclusion, it appears that sows require approximately 42.5 gld lysine to maximize 21-d litter weight gain. Surprisingly, litter size did not influence the sows lysine requirement. Increasing litter size increased sow weight loss, but this response was minimized by increasing dietary lysine.; Swine Day, Manhattan, KS, November 19, 1992

Keywords

Swine day, 1992; Kansas Agricultural Experiment Station contribution; no. 93-142-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 667; Swine; Sows; Lysine; Reproductive performance; Litter size

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EFFECTS OF THE INTERRELATIONSHIP BETWEEN DIETARY LYSINE AND LITTER SIZE ON SOW AND LITTER PERFORMANCE[1]

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Summary

One hundred and forty-three lactating primiparous sows were used in a study to determine the influence of four different litter sizes on the dietary lysine requirement as measured by sow and litter performance. At farrowing, sows were randomly assigned to one of three corn-soybean meal diets (.67, .94, or 1.22 % lysine) and one of four litter sizes (8, 9, 10, or 11 pigs). Sows were fed 7.7, 9.9, and 12.1 lb/d of their respective diet for the first, second, and third week of lactation. This provided an average daily lysine intake of 30.1, 42.2, or 54.8 g/d throughout the 21-day lactation period. Ratio of other amino acids relative to lysine were kept constant to ensure that lysine was first limiting, and all diets contained 5% soybean oil to increase the energy density. Sows were fed twice daily, and feed disappearance was recorded each day. Litters were adjusted to their treatment size within 72 h after farrowing. If a pig died during the lactation period, a pig of similar age and weight was used as a replacement. Sows and litters were weighed weekly, and average backfat was measured at farrowing and weaning (d 21). There were no interactions between litter size and lysine intake for litter weight gain. Litter weight gain was increased by increasing litter size. Increasing dietary lysine tended to improve litter weight gain. A dietary lysine × litter size interaction was observed for sow weight loss. Sow weight loss was increased as litter size increased. However, increased dietary lysine reduced sow weight loss. Sow backfat loss was not affected by litter size or dietary lysine. In conclusion, it appears that sows require approximately 42.5 g/d lysine to maximize 21-d litter weight gain. Surprisingly, litter size did not influence the sows lysine requirement. Increasing litter size increased sow weight loss, but this response was minimized by increasing dietary lysine.

(Key Words: Sows, Lysine, Reproductive Performance, Litter Size.)

Introduction

In recent years, there has been tremendous interest in the feeding strategies used for high producing sows. Development and identification of genetically superior white line sows for the breeding herd are primarily responsible for the renewed interest in nutritional requirements. Although the average swine producer in the U.S. weans only eight pigs per litter, several studies have shown excellent responses to increased dietary lysine from sows nursing litters with more than nine pigs. Therefore, the objective of this study was to take into account a wide range of litter sizes (8, 9, 10, or 11 pigs) and also a wide range of daily lysine intakes. This information will be used to construct a statistical model that would be used to predict lysine requirements based on week of lactation and number of pigs nursed by the sow. This requirement would meet two major criteria: 1) to maximize sow productivity in terms of milk production and litter weight gain and 2)

[1]The authors would like to thank Nutri-Quest, Inc. and BioKyowa for partial funding of this study and supplying amino acids.

to minimize sow weight loss and reduce nonproductive sow days.

Procedures

At farrowing, sows were randomly assigned to one of three experimental diets (.67, .94, or 1.22% lysine; Table 1) and one of four litter sizes (8, 9, 10, or 11 pigs). The corn-soybean meal ratio in the diets was adjusted to achieve the desired level of dietary lysine. Ratios of other amino acids relative to lysine were kept constant to ensure that lysine was first limiting (Table 2), and all diets contained 5% soybean oil to increase the energy density. All diets were pelleted through a 3/16 × 2 in. die to help maximize feed intake. Litters were adjusted to their treatment size within 72 h after farrowing. If a pig died during the lactation period, a pig of similar age and weight was used as a replacement. During the first week of lactation, sows were fed 7.7 lb/d of each diet. This provided sows with 23.4, 32.8, or 42.6 g/d lysine. During the second week of lactation, feed was increased to 9.9 lb/d, providing 30.1, 42.2, or 54.8 g/d lysine. Finally, during the third week of lactation feed intake was increased to 12 lb/d providing 36.8, 51.6, and 67.0 g/d lysine. Thus, the average daily lysine intakes throughout the 21 d lactation period were 30.1, 42.2, and 54.8 g/d lysine. Feed disappearance was measured daily and individual sow feed consumption was used in the statistical modeling of daily lysine intake to litter weight gain. Sows and litters were weighed on d 1, 7, 14, and at weaning. Average backfat was measured on d 1 and at weaning.

