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A total of 163 sows were used in a study to determine the requirement for total sulfur amino acids (TSAA), relative to lysine, during lactation. All experimental diets were cornsoybean meal-based and formulated to contain 0.88% true ileal digestible (TID) lysine (0.97% total lysine). The experimental diets contained 0.37% L-lysine HCl, with other crystalline amino acids added to ensure that TSAA was first limiting. The dietary TID TSAA rates were formulated to 0.44, 0.48, 0.53, 0.57, and 0.62%, corresponding to 50, 55, 60, 65, and 70% of lysine, respectively. Sows farrowed in six farrowing groups, and were randomly allotted to the dietary treatments on the basis of parity. Over the entire lactation period, there were no differences (P>0.14) in ADFI, weight loss, backfat loss, or plasma urea nitrogen among sows fed increasing TSAA:Lys ratios. Increasing TSAA, relative to lysine, had no effect (P>0.25) on litter weaning weight or preweaning mortality. In summary, there were no differences in litter performance with increasing TID TSAA:Lys ratio. These results suggest that the requirement for TID TSAA is no more than 50% of lysine. Additional research is needed to confirm this relatively low TSAA requirement, and that the relatively high feed (and amino acid) intake of sows, coupled with possible tissue breakdown as a source of TSAA, did not decrease the dietary requirement.; Swine Day, 2006, Kansas State University, Manhattan, KS, 2006

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DETERMINING THE TOTAL SULFUR AMINO ACID TO LYSINE REQUIREMENT OF THE LACTATING SOW

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Summary

A total of 163 sows were used in a study to determine the requirement for total sulfur amino acids (TSAA), relative to lysine, during lactation. All experimental diets were corn-soybean meal-based and formulated to contain 0.88% true ileal digestible (TID) lysine (0.97% total lysine). The experimental diets contained 0.37% L-lysine HCl, with other crystalline amino acids added to ensure that TSAA was first limiting. The dietary TID TSAA rates were formulated to 0.44, 0.48, 0.53, 0.57, and 0.62%, corresponding to 50, 55, 60, 65, and 70% of lysine, respectively. Sows farrowed in six farrowing groups, and were randomly allotted to the dietary treatments on the basis of parity. Over the entire lactation period, there were no differences ($P>0.14$) in ADFI, weight loss, backfat loss, or plasma urea nitrogen among sows fed increasing TSAA:Lys ratios. Increasing TSAA, relative to lysine, had no effect ($P>0.25$) on litter weaning weight or preweaning mortality. In summary, there were no differences in litter performance with increasing TID TSAA:Lys ratio. These results suggest that the requirement for TID TSAA is no more than 50% of lysine. Additional research is needed to confirm this relatively low TSAA requirement, and that the relatively high feed (and amino acid) intake of sows, coupled with possible tissue breakdown as a source of TSAA, did not decrease the dietary requirement.

(Key Words: Total Sulfur Amino Acid, Lactation, Sows.)

Introduction

Due to increased litter size and milk production in modern sows, the requirements for amino acids have changed during the past 10 to 15 years. This has resulted in an increase in dietary lysine concentrations in diets for lactating sows. With the increase in dietary lysine concentration, however, other amino acid concentrations should be increased proportionally in a ratio relative to lysine. Methionine concentrations may become limiting as more soybean meal is added to the diet to increase the dietary lysine concentrations. Furthermore, if crystalline lysine is used in lactation diets, concentrations of methionine, which acts as a methylating substrate for synthesis of other metabolites, will decrease relative to lysine, also increasing the potential for a deficiency. There are little data available on TSAA requirements of lactating sows. Therefore, our objectives in this study were to determine the TID TSAA:Lys ratio requirement of the high-producing lactating sow.

