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Non-Availability of Fecal Thiamine in Thiamine Deficiency.

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That fecal thiamine and cocarboxylase are not available to man was suggested recently by Alexander and Landwehr.[1] These investigators believed that the thiamine so excreted was present largely in the bodies of bacteria and other organisms. Furthermore, an amount of thiamine and cocarboxylase approximating that normally excreted was not absorbed when administered in a retention enema. On the other hand, Najjar and Holt[2] concluded that the large intestine could absorb thiamine as evidenced by the increased urinary excretion of thiamine following the administration of a large quantity of the vitamin by rectum.

Williamson and Parsons[3] have reported that the ingestion of pineapple fiber resulted in an increased fecal elimination of thiamine in human subjects. Increasing the thiamine intake alone did not affect an increased fecal excretion.

Leong[4] found that the fecal excretion of thiamine by rats was negligible if the intake was less than 30 International units (90 μg) daily. Incomplete absorption occurred if this level were exceeded. Guerrant and co-workers[5] have shown that the type of carbohydrate in the ration has a marked influence on the synthesis of thiamine in the digestive tract of the rat. The effect of coprophagy was less marked when the diet contained sucrose, glucose or commercial cornstarch than when dextrinized cornstarch was employed.

Experiments conducted in this laboratory indicate that thiamine-depleted rats, in which commercial cornstarch served as the carbohydrate, excrete appreciable quantities of this vitamin in their stools; that the total thiamine as measured following enzymatic hydrolysis of the feces is not nutritionally available is evidenced by the progress of the depletion state in the animals terminating in polyneuritis and death.

Weanling male rats were segregated into 3 like groups of 8 animals each and were placed on a thiamine low diet of the following composition: casein (technical) 16; cornstarch 60; autoclaved brewers' yeast, 9; salt mix U.S.P. No. 1, 4; crisco, 9; cod liver oil, 2; and non-irradiated brewers' yeast, 0.2.

One group of rats received no supplementation and served as controls while the 2 thiamine-dosed groups were given a sub-optimal level (5 μg) or an excess of the vitamin (50 μg) daily by stomach tube.

The fecal thiamine excretion was followed throughout the course of the experiment; the thiochrome method of Hennessy[6] being employed in the determination.

The rats receiving the thiamine-deficient diet excreted essentially the same total thiamine per g of feces throughout the experimental period as did the animals receiving 50 μg of thiamine (Table I). The quantity of feces decreased in the thiamine low group as the depletion progressed. The fecal output for the several groups followed the weight changes. The larger animals (those receiving thiamine) excreted more feces than did the depleting rats. The food consumption governed the fecal output.

Cocarboxylase was determined on the thirty-first day of the test. At this time the animals receiving the deficient regimen had

1 Alexander, B., and Landwehr, G., *Science*, 1945, **101**, 230.

2 Najjar, V. A., and Holt, L. E., Jr., *J. Am. Med. Assn.*, 1943, **123**, 683.

3 Williamson, A., and Parsons, H. T., *J. Nutr.*, 1945, **29**, 51.

4 Leong, P. C., *Biochem. J.*, 1937, **31**, 373.

5 Guerrant, N. B., Dutcher, R. A., and Tomey, L. F., *J. Biol. Chem.*, 1935, **110**, 233.

6 Hennessy, D. J., *Cereal Chem. Bull.*, 1942, **2**, 25.

TABLE I.
Fecal Thiamine Excretion of Rats with Varying Thiamine Intakes.

Days on test	Group	No. of rats	Avg wt, g	Avg 24 hr fecal output, g	Total thiamine, μg/g feces	Cocarboxylase % of total thiamine
1st day	Control period	8	46	0.28	12.9	—
10th	Thiamine low	8	79	0.19	22.2	—
	5 μg thiamine	8	68	0.47	7.2	—
	50 " "	8	82	0.54	24.0	—
23rd	Thiamine low	8	81	0.21	12.9	—
	5 μg thiamine	8	115	0.51	11.3	—
	50 " "	8	136	0.65	21.3	—
31st	Thiamine low	7	67	0.11	15.1	80
	5 μg thiamine	7	132	0.51	12.6	69
	50 " "	7	176	0.83	16.6	41
42nd	Thiamine low	2	77	0.10	17.5	—

declined in weight and one of the group had succumbed to thiamine deficiency. These rats excreted 80% of their total thiamine in the form of cocarboxylase as contrasted with 69% for the animals receiving 5 μg of thiamine and 41% for the rats receiving 50 μg of thiamine daily.

After 42 days on test 6 of the animals in the original group had succumbed. The 2 remaining rats although evidencing signs of severe thiamine deficiency still excreted an appreciable quantity of total thiamine in their stools.

The non-availability of fecal thiamine was further demonstrated by the feeding of feces to thiamine-depleted animals. Five rats, placed at weaning on the thiamine low diet, were maintained on the regimen until a plateau in weight had been reached (25 days). Each animal was then dosed by stomach tube with a suspension of feces from a like group of thiamine-deficient rats. The feces were fed in a quantity sufficient to supply 5 μg of thiamine daily (as determined by the thiochrome method). The feeding of the thiamine containing feces was without effect upon the progress of the deficiency. However, when 5 μg of thiamine was administered daily spectacular weight gains were observed.

Summary. Rats maintained on a thiamine-deficient diet excreted essentially the same concentration of thiamine in their stools as did animals receiving 5 or 50 μg of thiamine daily. The output of feces was greatly reduced in the thiamine low group. During the later stages of the depletion the thiamine was present largely in the form of cocarboxylase.

The fecal thiamine of the deficient rats was not available when administered curatively by the oral route to animals which had plateaued in weight on a thiamine-low diet.

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Fecal Riboflavin of Rats Receiving Varying Intakes of Riboflavin.

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The biosynthesis of vitamin B factors was suggested by Roscoe[1] who observed that coprophagous rats maintained on diets containing cornstarch lived and in some cases grew despite the absence of the vitamin B

[1] Roscoe, M. H., *Biochem. J.*, 1931, **25**, 2056.