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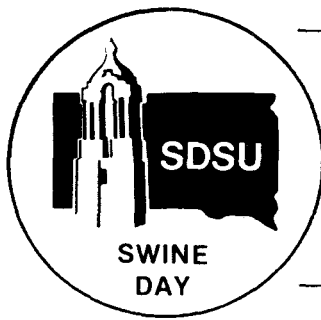
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EFFECTS OF EXCESS ARGININE ON LYSINE UTILIZATION
IN WEANED PIGS

D. L. Hagemeyer, G. W. Libal And R. C. Wahlstrom

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Much attention has been focused recently on the use of "balanced protein" feeds for swine. By using different combinations of protein sources and some synthetic amino acids, a more balanced array of essential amino acids can be achieved in the feed. This will reduce the amount of excess or "wasted" essential amino acids present in the diet, and it may also reduce or eliminate any specific antagonisms that might exist between two amino acids.

One possible antagonism is the relationship between lysine and arginine. In a corn-soybean meal starter diet, lysine is the first-limiting amino acid while arginine is present at levels approximately five times the amount required by the pig. Research at other universities has indicated that very high levels of dietary arginine can inhibit the absorption of lysine from the small intestine, making less lysine available to the pig for growth.

This research was conducted to evaluate the effect of excess arginine on the growth, feed efficiency, and plasma lysine and arginine levels of weanling pigs.

Experimental Procedure

A total of 96 4-week-old weanling pigs with an average initial weight of 18.1 pounds were allotted to four replications of the six treatments shown in table 1. There were four pigs per pen for a total of 16 pigs per treatment. The pigs were housed in the environmentally controlled swine room in the Animal Science Complex during the 4-week study.

The six treatments were in a 2 x 3 factorial arrangement, with two levels of lysine (.90% and 1.15%) and three levels of arginine (.90%, 1.20% and 1.15%) used. The lower lysine level was considered to be marginally adequate for the size of pigs used in this experiment, while the higher lysine level was considered adequate to support maximum growth in those pigs. The basal diet was formulated to have a low arginine/lysine ratio, and then synthetic arginine and lysine were added to create the six treatments shown in table 1. This approach was used so that arginine levels could be varied while the source and level of natural protein remained constant across treatments, thus eliminating any confounding effects of changing protein sources.

TABLE 1. PERCENT COMPOSITION OF DIETS

Total arginine, %	.90	1.20	1.50	.90	1.20	1.50
Total lysine, %	.90	.90	.90	1.15	1.15	1.15
Arginine/lysine ratio	1.00	1.33	1.67	.78	1.04	1.30
Corn	34.92	34.55	34.18	34.60	34.23	33.86
Rolled oats groats	48.87	48.87	48.87	48.87	48.87	48.87
Fish meal	3.50	3.50	3.50	3.50	3.50	3.50
Dried skim milk	10.00	10.00	10.00	10.00	10.00	10.00
Dicalcium phosphate	1.03	1.03	1.03	1.03	1.03	1.03
Limestone	.54	.54	.54	.54	.54	.54
Vitamin antibiotic premix ^a	.44	.44	.44	.44	.44	.44
Trace mineralized salt ^b	.50	.50	.50	.50	.50	.50
L-lysine HCl	.20	.20	.20	.52	.52	.52
L-arginine HCL	---	.37	.74	---	.37	.74

^aSupplied per pound of diet: vitamin A, 2000 IU; vitamin D, 200 IU; vitamin E, 4 IU; vitamin K, 1.6 mg; riboflavin, 2 mg; pantothenic acid, 8 mg; niacin, 12.8 mg; choline, 80 mg; vitamin B₁₂, 8 mcg; selenium, 72 mcg; penicillin, 25 mg; aureomycin, 50 mg; sulfamethazine, 50 mg; zinc,^b 40 milligrams.
^b.8% zinc.

Results

The results of the experiment are summarized in table 2. The addition of arginine to the diets had no effect on average daily gain or average daily feed intake except that pigs fed the high lysine/medium arginine diet gained

TABLE 2. EFFECT OF EXCESS ARGININE ON PIG PERFORMANCE AND PLASMA AMINO ACIDS

Dietary arginine, %	.90	1.20	1.50	.90	1.20	1.50
Dietary lysine, %	.90	.90	.90	1.15	1.15	1.15
Arginine/lysine ratio	1.00	1.33	1.67	.78	1.04	1.30
Initial pig wt, lb	18.1	18.1	18.1	18.1	18.1	18.1
4-week pig wt, lb	38.0	37.6	36.4	40.4	37.2	40.4
Average daily gain, lb ^a	.71	.70	.65	.80	.67	.79
Average daily feed, lb ^a	1.43	1.41	1.39	1.51	1.30	1.51
Feed/gain ^b	2.01	2.02	2.13	1.89	1.94	1.91
Plasma lysine, mg/100 ml						
plasma ^{c,d}	1.96	1.94	1.76	4.92	4.59	4.20
Plasma arginine, mg/100 ml						
plasma ^{b,e}	3.47	4.10	4.75	3.02	3.92	5.32

^aQuadratic effect of arginine at high level of lysine (P<.05).

^bLinear effect of arginine at low level of lysine (P<.05).

^cLysine effect (P<.01).

^dLinear effect of arginine at high level of lysine (P<.06).

^eLinear effect of arginine at high level of lysine (P<.01).

less weight and ate less feed than those pigs fed the high lysine/low arginine diet or the high lysine/high arginine diet. This result is inconclusive and is probably due to the fact that two pigs fed the high lysine/medium arginine diet performed poorly and their performance was not representative of other pigs fed this diet.

The pigs fed the low lysine/high arginine diet were significantly less efficient than those on the low lysine/low arginine and low lysine/medium arginine diet. Although the difference was statistically significant, more research is necessary to verify this effect.

When pigs were fed the high lysine diets, additions of arginine to the feed resulted in a linear decrease in blood plasma lysine levels. Apparently the medium and high levels of dietary arginine interfered with the absorption of lysine from the small intestine into the blood. However, there was no corresponding decrease in pig performance, suggesting the pigs had enough lysine to support normal growth in spite of their reduced plasma lysine levels.

High dietary arginine did not affect plasma lysine levels in pigs fed low lysine diets. Pigs fed the low lysine/high arginine diet had slightly lower plasma lysine levels, but the decrease was not significant.

Pigs tended to gain faster and be more efficient on the high lysine diets as compared to the low lysine diets, but the effect was not significant. The addition of lysine to the diet increased plasma lysine levels, and arginine additions increased plasma arginine levels. The latter two results are to be expected, as more of those amino acids would be absorbed from the small intestine into the bloodstream.

Summary

A 4-week growth trial was conducted to determine the effect of excess arginine on lysine utilization in a group of 96 weaned pigs weighing 18.1 pounds initially. Lysine levels of .90% and 1.15% and arginine levels of .90%, 1.20% and 1.50% were used in a 2 x 3 factorial design.

Excess arginine had no effect on daily gain or feed intake. Pigs fed the low lysine/high arginine diet required more feed per pound of gain, but more research is necessary to verify this effect. Excess arginine depressed plasma lysine levels of pigs fed 1.15% lysine but not plasma lysine levels of pigs fed .90% lysine. Overall, the results of this experiment were inconclusive but showed some evidence that excess dietary arginine may interfere with lysine utilization in weaned pigs. Further research is being conducted in our laboratory to study the relationship between lysine and arginine.