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Procedures

One hundred and sixty-three sows (PIC, Line 1050) were blocked by parity and were allotted to one of five diets. The sows used in this study were farrowed in six groups, with approximately 29 sows per group, at the KSU Swine Teaching and Research Center. Sows were randomly assigned to treatments on the basis of parity when entering the farrowing house on day 110 of gestation. During lactation, sows were provided *ad libitum* access to feed and water, and feed disappearance was recorded. All sows were fed a diet based on corn-soybean meal, containing 1,534 kcal of ME per lb. The diets were formulated to 0.44, 0.48, 0.53, 0.57, or 0.62% TID TSAA, which corresponds to a TID TSAA:Lys ratio of 50, 55, 60, 65 and 70% of lysine, respectively. (Table 1). All diets were formulated to contain 0.88% TID lysine (0.97% total lysine) and contained other crystalline amino acids to ensure that TSAA was first limiting. We selected 0.88% TID lysine based on previous studies at this research farm so that we would be slightly below the sows requirement for lysine, and, thus, be able to accurately determine the TSAA ratio relative to lysine.

All sows were weighed after farrowing and again at weaning to calculate weight change during lactation. Backfat was measured with a Renco Leanmeter® at the last rib, upon entering the farrowing house on d 110 of gestation and on d 18 of lactation, to determine change in backfat during lactation. Blood samples were obtained by venipuncture on d 18 of lactation from each sow, after a 3-h period of feed withdrawal, and samples were analyzed for plasma urea N (PUN). Cross-fostering occurred before d 2 to standardize all litters with approximately 11 pigs. Pigs were weighed individually at birth, after fostering on d 2, and again at weaning. Any pigs removed from the trial were recorded, along with their date of removal and weight. Data were analyzed by using the Mixed procedure of SAS.

Table 1. Composition of Diets (As-fed Basis)[a]

Item	Percent
Corn	76.09
Soybean meal (46.5%)	16.00
Soybean oil	2.50
Monocalcium P (21% P, 18% C)	2.00
Limestone	1.00
L-lysine HCl	0.37
L-valine	0.31
L-isoleucine	0.04
L-tryptophan	0.05
L-threonine	0.20
DL-methionine	---
Salt	0.50
Vitamin premix	0.25
Trace mineral premix	0.15
Sow add pack	0.25
Sand[c]	0.30
Total	100.00
Calculated Analysis	
ME, kcal/lb	1,534
Crude protein, %	13.91
Total lysine, %	0.97
TID amino acids, %	
Lysine, %	0.88
Methionine, %	0.21
Met + Cys, %	0.44
Valine, %	0.88
Threonine, %	0.64
Tryptophan, %	0.18
Isoleucine, %	0.53
Leucine, %	1.21
Ca, %	0.83
P, %	0.74
Available P, %	0.48

[a]All diets are formulated to contain 0.88% TID lysine.

[c]Crystalline amino acid diets are formulated to contain increasing TID TSAA:Lys ratios of 50.0, 55.0, 60.0, 65.0, and 70.0%. DL-methionine was added to the crystalline amino acid diets at the expense of sand to achieve desired TID TSAA rates.

Results and Discussion

Increasing TID TSAA:Lys had no effect on ADFI over the lactation period ($P>0.14$; Table 2). Sow body weight and backfat loss during lactation were not affected ($P>0.14$) by dietary TID TSAA:Lys ratio. Increasing dietary TID TSAA:Lys did not affect ($P>0.29$) PUN when blood was sampled on day 18 of lactation. Total sulfur amino acid to lysine ratio did not affect total litter weight at weaning ($P>0.25$; Table 3). Sows nursed an average of 9.85 pigs during lactation, and preweaning mortality increased (linear, $P<0.09$) as the TID TSAA:Lys ratio increased, but this response was variable, in that sows fed TSAA at 65% of lysine had the best preweaning survival and those fed either 60 or 70% had greatest preweaning mortality.

One concern with expressing the TSAA rates on a ratio to lysine is that sows can not be above their lysine requirement for accurate determination. To support the 101 lbs of litter weight gain from d 2 to 21, sows would have had to consume more than 54 g of TID lysine per day. With ADFI of approximately 13 lb/day, sows on the diets with high concentrations of crystalline amino acids actually consumed approximately 53 g of TID lysine per day. Thus, sows were below their lysine requirement in our study, allowing for an accurate calculation of a TSAA:Lys ratio. There was no difference seen in litter performance from sows fed the experimental diets, but the litters suckling sows fed the diet containing 50% TID TSAA:Lys ratio had the most gain. This ratio is less than the ratio of approximately 61% calculated from estimates of the National Research Council (1998)

