FEED ADDITIVES FOR SWINE 3.

Comparison of Copper and Antibiotics for Grower Rations

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Research Division Report 150

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H. R. Thomas and E. T. Kornegay*

Previous reports in this series (Kornegay, 1973; Kornegay and Thomas, 1973) showed that feedlot performance was improved when copper (150-220 ppm) and antibiotics were added to swine rations. Similar results have been reported by Braude (1965) and Wallace (1967). With both copper and antibiotics, the greatest improvements in growth and feed efficiency occur among the youngest pigs. Additive effects have been reported for copper and antibiotics (Wallace, 1967 and Miller et al. 1969; Kornegay and Thomas, 1971).

The objective of these trials was to compare copper and antibiotics, alone and in combination, as growth stimulants for growing pigs.

Experimental Procedure

In trials 1 and 2, 80 crossbred pigs averaging 49 lb and 120 pigs averaging 51.3 lb, respectively, were fed the basal ration plus the following additives: 1) none, 2) 110 ppm tylosin plus sulfamethazine, 3) 150 ppm copper, 4) 110 ppm tylosin plus sulfamethazine and 150 ppm copper. The length of the trial was 56 and 98 days for trials 1 and 2, respectively. In trial 3, 136 crossbred pigs (average initial wt, 31.2 lb) were fed the basal ration plus the following additives in an 85-day trial: 1) none, 2) 110 ppm neomycin and 110 ppm oxytetracycline, 3) 200 ppm copper, and 4) 110 ppm neomycin, 110 ppm oxytetracycline and 200 ppm copper. In trial 4, 120 crossbred pigs averaging 18.4 lb were fed the basal ration plus the following additives in a 56-day trial: 1) none, 2) 154 ppm neomycin, 3) 154 ppm oxytetracycline, 4) 154 ppm neomycin and 154 ppm oxytetracycline, 5) 220 ppm copper. The basal ration is shown in table 1.

Pigs were self-fed and housed in a totally enclosed building with pens having either partially slotted floors (trials 1 through 3) or totally slotted floors (trial 4). The pigs were started on tests at varying times after weaning. Pigs were assigned to rations from outcome groups based on body weight, sex, and litter. Average daily gain, feed intake, and hemoglobin were measured.

The data were statistically analyzed using the analysis of variance and Duncan's (1955) multiple range test.

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Results and Discussion

In trials 1 and 2, tylosin plus sulfamethazine produced an increase in gain and feed intake and a slight improvement in feed/gain, while the effect of copper was evident in only trial 1 (table 2). There appeared to be an additive effect of copper and tylosin plus sulfamethazine with the effect greater in trial 1 than in trial 2. A combination of neomycin and oxytetracycline in trials 3 and 4 produced a significant improvement in average daily gain, with feed intake and efficiency significantly improved only in trial 4. Copper increased average daily gain and feed intake in trials 3 and 4, with feed/gain improved only in trial 4. In all trials, hemoglobin levels were not different between treatments. Feed cost/gain was either no different or less for pigs fed rations with added copper, which is in agreement with results from Kornegay and Thomas (1973). When the two antibiotic combinations, tylosin plus sulfamethazine and neomycin - oxytetracycline, were added to the basal ration, or the basal ration plus copper, feed cost/gain was increased.

Results developed by the FDA Task Force on Antibiotics, Van Houweling (1972) show that, for all practical purposes, feed costs for the 40-210 lb pig are not reduced by the use of antibiotics in the ration, although they did report a small feed saving as well as increased gaining in pigs from 15 to 40 lb. The savings to the swine producer, as reported by the task force, was a reduction in nonfeed costs which resulted from less time (days) needed for pigs to attain a specific body weight.

Summary

The antibiotic combinations, neomycin - oxytetracycline, and tylosin plus sulfamethazine, appeared to be slightly more effective in improving gain than copper, with a trend towards an additive effect of copper and antibiotics. There was a consistent but small improvement in feed/gain ratios with a greater effect upon daily feed intake.

Feed cost/gain was less for pigs fed rations with added copper, although improvements in feed efficiency were small. Feed cost/gain was increased for pigs fed rations containing the antibiotic combinations compared with feed costs for pigs fed the basal ration or the basal ration with added copper. Pigs fed rations containing neomycin and oxytetracycline additives only had a slight decrease in feed cost/gain as compared with feed cost/gain of pigs fed the basal ration. The difference in feed cost/gain between copper and antibiotics was due to the lower cost of copper as compared to antibiotics.