Results and Discussion

Increasing litter size resulted in increased litter weight on d 7 and 14 and at weaning ($P<.01$). Increasing dietary lysine resulted in increased litter weight gain and d 21 litter weight ($P<.10$). Surprisingly, no dietary lysine × litter size interaction was observed for litter weight gain. This indicates that, regardless of litter size, sows require approximately 42 to 46 g/d dietary lysine to maximize litter weaning weight. A dietary lysine × litter size interaction ($P<.06$) was observed for sow weight loss. Sow weight loss was increased as litter size increased ($P<.08$). However, increased dietary lysine reduced sow weight loss ($P<.01$). Sow backfat loss was not affected by litter size or dietary lysine.

One possible explanation for the response observed between dietary lysine and litter size is the influence of amino acids contributed by sows' tissue catabolism. For example, litter weight gain increased linearly for sows nursing 8 or 9 pigs, whereas sow weight loss was not affected. However, for sows nursing 11 pigs, sow weight loss increased dramatically when sows were not allowed to consume sufficient lysine. Thus, sows in this study may have buffered increased milk production (litter weight gain) by depleting body tissue stores.

The information gathered in this study is currently being used to construct a statistical model that will predict the weekly lysine requirements of lactating sows based upon litter size. Preliminary regression analysis using lysing intake and litter size to predict litter weight gain and sow weight loss is presented in Figures 1 and 2, respectively. In conclusion, these data suggest that sows require at least 42 g/d lysine regardless of litter size to maximize litter weight gain. Improved litter weight gain and reduced sow weight loss increase sow productivity during lactation and should help reduce the nonproductive sow days associated with returning to estrus.

Table 1. Composition of Experimental Diets

	Lysine intake g/d		
Ingredient, %	30.1	42.2	54.8
Corn	75.48	66.20	56.42
Soybean meal (48.5 % CP)	15.17	24.69	34.23
Soybean oil	5.00	5.00	5.00
Monocalcium phosphate (21% P)	2.33	2.16	2.00
Limestone	.97	.90	.93
Salt	.50	.50	.50
Vitamin premix	.36	.36	.36
Trace mineral premix	.18	.18	.18
Amino acid mix	.01	.02	.44
Total	100.00	100.00	100.00
Calculated analysis			
CP, %	13.93	17.73	21.61
Lysine, %	.67	.94	1.22
Ca, %	.90	.90	.90
P, %	.80	.80	.80
Metabolizable energy, Mcal/lb	1,568	1,565	1,565

Table 2. Calculated Amino Acid Levels in Experimental Diets, %

		Lysine intake g/d		
Amino acid	Ratio[a]	30.1	42.2	54.8
Lysine	100	.67	.94	1.22
Arginine	131	.88	1.24	1.54
Histidine	58	.39	.47	.56
Isoleucine	88	.59	.76	.93
Leucine	216	1.45	1.68	1.68
Met & Cys	77	.52	.62	.81
Phe & Tyr	185	1.24	1.54	1.83
Threonine	79	.53	.74	.96
Tryptophan	22	.15	.21	.27
Valine	110	.74	1.04	1.34

[a]Amino acids at 110 % of 1988 NRC recommended levels relative to lysine.

Table 3. The Effect of Dietary Lysine and Litter Size (8 - 11 Pigs) on Sow and Litter Performance

	Lysine intake g/d											
	30.1				42.2				54.8			
Item	8	9	10	11	8	9	10	11	8	9	10	11
No. sows	12	12	10	12	11	13	14	12	12	10	12	12
Litter weight												
D 0[a]	25.7	26.8	28.6	33.0	24.5	28.8	29.7	31.6	23.6	26.0	31.8	32.3
D 7[a]	48.6	53.0	50.3	58.4	47.8	53.8	57.3	58.8	47.9	50.0	57.2	60.5
D 14[a]	79.7	87.1	80.0	96.8	81.0	90.3	96.7	99.4	79.7	83.8	92.0	123.9
Weaning[ab]	100.5	107.3	102.7	121.7	105.6	114.5	115.4	125.5	100.4	110.6	116.6	121.6
Litter gain[ab]	74.7	80.4	74.0	88.6	81.0	85.6	85.6	93.9	76.7	84.6	84.8	89.3
Lactation												
Length, d	20	19	21	20	21	20	19	20	20	20	19	
Sow performance												
Weight loss, lb[abc]	14.7	21.6	15.8	45.8	10.1	17.1	19.2	23.1	8.3	24.8	16.2	20.5
Backfat change, mm	-1.5	0.2	0.1	- 4.8	- 3.3	2.1	0.3	- 2.7	- 1.6	-2.7	- 0.2	- 2.0

