

Effect of Kidney Beans and Taurocholate on Serum Tocopherol and Nutritional Muscular Dystrophy in Chicks* (33898)

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(Introduced by W. G. Pond)

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Raw kidney beans increased the incidence of nutritional muscular dystrophy (NMD) in chicks fed a diet containing a marginal level of vitamin E but the mechanism(s) was not defined (1). Desai (2) proposed that raw kidney beans decreased vitamin E absorption. Garlich and Nesheim (3) reported that raw ether-extracted soybeans decreased fat absorption in young chicks. The decrease in absorption could be alleviated by the addition of sodium taurocholate to the diet. The following studies were conducted to determine: (i) if diets containing raw kidney beans were dystrophogenic when the diet contained high levels of vitamin E, (ii) if raw kidney beans decreased selenium storage in the carcass, and (iii) if the addition of sodium taurocholate would alleviate the effect of raw kidney beans on incidence of NMD in chicks fed a marginal level of vitamin E.

Materials and Methods. The chicks were housed as groups in electrically heated brooders with wire-mesh floors. Lighting was maintained 15 hr/day. The basal diet was of the same composition as that used in previous studies (1). All diets were fed *ad libitum*. The appearance of characteristic white striations in the breast muscle, visible either through the skin or upon autopsy at the termination of the experiment, was considered positive for NMD. Two trials were conducted as follows:

Trial 1. One hundred eighty chicks, 2 days of age, hatched from eggs of hens fed a diet containing a low level of vitamin E, were fed the basal diet for 4 days and then 20 chicks were assigned at random to each of the 9 dietary treatments listed in Table I. Beans when added to the diet replaced glucose.

Blood samples were taken via heart punc-

ture after 18 days and the chicks were killed and pancreas was removed and weighed. Blood samples from 3 chicks were pooled and tocopherol was determined according to the method described by Quaife and Buhler (4). The eviscerated, ground carcass was freeze-dried, pooled according to treatment and selenium content was determined according to the method described by Watkinson (5).

Trial 2. One hundred ninety chicks, 2 days of age, hatched from eggs of hens fed a low vitamin E diet, were fed the basal diet for 4 days and then randomly assigned to the 7 treatments listed in Table II. The chicks were fed the experimental diets for 21 days and then blood samples were taken for tocopherol determination and the chicks autopsied.

Results. In trial 1, the addition of 200 ppm vitamin E and 0.2 ppm of Se completely prevented exudative diathesis (ED) and NMD even when the diets contained 40% raw kidney beans (Table I). The addition of cystine alone prevented NMD but not ED. The addition of cystine to the basal diet decreased survival time of chicks presumably because the addition of cystine increased weight gains and hastened the appearance of ED.

The addition of beans to diets containing vitamin E decreased the serum tocopherol levels and the effect was alleviated by the addition of 0.3% sodium taurocholate. Observed serum tocopherol levels for the control and supplemented chicks were similar to those of Desai (2).

The selenium content of the carcass was not decreased when raw beans were added to the basal diet (0.24 vs. 0.26 ppm). The average content of the carcasses of chicks fed diets without beans but with added selenium was 0.38 ppm whereas the selenium content

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TABLE I. Effect of Cystine, Selenium, and Vitamin E on the Dystrophogenic Action of Raw Kidney Beans (Trial 1).

Treatments ^a	Av total gain/live chick (g)	Av daily feed intake (g)	Mortality (%)	Exudative diathesis (%)	NMD (%)	Plasma tocopherol ($\mu\text{g}/\text{ml}$)	Av survival time (days)	Se content (of dried carcass) (ppm)
Basal diet	77	13.7	65	80	100	1.3	17.1	0.24
+ vitamin E + Se ^b	143	19.7	0	0	0	45.1	18.0	0.39
+ vitamin E + Se + 0.3% cystine	304	29.1	0	0	0	49.5	18.0	0.37
+ 0.3% cystine	235	22.3	70	90	0	—	13.8	0.21
Bean basal (40% beans)	99	17.2	25	35	100	0.5	17.1	0.26
+ vitamin E + Se	104	18.9	0	0	0	14.0	18.0	0.31
+ vitamin E + Se + 0.3% cystine	210	27.2	0	0	0	13.8	18.0	0.53
+ vitamin E + Se + Na taurocholate	94	15.1	15	0	0	27.2	16.5	0.54
+ 0.3% cystine	183	27.8	20	20	0	0.4	16.8	0.21

^a 20 chicks/treatment.^b 200 mg/kg of α -tocopheryl acetate and 0.2 ppm of Se as Na_2SeO_3 .

of chicks fed similar diets but with beans was 0.46 ppm.

Hypertrophied pancreas were observed in all chicks fed diets containing kidney beans. The average weight of pancreas per 100 g of body weight was 0.26 g for chicks fed no beans and 0.55 g for chicks fed beans. Vitamin E, selenium, cystine, or sodium taurocholate had no significant effect on pancreas weight.

In trial 2 the addition of raw beans to a diet containing a marginal level of vitamin E increased the incidence of NMD but the NMD was prevented by additional vitamin E. The serum tocopherol level was depressed by raw kidney beans when added to diets containing either marginal or higher levels of vitamin E. The addition of 0.3% sodium taurocholate alleviated but did not completely prevent, the effect of the beans on serum tocopherol levels.

Discussion. Kidney beans did not appear to significantly affect the selenium content of carcasses but did decrease plasma tocopherol levels. This indicates the primary effect of kidney beans on the incidence of NMD in chicks is concerned with vitamin E rather than selenium. The dystrophogenic effect of beans could be partially alleviated by the addition of 0.3% sodium taurocholate. Garlich and Nesheim (3) demonstrated that sodium taurocholate improved fat absorption in chicks fed raw soybeans. Therefore, it is concluded that at least some of the increased incidence of NMD observed when raw kidney beans are added to a diet containing a marginal level of vitamin E is a result of decreased absorption of vitamin E.

Summary. Two trials were conducted with 370 chicks to study dystrophogenic action of raw kidney beans. The addition of 40% raw kidney beans to the basal diet decreased plasma tocopherol levels and induced NMD in chicks fed 30 ppm of vitamin E and decreased plasma tocopherol levels in chicks fed 200 ppm of vitamin E but NMD was induced in the latter chicks. The beans did not significantly affect the selenium content of the carcass. The addition of sodium taurocholate alleviated the dystrophogenic action.

TABLE II. Effect of Sodium Taurocholate on Incidence of NMD (Trial 2).

Treatment	Av total gain (g)	NMD (%)	Plasma tocopherol ($\mu\text{g/ml}$)
Basal	130.8	100	3.0 ^b
+ 30 ppm vitamin E ^a	153.7	7.7	9.5 ^d
+ 30 ppm + 40% raw beans	95.0	80.0	2.8 ^b
+ 30 ppm + 40% raw beans + 0.3% sodium taurocholate	88.2	32.9	4.9 ^c
+ 200 ppm vitamin E ^a	146.8	0	41.3 ^e
+ 200 ppm + 40% raw beans	94.6	0	15.9 ^e
+ 200 ppm + 40% raw beans + 0.3% sodium taurocholate	92.1	0	19.8 ^f

^a As α -tocopheryl acetate.

^{bdefg} Values with unlike superscripts significantly different ($p < .05$).

Therefore, it is suggested that at least some of the dystrophogenic effect of raw beans in chicks is due to decreased absorption of vitamin E.

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