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Earlier research has attempted to determine methods of increasing the concentration of antibiotics, such as chlortetracycline, in the blood of animals in order to more effectively treat diseases or obtain increased performance. This is called "potentiation" which means to make more active or powerful. Most of the research regarding potentiation of antibiotics has been done with poultry.

The primary objective of this experiment was to study the potentiation of chlortetracycline in swine. Several methods of potentiation were studied; they were increasing dietary levels of calcium sulfate, sodium sulfate and phosphorus.

Experimental Procedure

One hundred four pigs of an average weight of 46.3 lb. were allotted according to weight and sex to 13 treatments each replicated twice. The pigs were housed, four pigs per pen, in an enclosed, slatted floor confinement building. After allotment, all pigs were fed their respective diets for 3 days, fasted overnight and then given access to their diets for a period of approximately 5 hours when blood samples were obtained from the jugular vein of each pig for calcium and chlortetracycline determinations. Another blood sample was collected 14 days later.

The diets were all 16% protein corn-soybean meal diets and varied in mineral ingredients as shown in table 1. The experiment was conducted for 10 weeks.

Results and Discussion

Table 2 summarizes the data for average daily gain, feed per gain and blood serum calcium levels. Pigs fed diet 5, which contained a low level of calcium and phosphorus, developed rickets and were removed after 56 days. Pigs fed the various diets containing chlortetracycline gained faster than those fed diet 13 which did not contain antibiotic. There were no effects on growth performance due to dietary levels of calcium, phosphorus or sulfates. The lowest level of serum calcium was from pigs fed the highest phosphorus diet (diet 8) at both sampling periods. It would appear that the high level of phosphorus might have reduced the absorption of calcium.

Blood serum chlortetracycline values are presented in table 3. At the first collection period, blood from all pigs except those fed diets 10, 11 and 12, which contained calcium sulfate, had chlortetracycline levels which were significantly higher than the controls. In the second sample, only blood from pigs fed the lower calcium diet (diet 5) and the two high phosphorus diets (diets 8 and 9) had significantly higher chlortetracycline levels than the

controls (diet 1). Increasing amounts of dietary sodium sulfate resulted in a linear increase in serum chlortetracycline in blood sample 1. Chlortetracycline increased 114% in blood from pigs fed diet 4. The effect of the higher sulfate content of diet 5 may have been reduced due to its higher calcium content. However, there was still a 96% increase in blood chlortetracycline of pigs fed this diet.

Calcium sulfate in the diet did not significantly affect blood serum chlortetracycline levels at either collection period. At both collection periods, blood serum chlortetracycline was significantly higher when pigs were fed diets high in phosphorus (diets 8 and 9). The diet (diet 8) of .8% calcium and 1.2% phosphorus caused the greatest increase in chlortetracycline level, a 121% increase in sample 1 and a 38% increase in sample 2.

Summary

Several methods of potentiation of chlortetracycline were studied in a trial using 104 growing pigs.

A low calcium diet was an effective chlortetracycline potentiator. However, prolonged feeding of this diet to growing pigs for periods of over 6 weeks caused rickets. Sodium sulfate significantly increased blood serum chlortetracycline levels in a linear relationship. Increased levels of dietary phosphorus also significantly increased serum chlortetracycline. A level of 1.2% was more effective than 1.8% phosphorus in diets containing 0.8% calcium. Calcium sulfate was not an effective potentiator of chlortetracycline but did support equal growth performance to other diets.

Table 1. Sources of Calcium, Phosphorus, Sodium and Sulfates in Experimental Diets

Diet no.	Calcium carbonate	Mono-sodium phos-phate	Sodium sulfate	Calcium sulfate	Calculated analysis, % Ca	P	Na	Sulfate
1	1.9	0.9	--	--	0.8	0.6	0.23	--
2	1.9	0.9	0.355	--	0.8	0.6	0.35	0.24
3	1.9	0.9	1.07	--	0.8	0.6	0.58	0.73
4	1.9	0.9	1.775	--	0.8	0.6	0.81	1.21
5	0.7	--	--	--	0.35	0.37	--	--
6	2.9	2.0	--	--	1.2	0.9	0.64	--
7	2.9	2.0	2.13	--	1.2	0.9	1.3	1.45
8	1.9	3.2	--	--	0.8	1.2	0.69	--
9	1.9	5.5	--	--	0.8	1.8	1.04	--
10	1.5	0.9	--	0.7	0.8	0.6	0.23	0.39
11	0.75	0.9	--	2.05	0.8	0.6	0.23	1.15
12	--	0.9	--	3.43	0.8	0.6	0.23	1.92
13[a]	1.9	0.9	--	--	0.8	0.6	0.23	--

[a] Diet 1 without chlortetracycline.

Table 2. Average Daily Gain, Feed Per Gain and Serum Calcium of Pigs

Diet no.[a]	Dietary Ca	P	Na	So_4	ADG[b]	F/G	Blood serum calcium 1	2
	%						mg/100 ml	
1[c]	.8	.6	.23	--	1.35	--	10.38	10.95
2	.8	.6	.35	.24	1.72	2.82	10.70	11.03
3	.8	.6	.58	.73	1.70	2.96	10.68	11.39
4	.8	.6	.81	1.21	1.74	2.86	10.42	11.01
5[d]	.35	.37	--	--	1.57	2.75	10.54	11.47
6	1.2	.9	.64	--	1.57	3.07	10.54	10.68
7[c]	1.2	.9	1.3	1.45	1.74	--	10.43	11.11
8	.8	1.2	.69	--	1.74	2.87	10.11	10.45
9	.8	1.8	1.04	--	1.57	2.94	9.51	10.30
10[c]	.8	.6	.23	.39	1.83	--	10.83	11.20
11	.8	.6	.23	1.15	1.72	2.89	10.69	11.30
12	.8	.6	.23	1.92	1.70	3.00	10.36	11.11
13	.8	.6	.23	--	1.17	3.25	10.34	10.67

[a] All diets, except 13, contained 200 grams per ton of chlortetracycline.
[b] Significant increase in gain due to chlortetracycline.
[c] Feed/gain not calculated. Two pigs removed from treatment 1 for failure to grow and one pig died in each of treatments 7 and 10 due to stomach ulcers.
[d] Data for 56 days, all other treatments for 70 days.

Table 3. Blood Serum Chlortetracycline Levels (mcg/ml)

Diet	Blood sample[a] 1	2
1	.383[b]	.673[d]
2	.558[c]	.688[d]
3	.661[c]	.679[d]
4	.818[c]	.734[d]
5	.740[c]	.883[e]
6	.638[c]	.621[d]
7	.752[c]	.702[d]
8	.848[c]	.929[e]
9	.692[c]	.867[e]
10	.487[b]	.700[d]
11	.251[b]	.623[d]
12	.333[b]	.607[d]

[a] Each value is an average of serum from 8 pigs.

[b,c] Values with different superscripts differ significantly ($P<.01$).

[d,e] Values with different superscripts differ significantly ($P<.05$).