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Vitamin A Deficiency in Chicks Fed Purified Rations Containing Cod Liver Oil.*

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Previous publications from this laboratory[1,2,3] have described a type of paralysis of nutritional origin in growing chicks characterized by ataxia, loss of equilibrium, staggering gait, and lack of growth. This condition has been ascribed to vitamin B_4 deficiency. More recently histopathological studies on such paralyzed chicks revealed certain lesions which were very similar to those occurring in uncomplicated vitamin A deficiency, in spite of the fact that these chicks were receiving rations which contained 2% of cod liver oil

TABLE I.
Occurrence of Leg Paralysis and Loss of Equilibrium in Relation to Supply of Vitamin A.

Basal ration	Supplement	No. of chicks	No. with leg paralysis	No. with loss of equilibrium
452	None	12	10	6
452	20 mg oleum percomorphum/week	15	10	0
452	0.4 mg carotene/week	8	3	0
452S	2% liver extract + 2% autoclaved liver residue + 0.4 mg carotene/week + irradiation*	8	5	0
452S	2% liver extract + 2% autoclaved liver residue + irradiation	4	2	4
452S	3% bakers' yeast + 2% cod liver oil + 20 mg oleum percomorphum/week	4	4	0
452S	3% bakers' yeast + 0.4 mg carotene/week + irradiation	3	3	0
452S	3% irradiated yeast + 0.4 mg carotene/week	4	3	0
459	None	8	4	4
459	20 mg oleum percomorphum/week	8	0	0

*Chicks were irradiated, where indicated, with a quartz-mercury vapor lamp for ½ hour periods 3 times per week.

* Published with the approval of the Director of the Wisconsin Agricultural Experiment Station.

1 Keenan, J. A., Kline, O. L., Elvehjem, C. A., Hart, E. B., and Halpin, J. G., *J. Biol. Chem.*, 1933, **103**, 671.

2 Kline, O. L., Bird, H. R., Elvehjem, C. A., and Hart, E. B., *J. Nutrition*, 1936, **11**, 515.

3 Elvehjem, C. A., Phillips, P. H., and Hart, E. B., Proc. Soc. Exp. Biol. and Med., 1937, **36**, 129.

of medicinal grade. This oil contained at least 1500 vitamin A units (U.S.P.X.) per g. These findings led to an investigation of the adequacy of this level of oil as a source of vitamin A in purified rations kept at room temperature. The data are given in the table.

Ration 452S had the following composition: dextrin 70, reprecipitated casein 18, salts No. I 5, brewer's yeast 2, and water extracted lung 5. Ration 452 contained in addition 2% each of liver extract, autoclaved liver residue, and cod liver oil. Ration 459 contained in addition to the ingredients of 452S 2% of liver extract, 8% of defatted peanut residue, 2% of cod liver oil, and 5% of grit. These additions were made at the expense of the dextrin.

The results were very striking when either Oleum Percomorphum or a suspension of carotene in water was administered to chicks receiving these rations. There was complete prevention of the loss of equilibrium and staggering gait. For the most part the chicks were able to survive the experimental period, and there was a slight improvement in growth in some cases. However, the paralysis and incoördination of the leg muscles was accentuated so that the chicks walked with a characteristic high stepping gait and stood with hocks thrust forward and toes stiffened and extended as though there were a hypertonicity of the extensors. Tremors were observed in some cases. Thus it appears that loss of equilibrium is not a part of the vitamin B_4 syndrome, but is caused by a complicating deficiency of vitamin A, and that vitamin B_4 deficiency is characterized chiefly by incoördination of the leg muscles.

It is the purpose of this paper not only to describe this type of paralysis as it occurs uncomplicated by vitamin A deficiency, but also to point out the need for extreme care to avoid vitamin A deficiency when working with purified rations kept at room temperature. In all previous experiments the cod liver oil was mixed with the ration at intervals of one week or less because of the known instability of vitamin A, but destruction appears to have occurred in spite of the precautions that were taken. Further studies on this supposed destruction have not been undertaken, but the iron and copper salts in the salt mixture may play a part. We have eliminated this difficulty in all present work by administration twice weekly of standardized vitamin A concentrates directly to all chicks on synthetic diets.