Proceedings
of the
Society
for
Experimental Biology and Medicine

VOL. 82 FEBRUARY, 1953 No. 2

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Effect of Cobalt in Diet of the Chick.* (20058)

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It has been well established that dietary cobalt will stimulate the growth of ruminants if the diet is low or lacking in vit. B_{12}. Research conducted(1,2) since its chemical isolation has shown that vit. B_{12} contains cobalt. Abelson and Darby(3) showed that dietary cobalt was used by ruminants in the synthesis of vit. B_{12} presumably by the action of the rumen microflora. Becker *et al.*(4) have shown that cobalt might possibly have other uses by sheep beyond that used directly for vit. B_{12} synthesis. A later report by Smith *et al.*(5) showed that these early results reported by Becker *et al.*(4) occurred because the amounts of vit. B_{12} used were too small. Injections of 150 μg or more of vit. B_{12} overcame cobalt deficiency symptoms. Davis and Chow(6) used 2 different levels of radioactive Co^{60} in diets for rats and obtained a proportionate increase in the radioactive and microbiological vit. B_{12} content of the feces. These increases appeared to be greatly accelerated by the addition of aureomycin to the diet. When Cuthbertson *et al.*(7) fed Co^{60} to rats over long periods of time in a vit. B_{12} deficient diet they were unable to isolate tagged vit. B_{12} from the livers. It is interesting to note that the amount of Co^{60} fed was small and

* Published as paper No. 2725 Scientific Journal Series of the Minnesota Agricultural Experiment Station.

This investigation was supported in part by a grant from Merck and Co., Inc., Rahway, N. J.

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that there was no antibiotic included in the diet.

In the studies of Tappan and coworkers(8) the growth of rats was not significantly affected by the feeding of 0.1 mg per day of cobalt in a corn-soybean oil meal diet containing vit. B_{12}. When cobalt was fed at the level of 1.0 mg per day growth was depressed. Klosterman *et al.*(9) have obtained faster growth with swine fed a diet deficient in vit. B_{12} by supplementing this diet with a trace-mineralized, iodized salt containing 0.026% cobalt. Very little work has been done with cobalt in the vit. B_{12} deficient chick. Halbrook *et al.*(10) obtained slightly increased chick growth when cobalt chloride was added to unchanged litter at the rate of 2 g per square foot. When added to the basal diet at the rate of 3½ g of cobalt chloride per 100 lb of ration no growth stimulation occurred. Briggs *et al.*(11) reported that a low level of cobalt (1 mg/kg) was ineffective in promoting growth in a vit. B_{12} deficient diet.

The purpose of the studies reported here was to determine whether dietary cobalt would affect the growth of the chick if fed diets containing an antibiotic compounded with and without vit. B_{12}.

Materials and methods. Day-old White Leghorn female chicks from the Poultry Division flock were used in groups of 10. They were sexed shortly after hatching and reared in electrically heated metal batteries with raised wire screen floors. Feed was supplied *ad libitum* and the water changed daily. The basal ration consisted of the following ingredients (g/100.23 g): ground yellow corn, 61; solvent process soybean oil meal, 35; dicalcium phosphate, 1.5; iodized sodium chloride, 1; manganese sulfate, 0.03; chick size oyster shell, 1.5; and 3000A-400D fish oil, 0.2. In addition 0.33 mg of crystalline riboflavin and 2.5 mg of procaine penicillin G were included. 1.5 μg of crystalline vit. B_{12} was added to the diet of some of the groups as indicated in the tables. The cobalt used was supplied in the form of $CoSO_4 \cdot 7H_2O$ which contained less than 0.4% impurities. This compound is 20.9% cobalt.

Results and discussion. The addition of cobalt sulfate to the diet did not significantly affect chick growth, feed efficiency, or death loss when the diet contained vit. B_{12} (Table I). High levels of cobalt had no observable toxic effect on the chicks. These results indicate that the chick might have a much greater tolerance for dietary cobalt than the rat(8) although the penicillin included in these diets might have had an effect on this tolerance.

