Effect of Added Lysine in Swine Diets on Lean Cuts and Enzyme Activity in the Heart and Liver

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The effect of adding 0.4% L-lysine to corn-soybean meal rations fed swine has been studied in regard to feedlot performance, carcass characteristics, and isocitric dehydrogenase activity in the heart and xanthine oxidase activity in the liver. The amino acid had no effect on feedlot performance but increased slightly the percentages of four lean cuts. Isocitric dehydrogenase activity was greater ($P < 0.025$) in the hearts of the unsupplemented swine on both the wet weight and per mg. of nitrogen basis. Xanthine oxidase activity increased in the liver of those swine supplemented with the lysine.

BAUR and Filer (*2*) added 1.3% L-lysine on a dry solids basis to an infant formula already containing this amount of lysine and fed it to rats. The lysine appeared to stimulate appetite and growth but not food or nitrogen efficiency. Cahilly *et al.* (*4*) found that lysine·HCl added to corn-peanut meal diets at 0.0, 0.3, 0.6, and 0.9% produced an increase in weight and protein of muscle of swine. Aquirre *et al.* (*1*) reported that lysine improved the nutritive value of cottonseed meal. Cereal grains and the common protein supplements used in swine feeding are normally low in lysine. Siebert *et al.* (*7*) prepared from pig heart an isocitric dehydrogenase concentrate that showed a specific activity that was greater than any other previous preparation of this enzyme. Bothwell and Williams (*3*) have shown that lysine-deficient diets will cause a decrease of about 50% in the xanthine oxidase activity in livers of rats. In the present study, lysine has been evaluated in regard to its effect on performance of swine as well as the isocitric dehydrogenase activity in the heart and xanthine oxidase activity in the liver of the swine. Isocitric dehydrogenase is more active in pig heart than any other source, and as enzymes are protein in composition, it was believed justifiable to study the effect of a dietary amino acid on its activity.

Procedure

Eighty swine were divided into two groups of 40 each on the basis of breed, litter, and sex. The limited numbers for the various types of evaluation of the treatments were decided on the basis of hours available and statistical analysis of the data. One group was fed the ration shown in Table I without added L-lysine, and the other group was fed the ration with 0.4% added L-lysine. The rations were fed from weaning until market weight, which required 11 weeks. Twenty barrows from each group were selected on the basis of breeding and weight uniformity, and slaughtered after 11 weeks of feeding. The carcasses were evaluated for back fat thickness, carcass length, dressing percent, and percentage of ham, loin, picnic, and butt. The heart and the liver were obtained within 20 minutes after the swine were slaughtered, and frozen immediately at −8° C. in a freezer and analyzed within a week for enzyme activity. Isocitric dehydrogenase activity in the left ventricular wall of the heart of 15 animals of each dietary group was measured using the spectrophotometric method of Ochoa (*5*). Xanthine oxidase was determined in the livers of 12 animals of each dietary group using the manometric method of Dhungat and Sreenivasan (*6*). Analysis of variance of the data was done in accordance with procedures recommended by Snedecor (*8*).

Results and Discussion

There was no significant difference in feed consumption, in feed required per pound of gain, or in the daily gains due to lysine supplementation (Table II). In Table III the swine carcass data are presented. There was no significant difference between the slaughter weight, back fat thickness, carcass length, or dressing percent. The percentages of ham, loin, picnic, and butt were in favor of the lysine-supplemented pigs, which also had slightly larger loin eye areas.

The data obtained for the isocitric dehydrogenase activity in the heart of the swine are presented in Figure 1. The heart had an average absorbance (A) change between 30 and 300 seconds of 0.997 ± 0.121 and 0.871 ± 0.162 per mg. of nitrogen for the control and the group that received the added 0.4% L-lysine, respectively ($P<0.025$). On the fresh-weight basis, a similar de-

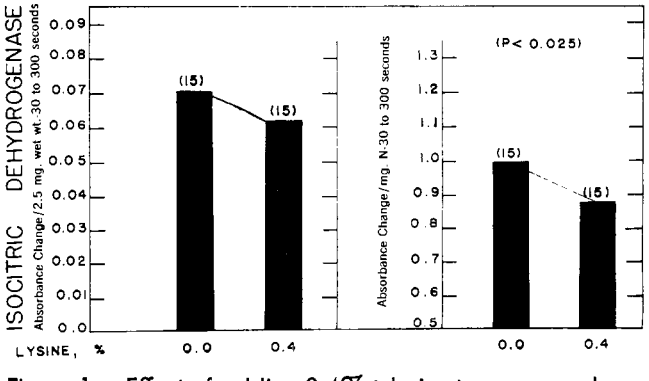

Figure 1. Effect of adding 0.4% L-lysine to a corn-soybean meal ration on the isocitric dehydrogenase activity in the heart of swine

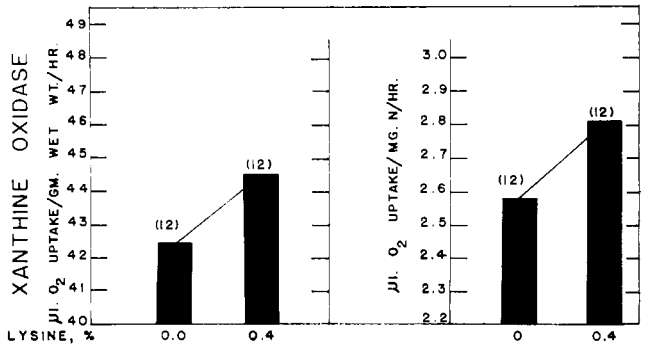

Figure 2. Effect of adding 0.4% L-lysine to a corn-soybean meal ration on xanthine oxidase activity in the liver of swine

