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EFFECT OF DIETARY CALCIUM LEVELS ON RESPONSE OF GROWING PIGS TO CHLORTETRACYCLINE

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Antibiotics have been used in swine rations for approximately 30 years for their growth promoting effects. Research with other species has shown that chlortetracycline may combine with calcium and certain other mineral elements, thus reducing the activity of the antibiotic. A previous trial reported in the 1978 South Dakota Swine Day report (A.S. Series 78-12) did not indicate any difference in antibiotic potentiating effect between calcium sulfate or calcium carbonate as sources of calcium in swine diets.

The study reported herein was designed to determine the effect of different levels of dietary calcium on growth performance as well as calcium and chlortetracycline levels in the blood serum of growing pigs.

Experimental Procedure

Ninety-six pigs of an average weight of approximately 47 lb. were allotted according to weight and sex to six treatments of four pigs per treatment with each treatment replicated four times. The pigs were housed in an enclosed confinement building having slatted floors and had access to feed and water *ad libitum*.

Corn-soybean diets calculated to contain 16% protein were used during the 6-week trial. During the first 4 weeks, the six treatments consisted of diets containing 0.3, 0.7 and 1.1% calcium with and without chlortetracycline (100 grams per ton). During the last 2 weeks, all diets contained 0.3% calcium and chlortetracycline was increased to 200 grams per ton in the diets containing antibiotic. Table 1 shows the composition of the diets. Blood was obtained from the jugular vein of all pigs at 0, 28 and 42 days for determination of calcium and chlortetracycline contents.

Results and Discussion

The growth and feed performance data are summarized in table 2. Calcium level of the diet did not affect rate or efficiency of gain during the 6-week period. However, pigs fed chlortetracycline gained significantly faster and required significantly less feed per gain than those fed the diets without chlortetracycline. There was also a significant calcium x chlortetracycline effect as pigs fed the two lower dietary calcium levels (.3 and .7%) responded to chlortetracycline significantly greater than those pigs fed the high calcium (1.1%) diet. Gains of pigs fed diets containing chlortetracycline were 1.50, 1.52 and 1.43, while pigs fed diets without chlortetracycline gained 1.19, 1.12 and 1.28 lb. per day when diets contained .3, .7 and 1.1% calcium, respectively. Antibiotic-fed pigs required 2.62 and nonantibiotic-fed pigs required 2.84 lb. of feed per pound of gain.

Blood serum calcium data are presented in table 3. There were no differences among treatments in serum calcium at the initial and final collection periods. However, samples of serum after 4 weeks of feeding the experimental diets showed higher levels of calcium when the diets contained 0.3% calcium. It has been shown that restriction of calcium intake increases efficiency of calcium retention. It is possible that, by the final blood sampling, these pigs were depleted of their exchangeable calcium, resulting in lower serum calcium values. Feeding diets containing 100 grams of chlortetracycline per ton increased blood serum calcium levels (P<.01) after 4 weeks of the experiment. Calcium levels were also higher (P>.05) after 6 weeks of feeding when pigs were fed diets containing chlortetracycline.

Blood serum chlortetracyline values as affected by dietary calcium and chlortetracycline are shown in table 4. Blood serum chlortetracycline decreased at the 4-week collection period as the dietary calcium level increased. Increased serum chlortetracycline concentration due to decreased calcium is also shown in table 4. A decrease in calcium from 1.1 to .7% in the diet resulted in an increase of 26.9% in serum chlortetracycline and a further decrease of .4% dietary calcium increased serum chlortetracycline another 25.3%. The serum concentrations of chlortetracycline in the blood 2 weeks later were also higher for those pigs fed diets lower in calcium the first 4 weeks, although all diets contained 0.3% calcium from the fourth to the sixth week. A higher level of dietary chlortetracycline during this period resulted in higher levels of blood serum chlortetracycline in all treatments at this sampling period.