TABLE I. Effect of Cobalt on Chicks Fed Diets Containing Vitamin B_{12}.

Trial	Group	$CoSO_4 \cdot 7H_2O$ /kg of basal ration, mg	Avg wt, g	No. chicks dead	Feed efficiency*
1†	1	0	415	1	2.56
	2	6	389	0	2.44
	3	10	401	0	2.49
	4	14	368	0	2.67
	5	50	394	0	2.52
2‡	1	0	341	1	2.47
	2	25	339	0	2.47
	3	50	340	1	2.45
	4	100	350	0	2.42
	5	150	347	0	2.24
	6	200	335	0	2.36
	7	300	355	1	2.30

* Feed efficiency $= \frac{\text{Total feed consumed}}{\text{Wt gained}}$.

† Carried on exp. 37 days.
‡ " " " 34 " .

The results given in Table II show that growth stimulation occurred when 10 to 100 mg of cobalt sulfate were added to each kg of the vit. B_{12} deficient diet. Although analysis of variation due to treatment does not show significance below the 5% level, the authors feel that the differences due to cobalt feeding are large enough to show nutritional importance. Because of the relatively high levels of cobalt sulfate which were necessary to produce the apparent growth stimulation it is felt that this effect might be caused by the stimulation or alteration of the intestinal flora to synthesize vit. B_{12}. In spite of the fact that all the chicks were raised on wire screen floors, vit. B_{12} present in the voided feces (or synthesized after voiding) and possibly consumed by the chicken may have been a factor in these results. Also, the cobalt content of the basal diet, present as an impurity, and the presence of an antibiotic may have been factors in-

TABLE II. Effect of Cobalt on Chicks Fed Diets Deficient in Vitamin B_{12}.

Trial	Group	$CoSO_4 \cdot 7H_2O$ /kg of basal ration, mg	Avg wt, g	No. chicks dead	Feed efficiency*
1†	1	0	309	1	2.93
	2	6	308	0	3.01
	3	10	336	1	2.90
	4	14	345	1	2.73
	5	50	356	1	2.91
	6	Pos. control (with B_{12})	415	1	2.56
2‡	1	0	246	1	2.50
	2	10	260	0	2.53
	3	50	279	1	2.88
	4	100	298	1	2.60
	5	Pos. control (with B_{12})	294	0	2.52

* Feed efficiency $= \frac{\text{Total feed consumed}}{\text{Wt gained}}$.

† Carried on exp. 37 days.
‡ " " " 35 " .

volved in this stimulatory effect (the cobalt content of the ration and of the water consumed, was not determined, unfortunately).

Jaffé(12) reported a beneficial action of cobalt on pregnancy and lactation of rats and mice deficient in vit. B_{12}. It appears possible, therefore, that under certain conditions cobalt may improve the nutrition of vit. B_{12}-deficient, non-ruminating animals.

Summary. 1. Chick growth was stimulated by the addition of 10 to 100 mg of cobalt sulfate to each kg of a corn-soybean oil meal diet which was deficient in vit. B_{12}. 2. When similar levels of cobalt sulfate were added to the same diet supplemented with ample vit. B_{12} they produced no observable effect.

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Received November 15, 1952. P.S.E.B.M., 1953, v82.

Inhibition of Rat Liver Succinoxidase by Testosterone-17β Diethyl Aminoethyl Carbonate.* (20059)

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Various natural and synthetic estrogens exert an *in vitro* inhibitory action on the succinoxidase activity of many tissues(1). Utilizing synthetic estrogens, McShan and Meyer(2) have localized this inhibition to the cytochrome oxidase component of the system while Case and Dickens(3) demonstrated that, depending upon the estrogen used, the point of action could be succinic dehydrogenase, cytochrome oxidase, or a hypothetical link between these two enzymes. Guidry *et al.*(4) found, however, that estrone and estradiol did not inhibit the oxidation of succinate by rat liver homogenates. Androgens inhibit the oxygen consumption of rat liver,

* This investigation was aided in part by a grant from the Cancer Research Coordinating Committee, University of California.