Comparative Effects of Copper and Terramycin on Performance of Broiler Chicks and Growers

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SUMMARY

BROILER chicks were divided into twelve groups each of which had either the basal ration, the basal ration and terramycin, the basal ration and graded levels of copper, or the basal ration and both the antibiotic and copper. Broiler growers were fed similarly. High level of dietary copper [300 ppm] depressed growth. A range of 100 to 200 ppm dietary copper produced liveweight gain as much as terramycin. No additional advantage was gained by combining both copper and terramycin. Either terramycin or 100 ppm copper gave equivalent body weight, feed consumption and feed conversion in the broiler chick starters and growers.

Lack of either dietary copper or terramycin resulted in high mortality. Combinations of dietary copper and terramycin stimulated abdominal fat deposition. It is concluded that either terramycin or 100 ppm dietary could be used for stimulating growth and for preventing enteritis in broilers and the choice of either would depend on availability and cost.

INTRODUCTION

GROWTH stimulation by antibiotics has been studied extensively by several workers. Thus Johansson, Sarles and Shapiro (1948) as well as Johansson and Sarles (1949) concluded that antibiotic growth stimulation was related to its effect on microorganisms in the digestive tract. Jukes (1955) attributed the anabolic effect of antibiotics in poultry and pigs to improved utilisation of protein, some vitamins and mineral while Nelson, Jensen and McGinnis (1963) found that stimulation of growth in chicks was correlated with an increase in metabolizable energy and decrease in intestinal weight. However use of

organic anaboles in animal production has been questioned since the report of the Swann Committee on the use of antibiotics in animal husbandry was published by Her Majesty's Stationery Office in 1969.

Consequently attempts are being made to utilise other normal nutrients to stimulate growth. Since Barber, Braude Mitchell, Rook and Rowell (1957) demonstrated clearly the action of antibiotic and copper supplements for fattening pigs, attention had been directed towards the possible use of copper as anabolic agent especially where the use of antibiotics may be prohibited for this purpose. Nevertheless, Copper at high levels had been shown to be toxic to animals by Scott, Nesheim and Young (1969).

MATERIALS AND METHODS

Four hundred and eighty day-old Arbor Acres broiler chicks were divided into twelve dietary groups of twenty birds per group and each treatment was replicated such that the average weights of the groups were about the same. A basal chick starter ration (Table 1) containing 24% protein was given to the first group of birds. The second group of birds had terramycin (water-soluble) administered in

TABLE 1

Percentage Composition of the Rations Fed

<i>Ingredients</i>	<i>Basal Chick Starter</i>	<i>Growing Chicks</i>
Maize	50	63
Groundnut cake	30	22
Fish meal	5	3
Milk powder	3	—
Yeast	2	2
Blood meal	1	1
Rice bran	1.5	2
Luru	2	22
DCP	4.5	4.0
Salt	0.5	0.5
Vitamins and Mineral*	0.5	0.4

Supplied the following per kg of diet: Vit. A. 6,000 I.U., 1,320 I.C.U. B₂ 4.4 mg. Niacin 22 mg. Ca pantothenate 8.8 mg. Choline 440 mg, B₁₂ 5mcg, Mn 52.4 mg, Fe 20.2 mg, Cu, 8 mg, Zn 50 mg, Co. 0.5 mg. and B.H.A. Copper in the basal chick starter ration was estimated to be 19.2 ppm. While 15 ppm of copper was in the ration for the growing chickens. The rations were supplemented with methionine and lysine to bring their respective levels to 0.5 and 1.0% of the ration.

addition to the basal diet. Five other groups had the basal ration with CuSO₄ 5H₂O supplementation such that 100, 150, 200, 250 and 300 ppm copper was supplied respectively. The remaining five groups had the basal diet, the respective level of copper supplementation and terramycin was added to the drinking water. This is shown in Table 2. In all the cases where terramycin was given, about 4 grams of the commercial antibiotics grain was added to 4 litres of water. Each pound of the powder contained 25g of the antibiotic. Thus about 220 mg of oxytetracycline hydrochloride was supplied per 4 litres of water.