Table I. Composition of Rations

Ration	Weaning to 125-Lb. Wt.	126-Lb. Weight to Market Wt.
Ground yellow corn	82.20	87.70
Soybean meal (50% protein)	13.00	7.50
Ground limestone	1.00	1.00
Steamed bonemeal	1.00	1.00
Iodized salt	0.50	0.50
Trace minerals[a]	0.05	0.05
Vitamin supplement[b]	0.10	0.10
Vitamin B_{12} supplement[c]	0.05	0.05
Antibiotic supplement[d]	0.10	0.10
Vitamin A and D mix[e]	2.00	2.00
% Digestible protein, calcd.	11.78	9.52
% Lysine, calcd.[f]	0.54	0.40

[a] Adds following to ration in p.p.m.: Mn, 29.6; Fe, 36.5; Cu, 2.5; Co, 0.83; Zn, 42; and K, 3.9.

[b] Contains 2000 mg. riboflavin, 4000 mg. pantothenic acid, 9000 mg. niacin, and 10,000 mg. choline chloride per pound of supplement.

[c] Contains a minimum of 9 mg. vitamin B_{12} per pound.

[d] Contains 10 grams terramycin per pound.

[e] Contains 14 grams vitamin A having 10,000 I.U. per gram; 4 grams vitamin D having 9 I.U. per gram; and 890 grams ground yellow corn.

[f] 0.4% L-Lysine added in addition to these amounts to the rations of half the swine.

crease in enzyme activity occurred. About half as much isocitric dehydrogenase activity was found in the liver as in the heart, but there was no dietary effect on the activity in the liver.

Table II. Feedlot Performance

	Control	+0.4% Lysine
No. swine	40	40
Initial wt., lb.	61.3	61.4
Final wt., lb.	196.1	193.0
Average daily gain, lb.	1.68	1.64
Average daily feed, lb.	5.67	5.58
Feed/lb. gain	3.38	3.40

Table III. Swine Carcass Data

	Control	+0.4% Lysine
No. swine	20	20
Slaughter wt., lb.	200.6	197.9
Back fat, in.	1.56	1.50
Carcass length, in.	28.94	29.15
Dressing, %	71.86	72.31
Ham, %	12.89	13.28
Loin, %	9.66	9.82
Picnic, %	6.19	6.24
Butt, %	4.24	4.48
Total % lean cuts (4)	32.98	33.82
Av. loin area, sq. in.	3.33	3.41

The data obtained for the xanthine oxidase activity in the liver are shown in Figure 2. Average values of 2.58 ± 0.68 and 2.82 ± 0.89 (μl.) of oxygen uptake per mg. of nitrogen per hour were found for the control and lysine-supplemented groups, respectively. Corresponding values of 42.4 ± 12.4 and 44.5 ± 15.8 μl. of oxygen uptake per gram of fresh weight per hour were obtained, respectively. These observations do not demonstrate as great a response to lysine as that of Bothwell and Williams (*3*), who reported that xanthine oxidase activity decreased to about 50% in the livers of rats deprived of lysine. The low lysine dietary group of swine in the present study were not as deprived of lysine as the rats referred to above. The present data suggest that lysine functions in swine in a manner similar to that in rats.

Acknowledgment

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SELENIUM TOXICITY

Effect of Arsenic on Selenium Metabolism in Rats

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Since Moxon (*11*) found that arsenic reduced the toxicity of seleniferous grains, a number of animal studies on the effect of arsenic compounds on selenium metabolism have been reported. Moxon and DuBois (*12*) concluded that the selenium content of livers from rats on a diet containing seleniferous wheat was decreased by sodium arsenite addition to the water. While limited data for swine under similar conditions indicated that arsenic increased the selenium content of the liver and decreased it in the hair and certain other tissues (*10*), results with dogs (*19*), cattle (*14*), and rats (*7, 13, 15*) on chronically toxic diets show no role for arsenic in the alteration of selenium metabolism. Further, Petersen *et al.* (*18*) administered sublethal doses of selenite and selenite plus arsenite to rats by stomach tube and concluded from their results that arsenite did not cause any significant variation in the absorption, excretion, or tissue deposition of the selenium. On the other hand, recent studies with chickens indicate that arsenic in seleniferous diets decreases selenium deposition in eggs (*8*) and increases it in muscle and liver tissues (*1*).

Kamstra and Bonhorst (*5*) first reported an effect for arsenic on the exhalation of selenium. They found that the amount of selenium exhaled by rats injected with sublethal doses of selenite was greatly reduced by arsenite injections. This work was confirmed by Ganther and Baumann (*2*), who also found that arsenite markedly increased excretion of the selenium into the gastrointestinal tract and its level in the kidneys while reducing its level in the blood, liver, and carcass. Palmer and Bonhorst (*16*) in a similar study found that arsenite decreased the level of selenium in the liver, but for periods of up to 3 hours following injection the arsenite increased the selenium in the blood.

The variability in the results of the