Amino acid requirements for lactating sows are generally difficult to calculate because a small sample size may produce variable results. To our knowledge, there has been only one published journal article that researched the sulfur amino acid requirements of lactating sows. The results of that trial suggest a requirement of 0.23 to 0.36% total dietary sulfur amino acid for a diet containing 0.52% lysine. This would calculate to a range in total TSAA:lys ratios of from 44 to 69%. In a preliminary trial that we conducted, the ratio of TID TSAA to lysine was greater than 50%. In this study, however, there was no significant difference in litter weight gain among the experimental treatments, with the greatest gain found at 50% TID TSAA:Lys ratio. The discrepancies between the previous study in our lab and the current research may be due to the large amount of sow body tissue that was mobilized. The breakdown in tissue would have allowed the lactating sow fed the low TSAA:Lys ratio diets to obtain essential amino acids necessary for milk production. Thus, the mobilization of body reserves of these sows buffered them from a dietary restriction of amino acid intake. Furthermore, other authors and the NRC (1998) have suggested that the ideal amino acid profile may change in relation to the rate of sow body tissue mobilization during lactation. The sows in this study lost amounts of weight similar to those in the NRC (1998) model that suggests a TID TSAA:Lys ratio of 61%, but maximal litter gain was achieved at a ratio of 50%. The difference in ratio may be explained by an increased loss of body protein in the modern sow versus sows used in the NRC (1998) model. Additional research is needed to determine the effects of a high amino acid intake, coupled with tissue breakdown, as a possible source of TSAA, thus decreasing the dietary requirement.

Table 2. Effects on Sow Performance of Increasing Dietary True Ileal Digestible Total Sulfur Amino Acids (TSAA) During Lactation[a]

	True Ileal Digestible TSAA:Lysine Ratio (%)[b]						Probability, P <	
Item	50	55	60	65	70	SE	Linear	Quad-ratic
Number of sows	32	35	32	32	32			
Lactation length, d	20.7	20.2	19.9	19.4	19.9			
ADFI, lb	13.4	12.7	13.2	12.9	13.6	0.46	0.14	0.21
Sow weight, lb								
Day 2	522.9	523.2	514.3	495.4	511.3	11.39	0.28	0.15
Weaning	493.2	494.5	492.9	474.9	491.9	11.38	0.40	0.07
Loss	29.5	29.0	21.6	20.3	19.2	4.63	0.53	0.47
Backfat, mm								
Day 2	16.8	17.6	17.4	16.8	16.5	0.65	0.51	0.30
Weaning	14.4	15.3	15.7	15.0	14.7	0.62	0.87	0.14
Loss	2.3	2.3	1.8	1.9	1.8	0.54	0.36	0.78
PUN, mM	3.51	3.86	3.58	3.84	3.83	0.18	0.29	0.79

[a]Lactation length was used as a covariate to analyze sow and litter performance.
[b]All diets are formulated to contain 0.88% TID lysine.

Table 3. Effects on Litter Performance of Increasing Dietary True Ileal Digestible Total Sulfur Amino Acids (TSAA) During Lactation[a]

	True Ileal Digestible TSAA:Lys Ratio (%)[b]						Probability, P <	
Item	50.0	55.0	60.0	65.0	70.0	SE	Linear	Quadratic
Number of sows	32	35	32	32	32			
Day 2 No. pigs	10.7	10.4	10.5	10.7	10.5	0.22	0.43	0.75
Day 2 litter wt, lb	34.7	32.9	33.1	32.6	33.8	1.05	0.33	0.31
No. of pigs weaned	10.1	9.8	9.6	10.2	9.5	0.21	0.11	0.61
Litter weaned wt, lb	143.4	134.5	131.5	128.8	134.1	4.26	0.25	0.70
Litter wt. gain, lb[c]	108.7	101.7	98.4	96.1	100.2	3.82	0.34	0.90
Preweaning mortality, %[c]	5.5	5.7	8.2	4.4	8.2	1.41	0.09	0.69

[a]Lactation length was used as a covariate to analyze sow and litter performance.
[b]All diets are formulated to contain 0.88% TID lysine.
[c]Calculated from d 2 to weaning.