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The effect of protein level and added amino acids in sorghum grain-soybean meal rations for swine

Abstract

More information is needed on the optimum level of protein in sorghum grain-soybean meal rations for swine. Theoretically the protein value of a swine ration should be improved if the most limiting amino acids are added. This experiment was conducted to determine the most favorable level of protein in sorghum grain-soybean meal rations and the effect of added lysine and methionine.; Swine Day, Manhattan, KS, September 26, 1968

Keywords

Swine day, 1968; Swine; Sorghum; Protein; Amino acid; Methionine

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The Effect of Protein Level and Added
Amino Acids in Sorghum Grain-Soybean
Meal Rations for Swine

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More information is needed on the optimum level of protein in sorghum grain-soybean meal rations for swine.

Theoretically the protein value of a swine ration should be improved if the most limiting amino acids are added.

This experiment was conducted to determine the most favorable level of protein in sorghum grain-soybean meal rations and the effect of added lysine and methionine.

Procedure

Forty Duroc, Poland and Poland-Duroc crossbred pigs averaging about 70 pounds at the beginning of experiment were divided into 10 groups of 4 pigs each (3 gilts and 1 barrow). Two groups were randomly assigned to each of 5 ration treatments (See Table 1 for rations).

Pelleted, fortified, sorghum grain - soybean meal rations were fed with the following calculated composition: Lot 1, 16% protein; Lot 2, 13% protein; Lot 3, 15% protein; Lot 4, 13% protein + 0.2% Lyamine 50 (50% L-Lysine) + 0.03% DL-Methionine. Lots 1, 2 and 3 were set up to determine optimum protein levels for gain and feed/gain ratio, as well as for optimum carcass meatiness. Lot 4 was used to determine if supplementation with lysine and methionine would improve protein utilization above that of the 13% protein ration, possibly to the equivalent of the 15 or 16% protein rations. Lot 5 had a still lower protein content but lysine and methionine (3 times level supplemented to Lot 4) were added. Calcium - phosphorus ratios were equal in all rations. Rations were self fed and the experiment was initiated on August 17, 1966. Protein level was not reduced as pigs became heavier.

Table 2 shows the lysine and methionine requirements for the finishing hog for the various protein levels used. Amino acid requirements, as % of ration, increase as ration protein level increases but not in an amount proportionate with protein level. The level of lysine and methionine in all rations appears adequate to meet requirements, but additional amounts above minimum requirements may enhance growth and carcass composition, unless some other amino acid becomes limiting.

Table 1

Protein Level and Added Amino Acids with
Sorghum Grain-Soybean Meal Rations for Swine

| Ingredients | Composition of Rations | | | | |
|---------------------------------------|------------------------|-------|-----------------------------|-----------------------------|-------|
| | Lot 1 | Lot 2 | Lot 3 | Lot 4 | Lot 5 |
| | 16% | 13% | 15% | 13% | 12% |
| | | | +lysine +Methionine (1X) | +lysine +Methionine (3X) | |
| Pounds | | | | | |
| Soybean meal (44%) | 100 | 50 | 82.5 | 52.5 | 25 |
| Sorghum grain | 384 | 432 | 401 | 429 | 482 |
| Di-Cal Phos | 5.0 | 6.5 | 5.0 | 5.0 | 6.5 |
| Limestone | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Salt | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Trace Mineral (CCCZ5) ^a | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Grams | | | | | |
| Vit D (15,000) | 5 | 5 | 5 | 5 | 5 |
| Vit A (10,000) | 75 | 75 | 75 | 75 | 75 |
| B - Comp (Merck 1-2-3-3) ^b | 75 | 75 | 75 | 75 | 75 |
| B ₁₂ | 50 | 50 | 50 | 50 | 50 |
| Aurofac 10 ^c | 227 | 227 | 227 | 227 | 227 |
| Sorghum grain | 1863 | 1863 | 1863 | 894 | 522 |
| Lyamine 50 ^d | --- | --- | --- | 908 | 908 |
| Methionine | --- | --- | --- | 136 | 408 |

^aTrace Mineral Mix contains 5% Zinc.

^bMerck 1-2-3-3 contains 80 gms. Choline chloride, 24 gms. Niacin, 8 gms. Riboflavin, 16 gms. Calcium Pantothenate per lb.

^cAurofac 10 supplies 10 gms. aureomycin hydrochloride per lb.

^dLyamine 50 contains 226 gms. L-Lysine activity per lb.

