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The effects of an "ideal protein" lactation diet on sow and litter performance

Abstract

Four hundred lactating sows were used to determine the influence of an ideal protein lactation diet on sow productivity. Sows were fed either a 15.8% crude protein, corn soybean meal, control diet or a 12.6% protein diet supplemented with synthetic amino acids to a 15.8% crude protein equivalent. Lactation diet had no influence on litter weaning wt (114.5 vs 114.7 lb), daily feed intake (12.5 vs 12.7 lb), pig survivability (92.3 vs 93.1 %), or sow backfat loss (.11 vs .12 in). However, sows fed the ideal protein diet lost more weight than sows fed the control diet (18.6 vs 25.1 lb). These results indicate that an ideal protein diet based on synthetic amino acid additions can be effectively used during lactation without depressing sow milk production, as measured by litter weaning wt. However, the ideal protein diet did not improve sow productivity and resulted in increased sow weight loss.; Swine Day, Manhattan, KS, November 21. 1991

Keywords

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THE EFFECTS OF AN "IDEAL PROTEIN" LACTATION DIET ON SOW AND LITTER PERFORMANCE[1]

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Summary

Four hundred lactating sows were used to determine the influence of an ideal protein lactation diet on sow productivity. Sows were fed either a 15.8% crude protein, corn-soybean meal, control diet or a 12.6% protein diet supplemented with synthetic amino acids to a 15.8% crude protein equivalent. Lactation diet had no influence on litter weaning wt (114.5 vs 114.7 lb), daily feed intake (12.5 vs 12.7 lb), pig survivability (92.3 vs 93.1%), or sow backfat loss (.11 vs .12 in). However, sows fed the ideal protein diet lost more weight than sows fed the control diet (18.6 vs 25.1 lb). These results indicate that an ideal protein diet based on synthetic amino acid additions can be effectively used during lactation without depressing sow milk production, as measured by litter weaning wt. However, the ideal protein diet did not improve sow productivity and resulted in increased sow weight loss.

(Key Words: Sow, Performance, AA, Intake, Protein)

Introduction

Ideal protein is a term used to describe a diet with a pattern of amino acids in the exact proportion required by the pig. Typical corn- or milo-soybean meal diets are formulated to the lysine requirement of the pig, because it is the first-limiting amino acid. This results in a diet with excess levels of all other essential amino acids. In theory, pigs should perform optimally if all amino acids are provided in the exact proportion to their requirements. In a true ideal protein diet, all amino acids would be equally limiting and none would be present in excess. Amino acids in excess of the pig's requirement must be deaminated and broken down, and the nitrogen must be removed from the body. The deamination and nitrogen removal process requires energy. Thus, in theory, decreasing the amount of excess amino acids that must be deaminated should conserve energy for other body functions, such as milk production, reproduction, or growth.

Lactating sows are often in a negative energy state. Milk production requires more energy than sows consume in most production units. Therefore, any dietary change that alters metabolism to conserve energy should increase production. Decreasing excess amino acids by feeding an ideal protein diet should be one means of conserving energy. Therefore, the objective of this trial was to determine the influence of an ideal protein lactation diet on sow productivity.

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Procedures

At farrowing, 400 crossbred sows were randomly assigned to a 15.8% crude protein diet (Control) or a 12.6% crude protein diet supplemented with amino acids in an ideal protein ratio (Ideal). The ideal protein diet was formulated by using corn and soybean meal to meet the isoleucine requirement, with synthetic amino acids added to achieve the desired dietary levels of lysine, valine, threonine, tryptophan, and methionine (Table 1). The ideal amino acid ratio used to formulate the diets was the ratio suggested for the lactating sow by NRC (1988). This ratio, adjusted to a .8% lysine diet, and the amino acid concentrations in the experimental diets are listed in Table 2. Diets were calculated to contain .80% lysine, .9% calcium, and .8% phosphorus.

Sows were weighed and ultrasonically scanned for backfat at farrowing and weaning to determine weight and backfat loss. Litters were standardized by d 2 of lactation. Litters were weighed at farrowing and weaning. Sow were provided ad libitum access to feed during lactation, and feed intake was recorded daily.

Table 1. Composition of Experimental Diets, %

Ingredient	Control	Ideal
Corn	72.14	80.33
SBM (47% CP)	20.50	11.57
Soybean oil	3.00	3.00
Monocalcium phosphate (21% P)	2.22	2.39
Limestone	1.00	1.02
Salt	.50	.50
Vitamin premix[a]	.25	.25
Sow add pac[b]	.25	.25
Trace mineral premix[c]	.15	.15
Amino acid mix[d]	.54	—
Total	100.00	100
Calculated Analysis		
Crude protein, %	15.8	12.6
Lysine, %	.80	.80
Metabolizable energy, Mcal/lb	1533	1523

[a]Each lb of premix contains: 2,000,000 IU vitamin A, 200,000 IU vitamin D, 8,000 IU vitamin E, 800 mg menadione, 6 mg vitamin B_{12}, 1,500 mg riboflavin, 5,200 mg pantothenic acid, 9,000 mg niacin, and 30,000 mg choline.