Summary

Ninety-six pigs were used in this 6-week trial to study the effect of calcium level on the response of pigs to chlortetracycline. During the first 4 weeks, three levels of calcium (0.3, 0.7 and 1.1%) were fed with and without 100 grams per ton of chlortetracycline. During the last 2 weeks, all diets were changed to 0.3% calcium and antibiotic diets were increased to 200 grams per ton of chlortetracycline.

Chlortetracycline increased gains and decreased feed/gain significantly. Pigs fed the two lower levels of calcium responded to chlortetracycline more than those fed the high calcium level. Serum chlortetracycline, at 4 weeks, increased linearly with decreasing levels of dietary calcium.

Table 1. Composition of Diets (Percent)

Ingredient	Calcium level, %[a]		
	0.3	0.7	1.1
Corn	79.3	79.5	74.3
Soybean meal (48% crude protein)	18.5	19.0	19.4
Calcium carbonate	0.6	1.6	2.6
Monosodium phosphate	--	1.3	2.1
Trace mineral salt (1% zinc)	0.4	0.4	0.4
Premix[b]	1.2	1.2	1.2

[a] Each diet fed with and without chlortetracycline, 100 grams per ton, first 28 days, 200 grams per ton next 14 days.
[b] Supplied per lb. of diet: vitamin A, 1500 IU; vitamin D, 150 IU; vitamin E, 2.5 IU; vitamin K, 1 mg; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 50 mg and vitamin B_{12}, 5 micrograms.

Table 2. Effect of Chlortetracycline and Dietary Calcium on the Performance of Growing Swine

	Dietary calcium level, %					
	0.3		0.7		1.1	
Antibiotic	+	-	+	-	+	-
No. of pigs	16	16	16	16	16	16
Avg. initial wt., lb.	46.7	46.7	46.7	46.7	46.3	46.3
Avg. final wt., lb.	109.1	96.3	110.7	93.9	106.5	99.9
Avg. daily gain, lb.[a]	1.50	1.19	1.52	1.12	1.43	1.28
Daily feed intake, lb.	3.92	3.42	3.86	3.22	3.86	3.57
Feed/gain[a]	2.62	2.87	2.54	2.86	2.70	2.80

[a] Significant antibiotic effect (P<.01).

Table 3. Blood Serum Calcium Data

Sample[a]	Antibiotic	Dietary calcium level, % 0.3	0.7	1.1	Mean
		Blood serum, mg/100 ml			
1	+	10.23	10.42	10.33	10.33
	-	10.46	10.12	10.26	10.28
	Mean	10.35	10.27	10.29	
2	+	11.31	10.58	10.96	10.95[c]
	-	11.08	10.46	10.30	10.61[d]
	Mean	11.19[c]	10.52[d]	10.63[d]	
3	+	10.25	10.60	10.47	10.44
	-	9.79	10.20	10.07	10.02
	Mean	10.02	10.40	10.27	

[a] First sample at day 0, second sample at day 28 and third sample at day 42.
[b] From day 28 to 42 all diets contained 0.3% calcium and 200 grams per ton of chlortetracycline.
[c,d] Values with different superscripts within the same line or column differ significantly (P<.01).

Table 4. Blood Serum Chlortetracycline as Affected By Dietary Calcium

Sample[a]	Dietary Calcium %	Dietary Chlortetracycline mcg/ml	Serum levels mcg/ml	Increase[e] mcg/ml	Increase[e] %
2	1.1	100	0.263[d]		
	0.7	100	0.360[c]	0.097	26.9
	0.3	100	0.483[b]	0.122	25.3
3	0.3	200	0.560[c]	0.297	53.0
	0.3	200	0.662[b]	0.302	45.6
	0.3	200	0.695[b]	0.212	30.5

[a] See footnote a, table 3.
[b,c,d] Values with different superscripts within the same column differ significantly (P<.01).
[e] Increase due to decreased dietary calcium in sample period 2 and increase from period 2 to period 3 in sample period 3.