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TABLE 1. PERCENTAGE COMPOSITION OF BASAL RATIONS (16% crude protein)[1]

Ingredients[2]	Percent
Corn	79.20
Soybean meal (48.5%)	17.75
Defluorinated phosphate	2.20
Swine trace mineral salt[3]	0.50
Vitamin premix[4]	0.35

[1] The crude protein level was lowered by changing the proportions of corn and soybean meal according to the following schedule: 18% - 15 to 40 lb.; 16% - 40 to 75 lb.; 14% - 75 to 150 lb.; 12% - 150 to 220 lb. The amount of defluorinated phosphate and vitamin premix was also lowered at each stepdown of protein. Costs of ingredients were (¢/lb.): corn, 2.41; soybean meal, 6.25; defluorinated phosphate, 5.35; swine trace mineral salt, 3.10; vitamin premix, 30.00; bluestone (Cu), 29.70; ferrous sulfate, 6.50; zinc sulfate, 20.00; tylosin plus sulfa, 127.00; neomycin - oxytetracycline (50/50), 305.00.

[2] Copper (in the form of copper sulfate) was added at 150 ppm in trials 1, 2 and 3 and 200 ppm in trial 4 to the appropriate rations. In trials 1 and 2, iron was added at a level of 80 ppm. Iron sulfate (copperas) was added to supply 60 ppm. The other 20 ppm came from the trace mineral salt. Zinc was added at a level of 80 ppm in the form of zinc sulfate.

[3] Contained (%): 0.8 Mn, 0.4 Fe, 0.08 Cu, 0.01 Co, 0.01 I, 1.0 Zn and 95.9 salt.

[4] Supplied (per lb. of ration): 2.1 mg riboflavin, 10.9 mg pantothenic acid, 10.9 mg niacin, 16.8 mg vitamin B_{12}, 350 mg choline chloride, 2100 I.U. vitamin A, 350 I.U. vitamin D.

TABLE 2. AVERAGE DAILY GAIN, FEED INTAKE, FEED PER GAIN, HEMOGLOBIN AND FEED COST OF GROWING PIGS FED RATIONS WITH ADDED COPPER AND ANTIBIOTICS

Trials[1] & Treatments	Criteria				
	Daily[2] Gain	Daily Intake	Feed[2] Per gain	Hemoglobin	Feed/cost[3] Per gain
	lb	lb	lb	gm/100 ml	¢/lb
Trial 1					
Basal ration	1.17(0)[5]	3.95	3.50(0)	14.4	10.4
110 ppm Tylosin-S	1.30(11)	4.22	3.25(-7)	14.4	11.2
150 ppm copper	1.30(11)	4.19	3.23(-8)	14.2	9.7
110 ppm Tylosin-S and 150 ppm copper	1.46(25)	4.44	3.45(-1)	14.2	11.9
Trial 2[4]					
Basal ration	1.35(0)	4.94	3.72(0)	13.6	11.1
110 ppm Tylosin-S	1.40(4)	5.04	3.61(-3)	14.0	12.4
150 ppm copper	1.37(1)	5.00	3.74(-1)	14.1	11.2
110 ppm Tylosin-S and 150 ppm copper	1.39(3)	4.94	3.59(-3)	13.5	12.4
Trial 3[4]					
Basal ration	1.36(0)[5]	3.64	2.74(0)	13.3	8.6
110 ppm Neo and 110 ppm Oxy	1.45(7)	3.83	2.64(-4)	14.0	8.9
200 ppm copper	1.42(4)	3.80	2.71(-1)	13.1	8.6
110 ppm Neo, 110 ppm Oxy and 110 ppm copper	1.49(10)	3.83	2.56(-7)	13.6	8.7
Trial 4[6]					
Basal ration	0.98(0)^{a}	2.17^{a}	2.29(0)^{b}	13.6	8.4
154 ppm Neo	1.07(9)^{ab}	2.20^{a}	2.03(-11)^{a}	--	8.3
154 ppm Oxy	1.13(15)^{bc}	2.34^{ab}	2.14(-7)^{ab}	--	8.3
154 ppm Neo and 154 ppm Oxy	1.19(21)^{c}	2.46^{b}	2.10(-8)^{a}	12.8	8.6
200 ppm copper	1.12(14)^{c}	2.37^{ab}	2.11(-8)^{a}	13.0	7.7

[1]The length of trial (days), pigs per treatment (number) and initial weight (lb) were 56, 20, and 49.0 respectively, in trial 1; 98, 30, and 51.3 in trial 2; 85, 34 and 31.2 in trial 3; 56, 30 and 18.4 in trial 4.

[2]Values in parentheses are the percentage change from the basal ration.

[3]For cost of ingredients see Table 1.

[4]Initially-dropped to 55 ppm after 56 days.

[5]Significant effect of copper ($P<.01$) and antibiotic ($P<.05$). Significant interaction ($P<.01$) in Trial 1.

[6]Means within trials and in the same column with different superscript letters are significantly different ($P<.01$) and ($P<.05$).