Pigs were individually slaughtered in the Animal Science and Industry Department meat laboratory as they reached 200 + 10 pounds live weight. Carcass measurements and cut-out data were obtained by standard methods. Color, firmness and marbling of the ham butt surface and the loin eye cross-section at the 10th rib were subjectively evaluated using Wisconsin Special Bulletin #9 as a guide.

Results

Average daily gain was significantly affected by ration (Table 3) with slowest gains in the group receiving 12% protein plus lysine and the higher level of added methionine (lot 5) and most rapid gains in the group receiving 16% protein (Lot 1). Days on test tended to follow daily gain very closely, with slowest gaining pigs being on test the longest, although differences were not significant. One should keep in mind that 6 out of 8 pigs in each group were gilts and similar results might not be obtained if predominantly barrows were fed.

Perhaps another amino acid became severely limiting in the Lot 5 ration. Pronounced amino acid imbalances can cause sharply reduced gains.

Earlier work has shown that addition of lysine in crystalline form can adversely affect ration palatability and reduce daily feed consumption. Daily feed consumption tended to decrease in Lot 5, but was not reduced in Lot 4 where a similar amount of lysine was added. Therefore, one cannot conclude that this form of lysine reduced feed consumption.

Feed to gain ratio was not significantly affected by treatment. Adding lysine and methionine to a 13% protein ration (Lot 4) resulted in slight improvement in feed to gain ratio over that shown by pigs receiving 13% protein.

The varied results obtained here indicate that added levels of amino acids for swine rations should be calculated very carefully to avoid imbalances. Daily protein consumption varied considerably between groups and was highest in Lot 1 where pigs consumed the most feed daily and rations contained a higher protein level. When ration crude protein per pound of gain was calculated, this was highest for Lot 1 and lowest for Lot 5, with no difference between other groups.

Carcass length, backfat thickness and dressing % were not significantly affected by ration (Table 4). However, loin eye size was improved by higher ration protein levels (15% and 16% compared to 13%) and also by adding lysine and methionine to a 13% protein ration (Lot 4 compared to Lot 2).

Table 2

Protein Level and Added Amino Acids With
Sorghum Grain - Soybean Meal Rations For Swine

Protein and Amino Acid Composition and
Amino Acid Requirements

| | Lot 1 | Lot 2 | Lot 3 | Lot 4 | Lot 5 |
|-------------------------------|---------------|-------|-------|------------------|------------------|
| | Protein Level | | | | |
| | 16% | 13% | 15% | 13% | 12% |
| | | | | +lysine | +lysine |
| % of Ration | | | | +Methionine (1X) | +Methionine (3X) |
| By Analysis ^a | | | | | |
| Protein | 15.85 | 12.38 | 15.10 | 13.40 | 11.25 |
| Lysine | 0.78 | 0.49 | 0.54 | 0.68 | 0.52 |
| Methionine | 0.33 | 0.23 | 0.23 | 0.24 | 0.34 |
| Requirement for Finishing Pig | | | | | |
| Lysine | 0.62 | 0.53 | 0.59 | 0.53 | 0.50 |
| Methionine | 0.37 | 0.32 | 0.35 | 0.32 | 0.30 |
| Methionine X60% ^b | 0.22 | 0.19 | 0.21 | 0.19 | 0.18 |

^aDetermined by chemical analysis using Beckman 120 autoanalyzer.

^bThis assumes that 40% of methionine requirement can be supplied by cystine.

Table 3

Protein Level and Added Amino Acids With
Sorghum Grain - Soybean Meal Rations For Swine

Feed and Gain Data
(Ration Means)

| | Lot 1 | Lot 2 | Lot 3 | Lot 4 | Lot 5 |
|------------------------------|-------------------|--------------------|--------------------|-----------------------------|-----------------------------|
| | Protein Level | | | | |
| | 16% | 13% | 15% | 13% | 12% |
| | | | | +lysine +Methionine (1X) | +lysine +Methionine (3X) |
| No. of pigs | 8 | 8 | 8 | 8 | 8 |
| Initial weight, lbs. | 71.2 | 71.1 | 71.5 | 69.6 | 70.4 |
| Final weight, lbs. | 202.7 | 190.5 | 200.8 | 206.4 | 193.2 |
| Days on test | 74.8 | 82.9 | 80.8 | 86.6 | 91.7 |
| Average daily gain, lbs. | 1.87 ^c | 1.63 ^{ab} | 1.74 ^{bc} | 1.69 ^{bc} | 1.45 ^a |
| Daily feed consumption, lbs. | 5.61 | 5.04 | 5.00 | 5.14 | 4.64 |
| Feed/gain ratio | 3.02 | 3.48 | 2.88 | 3.10 | 3.38 |
| Daily protein intake, lbs. | 0.89 | 0.62 | 0.76 | 0.69 | 0.52 |
| Crude protein/gain, lbs. | 0.48 | 0.43 | 0.43 | 0.42 | 0.38 |

a,b,c Means on the same line with the same superscript or no superscript are not significantly different (P<.05).