[b]Each lb of premix contains: 70,000 mg choline, 40 mg biotine, and 300 mg folic acid.

[c]Each lb of premix contains: 50 g zinc, 50 g iron, 12 g menganese, 5 g copper, 90 mg iodine, and 90 mg selenium.

[d]Amino acid mix supplied ideal diet with .316% L-lysine HCl, .137% L-valine, .078% L-threonine, .01% L-tryptophan, and .001% L-methionine.

Table 2. Amino Acid Levels in Experimental Diets, %

Amino Acid	Ideal Ratio[a]	Control	Ideal Protein
Lysine	.80	.80	.80
Arginine	.54	1.04	.76
Histidine	.34	.43	.35
Isoleucine	.52	.68	.52
Leucine	.64	1.58	1.36
Met & Cys	.48	.57	.48
Phe & Tyr	.94	1.41	1.13
Threonine	.58	.64	.58
Tryptophan	.16	.20	.16
Valine	.80	.84	.80

[a]Ideal ratio is the ratio suggested for the lactating sow by NRC (1988) adjusted to .8% lysine. This ratio was used to formulate the ideal protein diet.

Results and Discussion

There were no parity by diet interactions for any of the response criteria. There were no differences related to diet for number of pigs born alive, after equalization, or weaned (Table 3). Piglet survivability averaged 92.7% and was not different between lactation diets. Litter birth wt and weaning wt were not affected by treatment.

Sows fed the ideal protein diet were slightly heavier at farrowing ($P < .05$) and lost more weight ($P < .01$) during lactation than sows fed the control diet. Backfat at farrowing or weaning was not affected by treatment. Feed intake increased as lactation progressed; however, diet did not influence feed intake.

The results of this trial can be viewed in two different ways. First, feeding the ideal protein diet did not decrease litter weaning wt, indicating that a portion of the protein in the lactation diet can be replaced with synthetic amino acids without influencing sow productivity. These results suggest that synthetic amino acids can be effectively used in sow lactation diets when an ideal amino acid ratio is maintained.

However, a second perspective is that sows fed the ideal protein diet should have had fewer amino acids to deaminate and, thus, more energy available for milk production. This should have resulted in increased litter weaning wt. Actually, litter weaning wt was not changed and sow wt loss increased for sows fed the ideal protein diet compared to sows fed the control diet. Several possible reasons may be cited for the failure of the ideal protein diet to improve sow productivity in this experiment. The energy savings from deamination of fewer excess amino acids may not have been great enough to increase milk production. Also, the ideal amino acid ratio listed by NRC (1988) may not be applicable to high-producing sows. Many of the amino acid requirements listed by NRC (1988) were determined using sows that weaned 7 to 8 pigs per litter. The simple upwards adjustment of all amino acids in a constant ratio may not be appropriate. Additionally, faster absorption rates for synthetic amino acids may have decreased their utiliza-

tion for protein synthesis and limited the effectiveness of the ideal protein.

In conclusion, these results indicate that an ideal protein diet based on synthetic amino acid additions can be effectively used during lactation without depressing sow milk production, as measured by litter weaning wt. However, similar to the response in earlier experiments with the growing-finishing pig, formulating the lactation diet to an ideal amino acid ratio did not improve performance.

Table 3. Influence of Ideal Protein Diet on Sow Productivity

Item	Control	Ideal Protein	CV[a]
No. of sows	190	210	
Lactation length, d	20.1	20.1	10.6
Pig performance			
No. pigs born alive	9.43	9.66	24.3
No. pigs after equalization	9.67	9.62	15.9
No. pigs weaned	8.86	8.90	15.7
Pig survival, %	92.3	93.1	11.6
Litter birth wt, lb	34.4	34.5	23.9
Litter wean wt, lb	114.5	114.7	20.6
Sow performance			
Postfarrowing wt, lb[b]	470.3	479.7	9.7
Weaning wt, lb	451.8	454.5	10.5
Wt loss, lb[c]	18.6	25.1	105.8
Postfarrowing backfat, in	.95	.93	22.3
Weaning backfat, in	.84	.81	21.1
Backfat loss, in	.11	.12	110.8
Feed intake, lb/d			
Week 1	9.8	10.0	27.0
Week 2	13.1	13.6	21.9
Week 3	14.6	14.8	36.2
Overall	12.5	12.7	18.6

[a]CV = coefficient of variation.
[b]Diet effect ($P < .05$).
[c]Diet effect ($P < .01$).