In the second experiment 480 birds at 4 weeks of age were selected and divided into 12 groups, each group being replicated. The first group had a basal broiler ration containing 18% protein (Table 1). The second group had the basal diet and water-

TABLE 2

<i>Group No.</i>	<i>Terramycin</i>	<i>Copper (ppm)</i>
1	0	0
2	+	0
3	—	100
4	—	150
5	—	200
6	—	250
7	—	300
8	+	100
9	+	150
10	+	200
11	+	250
12	+	300

soluble terramycin while the next five groups had the basal diet with CuSO₄ 5H₂O supplementation as in the first experiment. Similarly five other groups had both CuSO₄ 5H₂O and terramycin in addition to the diet. The body weight gain, feed consumption, the efficiency of feed conversion as well as mortality were recorded for both the chicks and growing broilers on the respective treatments. The copper in organs was determined during the eighth week of each experiment, the samples being wet-ashed and the solution read in an atomic absorption spectrophotometre as described by Perkin Elmer (1973).

RESULTS AND DISCUSSIONS

The body weights of the broiler chick starters are shown in table 3. Presence of copper at 300 ppm in the ration resulted in the lowest body weight of the 5-week old chicks. The result was as good as for the chicks given the basal ration without copper or terramycin supplementation. Presence of terramycin or a range of 100 to 200 ppm dietary copper gave comparable results. Also the addition of graded levels of copper to diets of chicks given terramycin produced body weights that were as good as in chicks given either the anti-

biotic or a range of 100 to 200 ppm of the mineral. Thus it is evident that increasing the copper content of the diet when terramycin is being administered does not impart additional benefit in terms of body weight gain of the broiler starter chicks.

Results of body weights for broiler growers showed a depression in growth when terramycin and 300 ppm copper were given. Actually the administration of terramycin and 250 ppm copper resulted in the live weight of the broiler growers being equivalent to that of the birds given the basal ration. As in the case of the broiler chick starters, terramycin given along with the basal diet produced significant differences when the results were compared with those of birds given the basal ration. This result was similar for birds that had between 100 and 200 ppm copper but when 250 or 300 ppm copper was fed, lower liveweights were obtained. The depression of growth of broiler growers/finishers at high dietary

level of copper is similar to the observations of Smith (1969), hence the administration of copper above 200 ppm is not advisable.

Feed consumption was highest for broiler starter chicks given the combination of basal ration and 200 ppm Cu, although the value was not significantly different for chicks fed either the basal ration or additional 150 ppm, Cu, terramycin and 250 or 300 ppm Cu. The lowest feed consumption was by chick given terramycin and 100 ppm copper and the efficiency of feed conversion by these birds was the best although the average body weight for this group was as good as for those given either terramycin or a range of 100 to 200 ppm copper. In effect either terramycin or 100 ppm copper would be economically given to obtain equivalent body weight, feed consumption and feed conversion in the broiler chick starters. Similar results were obtained for the broiler growers up to 8 weeks of age.

TABLE 3
Body Weight and Feed Data

	Average Wt. (g)		Feed Consumption (kg)		Feed Conversion	
	Chicks (5 weeks)	Growers (8 weeks)	Chicks (5 weeks)	Growers (8 weeks)	Chicks (5 weeks)	Growers (8 weeks)
Basal ration	544a	1186b	1.643c	4.104a	3.02d	3.46b
Added terramycin	697c	1625d	1.485b	5.265b	2.13b	3.24a
100 ppm Cu	684c	1648d	1.535b	5.405b	2.23b	3.28a
150 ppm Cu	704c	1611d	1.605c	5.171b	2.28b	3.21a
200 ppm Cu	707c	1642d	1.660c	5.074b	2.22b	3.09a
250 ppm Cu	602b	1474c	1.481b	5.012b	2.46c	3.40b
300 ppm Cu	500a	1399c	1.545b	4.883b	3.09d	3.49b
Terramycin + 100 ppm Cu	691c	1626d	1.334a	5.236b	1.93a	3.22a
Terramycin + 150 ppm Cu	711c	1628d	1.543b	5.307b	2.17b	3.26a
Terramycin + 200 ppm Cu	684c	1625d	1.587bc	5.216b	2.32b	3.21a
Terramycin + 250 ppm Cu	716c	1175b	1.604c	3.983a	2.24b	3.39b
Terramycin + 300 ppm Cu	697c	1116a	1.624c	3.906a	2.33bc	3.50b

Means in the same vertical column not marked by the same suffix are significantly different from each other ($P < 0.05$)

The mortality of both chicks and broilers that had neither terramycin nor additional copper was significantly higher than for the other groups as shown in Table 4. Veterinary reports showed that twenty of the twenty-seven broiler chicks and all the broiler growers that died succumbed to enteritis. The diagnosis was not specific for the other birds that died during the experiment. It is noteworthy that neither the chicks nor the growers given terramycin, 100 or 150 ppm copper suffered any mortality.