Table 4

Protein Level and Added Amino Acids With
Sorghum Grain - Soybean Meal Rations for SwineCarcass Data
(Ration Means)

| | Lot 1 | Lot 2 | Lot 3 | Lot 4 | Lot 5 |
|---------------------------|--------------------|-------------------|-------------------|--------------------|--------------------|
| | 16% | 13% | 15% | 13% | 12% |
| | | | Protein Level | | |
| | | | +lysine | | |
| | | | +Methionine (1X) | | +Methionine (3X) |
| Chilled Carcass Wt., lbs. | 148.6 | 139.2 | 150.6 | 152.9 | 143.8 |
| Dressing % | 77.1 | 74.8 | 76.9 | 78.0 | 76.3 |
| Carcass Length, inches | 28.6 | 28.1 | 28.8 | 28.8 | 28.6 |
| Backfat Thickness, inches | 1.41 | 1.39 | 1.25 | 1.41 | 1.28 |
| Loin Eye Area sq. inches | 4.30 ^{bc} | 3.63 ^a | 4.73 ^c | 4.31 ^{bc} | 4.10 ^{ab} |
| % of Carcass Weight | | | | | |
| Ham + Loin | 35.2 | 34.0 | 36.2 | 35.1 | 35.3 |
| 4 Lean Cuts | 52.8 | 51.5 | 54.4 | 52.7 | 52.7 |
| 5 Primal Cuts | 71.3 | 70.7 | 73.7 | 71.4 | 72.1 |
| Ham Loin Index | 89.3 | 76.9 | 101.2 | 97.0 | 91.4 |
| Loin Eye Score | | | | | |
| Color | 2.7 | 2.9 | 2.4 | 2.3 | 2.2 |
| Firmness | 2.2 | 2.8 | 2.1 | 2.4 | 2.1 |
| Marbling | 2.5 | 2.9 | 1.9 | 2.8 | 2.4 |
| Ham Score | | | | | |
| Color | 2.4 | 2.5 | 2.1 | 2.2 | 2.1 |
| Firmness | 2.3 | 2.2 | 2.1 | 2.2 | 1.9 |
| Marbling | 2.5 | 2.6 | 2.1 | 2.1 | 2.1 |

a,b,c Means on the same line with the same superscript or no superscript are not significantly different ($P < .05$).

Carcass yields of ham plus loin, 4 lean cuts and 5 primal cuts were not significantly affected, although they tend to be lowest for the 13% protein group with no added amino acids and highest for the 15% protein group. Ham - loin index follows the same trend.

A logical conclusion would be that the 15% protein ration was completely satisfactory, since carcass yields of valuable cuts and also loin eye area was largest for this group. At the same time gains compared favorably to the group receiving 16% protein but the ration crude protein to gain ratio tended to be lower.

Limited growth, such as shown in Lot 5, often results in greater carcass trimness and improved cut-out values without an actual improvement in muscling.

Color, firmness and marbling of ham or loin muscling was not affected by treatment.

Summary

Forty pigs of Duroc, Poland, and Duroc-Poland breeding were self fed pelleted, fortified rations containing varying sorghum grain - soybean meal rations to supply 16, 13 and 15% protein without supplemental amino acids, also 13% and 12% protein plus lysine and methionine. Pigs weighed about 70 pounds at the start and were individually removed from test for slaughter when weighing 200 ± 10 pounds. The following results were noted:

1. Slowest gains were recorded by pigs receiving 12% protein plus lysine and methionine and most rapid gains were found for pigs receiving 16% protein.
2. Carcass yield of ham plus loin, 4 lean cuts or 5 primal cuts was not affected. Carcass length or backfat was not altered by ration but loin eye area was improved by higher protein rations and by addition of lysine and methionine to the 13% protein ration.
3. Muscle color, firmness and marbling was not affected by treatments used in this study.