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EFFECT OF POTASSIUM SUPPLEMENTATION AT TWO LEVELS OF LYSINE IN PIG STARTER DIETS

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Lysine is the first limiting amino acid in cereal-based diets for growing pigs. Lysine requirements depend on its bioavailability, the crude protein and energy level of the diet, the source of protein and its digestibility, the amino acid balance and probably the electrolyte balance of the diet.

Since most feedstuffs used in swine feeding contain more potassium than required by the pig, growing pig diets are not usually supplemented with potassium. However, research has indicated that potassium supplementation in chick diets counteracts growth depression caused by excess lysine. Potassium supplementation in low protein and/or low lysine pig diets has been found to improve weight gains.

The objective of this study was to determine whether potassium supplementation to growing pig diets containing slightly inadequate or excess lysine would improve performance. The influence of supplemental dietary lysine on plasma potassium and plasma lysine concentrations was also determined.

Experimental Procedure

Two trials involving 216 crossbred weanling pigs were conducted for this study. The pigs averaged about 18 pounds initially when allotted on the basis of weight and litter group to six treatments replicated four times. There were five pigs per pen in trial 1 and four pigs per pen in trial 2. At the completion of the trials, which were conducted for 35 and 32 days, blood samples were obtained for analysis of plasma potassium and lysine. The six treatments were as follows:

Treatment 1 -- .85% lysine, no added potassium
Treatment 2 -- .85% lysine, .4% added potassium
Treatment 3 -- .85% lysine, .8% added potassium
Treatment 4 -- 1.15% lysine, no added potassium
Treatment 5 -- 1.15% lysine, .4% added potassium
Treatment 6 -- 1.15% lysine, .8% added potassium

Tables 1 and 2 show the compositions of the diets used in the study.

TABLE 1. COMPOSITION OF DIETS (%)
TRIAL 1

Ingredients	Dietary treatments					
	1	2	3	4	5	6
Oat groats	40.0	40.0	40.0	40.0	40.0	40.0
Corn	35.0	34.6	34.2	33.4	33.8	33.0
Corn gluten meal	14.0	14.0	14.0	14.0	14.0	14.0
Meat meal	7.0	7.0	7.0	7.0	7.0	7.0
Fish meal	3.5	3.5	3.5	3.5	3.5	3.5
Trace mineralized salt	.3	.3	.3	.3	.3	.3
Vitamin antibiotic mix[a]	.2	.2	.2	.2	.2	.2
L-lysine HCl	---	.4	---	---	.4	.4
Potassium chloride	---	---	.8	1.6	.8	1.6

[a]To supply per pound: 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 B_{12}, 8 mcg; selenium, .07 mg; penicillin, 25 mg; chlortetracycline, 50 mg and sulfamethazine, 50 milligrams.

TABLE 2. COMPOSITION OF DIETS (%)
TRIAL 2

Ingredients	Dietary treatments					
	1	2	3	4	5	6
Oat groats	50.0	50.0	50.0	50.0	50.0	50.0
Ground corn	34.0	33.6	33.2	33.2	32.4	32.0
Meat meal	7.0	7.0	7.0	7.0	7.0	7.0
Fish meal	3.5	3.5	3.5	3.5	3.5	3.5
Soybean meal	3.0	3.0	3.0	3.0	3.0	3.0
Trace mineralized salt	.3	.3	.3	.3	.3	.3
Bentonite	2.0	2.0	2.0	2.0	2.0	2.0
L-lysine HCl	---	.4	---	.4	---	.4
Potassium chloride	---	---	.8	.8	1.6	1.6
Vitamin antibiotic mix[a]	.2	.2	.2	.2	.2	.2

[a]To supply per pound: 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 B_{12}, 8 mcg; selenium, .07 mg; penicillin, 25 mg; chlortetracycline, 50 mg and sulfamethazine, 50 milligrams.

Results

Pig performance data and blood plasma analyses for the two trials were combined and are given in table 3. The data obtained in this study indicated that there were no significant differences in average daily gain, final weights, feed consumption or feed per gain due to potassium supplementation in the pig diets. However, pigs receiving the low lysine diet supplemented

with either .4 or .8% potassium gained 13% faster (.70 vs .62 lb/day) than pigs fed this diet without supplemental potassium. There were significant differences in daily gain and feed per gain between pigs fed diets containing the two levels of lysine. By chemical analysis, these diets averaged .92 and 1.30% lysine, slightly higher than the calculated values of .85 and 1.15 percent.

TABLE 3. PIG PERFORMANCE AND BLOOD PLASMA ANALYSES

Dietary treatment	1	2	3	4	5	6
Dietary lysine, %	.85	.85	.85	1.15	1.15	1.15
Added potassium, %	0	.4	.8	0	.4	.8
Initial wt, lb	17.87	17.85	17.90	17.85	17.85	17.90
Final wt, lb	38.26	41.16	41.05	46.44	46.46	45.21
Average daily gain, lb	.62	.70	.70	.86	.86	.84
Average daily feed, lb	1.32	1.46	1.46	1.50	1.50	1.48
Feed/gain	2.17	2.17	2.20	1.76	1.74	1.82
Plasma lysine, mg %	4.14	4.09	3.77	5.31	5.20	5.11
Plasma potassium, meq/liter	5.36	5.97	6.23	5.40	5.74	6.12

The blood plasma data indicated that plasma lysine levels increased ($P<.01$) with increasing levels of lysine in the diet while plasma potassium simultaneously decreased ($P<.05$). Plasma potassium levels increased ($P<.01$) with increasing levels of potassium in the diet. Nonetheless, increases in dietary potassium had no effect on plasma lysine.

It thus appears that potassium supplementation is of little benefit when the diet contains slightly inadequate or excess lysine. The response to lysine indicates that the lysine requirements for maximum gain in growing pigs may be above the NRC (1979) recommendations. It is also possible that the diets, which contained a high level of arginine (1.4%), were unbalanced and the extra lysine in the high lysine diets partially corrected the imbalance and improved performance. Blood plasma levels of lysine and potassium were unrelated to pig performance. The variations in plasma levels therefore might have been due to the maintenance of cation balance across the cell wall.

Summary

Two hundred sixteen crossbred weanling pigs were allotted to six dietary treatments containing .85% lysine or 1.15% lysine with 0, .4 or .8% added potassium. Results in this study gave nonsignificant differences among potassium treatments. However, there were significant improvements in average daily gain and feed efficiency when animals received the higher lysine diet.