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Metabolism of Iron and Copper in Anemic Rats.

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Rats were made anemic by restriction to a diet of cow's milk. This milk was obtained directly in glass bottles from Guernsey cows and contained an average of 0.14 mg. of copper per liter. One group of 5 anemic rats was sacrificed. The stomachs and intestines were removed, and the carcasses were analyzed for iron and copper. Another group of 5 rats received daily supplements of 0.5 mg. of iron as pure ferric chloride. A third group of 6 rats received daily intraperitoneal injections of 0.5 mg. of iron, and a fourth group received 0.5 mg. of iron and 0.025 mg. of copper as copper sulfate each day *per os*.

Hemoglobin determinations were made at intervals on blood samples secured from the tails. In 17 days the animals receiving iron by mouth had increased their hemoglobin from an average concentration of 4.15 gm. to 7.23 gm. per 100 cc. of blood. The rats receiving iron intraperitoneally increased their hemoglobin from 4.03 gm. to 12.92 gm. in the same time, and the rats receiving iron and copper orally increased their hemoglobin from 3.90 gm. to 13.40 gm. per 100 cc. of blood. These data confirm conclusions reached in previous work from this laboratory,[1] namely, that supplements of iron bring about some hemoglobin production in anemic rats and that intraperitoneal injections of iron result in hemoglobin production at about the same rate and to the same extent as oral administrations of both iron and copper.

TABLE I.
Average Values of the Iron and Copper Contents of the Rats.

Group	No. Rats	Net Body Wt. gm.	Iron Content mg.	Copper Content mg.
1. Controls	5	58	1.13	0.051
2. Fe orally	5	68	2.12	0.061
3. Fe injected	6	88	6.78	0.104
4. Fe + Cu orally	5	87	3.63	0.115

The average values for the analyses of the carcasses of the rats for iron and copper are recorded in Table I. These figures show

[1] Eveleth, M. W., Bing, F. C., and Myers, V. C., *J. Biol. Chem.*, 1933, **101**, 359.

that the hemoglobin production in the rats receiving injections of iron is associated with an increase in the copper content of the body over that of control rats sacrificed at the beginning of the experiment. It has been calculated that the average retention of copper in this group of rats was 73% of the total intake in the form of the copper of the milk, while in the group receiving iron orally it was 17% and, in the group receiving both iron and copper, only 12% of the total intake during the experimental period.

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Carotenemia. Its Influence on the Validity of the Icteric Index.

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In a paper with Hess[1] one of us called attention to the occurrence of carotenemia. At the time it was pointed out that this might in certain cases cause confusion with icterus. Later it was observed that the carotenemia might be very intense in diabetic patients on the high vegetable diet of the time.

It is obvious that carotene must exert some influence on the icteric index of the blood, a fact which has been appreciated by most of the workers in this field. Fiessinger, Walker and Thierry[2] from their work felt that the effect was negligible, Boeck and Yater[3] found that carotene accounted for from 10 to 55% of the icteric index, while White[4] concluded that the influence was negligible except in marked cases of xanthemia accompanying diabetes.

The subject has been reinvestigated on 161 patients, 75 of whom were suffering from diabetes mellitus, the carotene being determined in terms of the icteric index (lipochrome index) and in mg. per 100 cc. of serum. In 43 diabetic cases on which icteric indices were determined carotenemia was found to account for an average of 45% of the corresponding icteric indices, the extremes being 19.3 and 70.5%. The average icteric index was 7.1. The average

[1] Hess, A. F., and Myers, V. C., *J. Am. Med. Assn.*, 1919, **73**, 1743.

[2] Fiessinger, N., Walter, H., and Thierry, J. E., *Compt. rend. Soc. de Biol.*, 1928, **98**, 1299.

[3] Boeck, W. C., and Yater, W. M., *J. Lab. and Clin. Med.*, 1929, **14**, 1129.

[4] White, F. D., *J. Lab. and Clin. Med.*, 1931, **17**, 53.