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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
Swine day, 1991; Kansas Agricultural Experiment Station contribution; no. 92-193-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 641; Swine; Sow; Performance; AA; Intake; Protein

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

M. D. Tokach, R. D. Goodband, J. L. Nelssen,
J. L. Laurin, J. A. Hansen,
R. D. Richards, and C. E. Huffman

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 de-
pressing 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 re-
moval 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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1Appreciation is expressed to Nutri-Quest, Inc. for donating synthetic amino acids used for the
trial. The authors also wish to thank Dale Keesecker and Keesecker Agribusiness, Washington,
KS, for use of facilities and animals.
2Extension Specialist, Livestock Production and Management, Northeast; Northeast Area
Extension Office, 1515 College Ave., Manhattan, KS 66502.
3Keesecker Agribusiness, Inc., Washington, KS.
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, %

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Control</th>
<th>Ideal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>72.14</td>
<td>80.33</td>
</tr>
<tr>
<td>SBM (47% CP)</td>
<td>20.50</td>
<td>11.57</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Monocalcium phosphate (21% P)</td>
<td>2.22</td>
<td>2.39</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.00</td>
<td>1.02</td>
</tr>
<tr>
<td>Salt</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>Vitamin premix(^a)</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>Sow add pac(^b)</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>Trace mineral premix(^c)</td>
<td>.15</td>
<td>.15</td>
</tr>
<tr>
<td>Amino acid mix(^d)</td>
<td>.54</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100</td>
</tr>
</tbody>
</table>

Calculated Analysis

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Ideal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein, %</td>
<td>15.8</td>
<td>12.6</td>
</tr>
<tr>
<td>Lysine, %</td>
<td>.80</td>
<td>.80</td>
</tr>
<tr>
<td>Metabolizable energy, Mcal/lb</td>
<td>1533</td>
<td>1523</td>
</tr>
</tbody>
</table>

\(^a\)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 manganese, 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, %

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Ideal Ratio*</th>
<th>Control</th>
<th>Ideal Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysine</td>
<td>.80</td>
<td>.80</td>
<td>.80</td>
</tr>
<tr>
<td>Arginine</td>
<td>.54</td>
<td>1.04</td>
<td>.76</td>
</tr>
<tr>
<td>Histidine</td>
<td>.34</td>
<td>.43</td>
<td>.35</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>.52</td>
<td>.68</td>
<td>.52</td>
</tr>
<tr>
<td>Leucine</td>
<td>.64</td>
<td>1.58</td>
<td>1.36</td>
</tr>
<tr>
<td>Met &amp; Cys</td>
<td>.48</td>
<td>.57</td>
<td>.48</td>
</tr>
<tr>
<td>Phe &amp; Tyr</td>
<td>.94</td>
<td>1.41</td>
<td>1.13</td>
</tr>
<tr>
<td>Threonine</td>
<td>.58</td>
<td>.64</td>
<td>.58</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>.16</td>
<td>.20</td>
<td>.16</td>
</tr>
<tr>
<td>Valine</td>
<td>.80</td>
<td>.84</td>
<td>.80</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Ideal Protein</th>
<th>CVa</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of sows</td>
<td>190</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>Lactation length, d</td>
<td>20.1</td>
<td>20.1</td>
<td>10.6</td>
</tr>
</tbody>
</table>

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, lbb           470.3         479.7         9.7
- Weaning wt, lb                 451.8         454.5         10.5
- Wt loss, lbc                   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

CV = coefficient of variation.

bDiet effect (P < .05).

cDiet effect (P < .01).