[a]Linear litter size effect ($P<.01$).
[b]Linear dietary lysine effect ($P<.10$).
[c]Dietary lysine × litter size effect ($P<.06$).

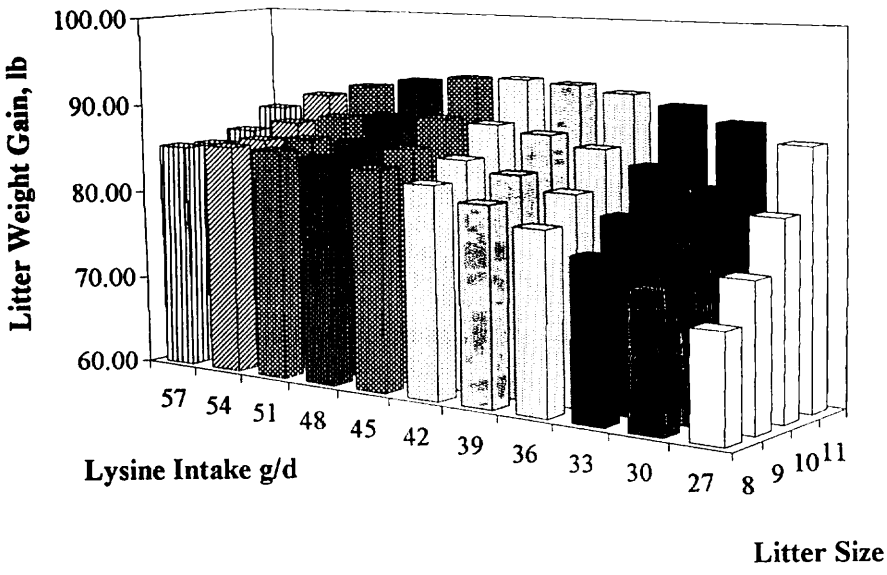

Figure 1. Regression Analysis of Effects of Daily Lysine Intake on Litter Weight Gain

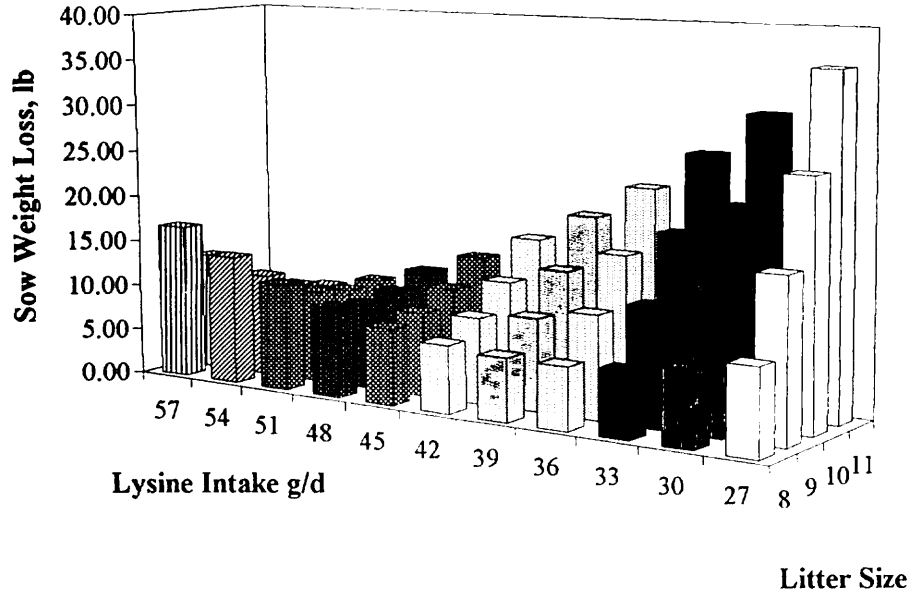

Figure 2. Regression Analysis of Effects of Daily Lysine Intake on Sow Weight Loss