The weights of the plucked bird, the carcass, the edible meat, the giblet and bone were expressed as percentages of the liveweight of the birds as shown in Table 5. Values for these parameters were not significantly different. However the actual weights varied as the average weights of the birds on the respective treatments varied as shown in Table 3. Nevertheless the percentage abdominal fat varied significantly. Presence of terramycin in addition to copper or high levels of copper tended to stimulate fat deposition in the

TABLE 4
Mortality of Experimental Birds

<i>Treatment</i>	<i>Chicks</i>	<i>Broilers</i>
Basal ration	27	15
Added terramycin	—	—
100 ppm Cu	—	—
150 ppm Cu	—	—
200 ppm Cu	4	—
250 ppm Cu	2	—
300 ppm Cu	1	—
Terramycin + 100 ppm Cu	—	—
Terramycin + 150 ppm Cu	2	—
Terramycin + 200 ppm Cu	—	—
Terramycin + 250 ppm Cu	3	—
Terramycin + 300 ppm Cu	5	—

TABLE 5
Average Dressing percentage of the Experimental Birds at 8 weeks Old

<i>Treatment</i>	<i>Plucked bird</i>	<i>Carcass</i>	<i>Edible Meat</i>	<i>Giblet</i>	<i>Bone</i>	<i>% fat in abdomen</i>
Basal ration (15 ppm Cu)	94.8	67.5	45.9	5.2	19.0	0.52a
Added terramycin	95.2	66.8	47.2	6.1	18.7	0.74b
100 ppm Cu	95.0	68.3	49.5	5.8	18.3	0.79b
150 ppm Cu	95.8	69.1	46.8	6.5	18.0	0.70b
200 ppm Cu	95.6	68.5	48.1	6.9	19.1	0.78b
250 ppm Cu	95.0	67.2	45.8	7.2	18.5	0.93c
300 ppm Cu	95.8	66.8	49.0	6.3	18.2	1.11c
Terramycin + 100 ppm Cu	95.0	68.9	48.5	5.9	18.4	0.96c
Terramycin + 150 ppm Cu	95.6	68.0	47.4	5.8	18.6	1.25d
Terramycin + 200 ppm Cu	94.5	67.9	49.3	6.7	19.2	1.30a
Terramycin + 250 ppm Cu	95.3	67.4	49.4	5.9	18.7	1.46e
Terramycin + 300 ppm Cu	95.5	68.5	50.1	6.8	18.4	1.53e

Means in the same vertical column not marked by the same suffix are significantly different from each other ($P < 0.05$).

TABLE 6

Mean Copper Content of Dried Organs of Broilers (ppm)

Treatment	Liver	Heart	Lungs	Kidney
Basal ration	12.8	15.3	2.6	11.9
Added terramycin	13.5	15.0	2.6	12.2
100 ppm Cu	17.4	18.9	3.2	13.4
150 ppm Cu	19.0	18.8	3.9	13.9
200 ppm Cu	20.8	20.5	4.5	14.3
250 ppm Cu	21.3	21.3	4.9	15.0
300 ppm Cu	23.1	23.5	5.4	15.9
Terramycin + 100 ppm Cu	25.6	26.4	6.0	17.5
Terramycin + 150 ppm Cu	26.4	27.9	6.3	17.0
Terramycin + 200 ppm Cu	26.9	28.3	6.8	17.8
Terramycin + 250 ppm Cu	27.2	28.0	6.4	17.4
Terramycin + 300 ppm Cu	27.5	28.6	6.2	17.0

abdomen. Also dietary copper at 250 and 300 ppm produced abdominal fat higher than the basal ration which contained 15 ppm copper. There was no significant difference in abdominal fat when either terramycin or a range of 100 to 200 ppm copper was fed.

Deposition of copper in selected organs of 8-week old broilers is shown in Table 6. Far more copper was deposited in the liver although on unit basis the heart appeared to have a higher concentration of the mineral. The copper content of the liver increased with increasing dietary level of the mineral. Similar results were obtained for the deposition of copper in the heart, the lungs and the kidney. However increasing the dietary level of copper in the presence of terramycin did not give corresponding increased copper content in these organs. A possible explanation can be given for this phenomenon. The accumulation of copper in these organs could have approached the physiologically feasible limit in which case additional available copper would not be deposited.

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