

Table I presents the results of the average daily changes occurring in the several constituents of the blood during the course of ontogenetic development. The numbers in parentheses indicate the number of separate analyses from different embryos used to compute the average. From these results it is observed that the embryonic blood sugar is increased beginning with the 16th day of incubation. The increase in the uric acid concentration is observed much earlier in the developmental period. Similar increases are observed in the concentration of cholesterol and hemoglobin, and in red blood cell counts, with the exception of a definitely lowered level during the hatching period.

Further studies are in progress to determine more exactly the extent and significance of these changes.

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### Availability of Iron in Wheat.

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Elvehjem, Hart, and Sherman<sup>1</sup> have reported that the inorganic iron content of wheat is approximately 47% of the total iron content. Their biological studies indicated that this figure also represents the available iron content. On the contrary Rose, Vahlteich, and MacLeod<sup>2</sup> observed that wheat is an excellent source of iron for hemoglobin formation.

In order to determine whether there is any great variation in the form of iron in different varieties of wheat, 11 samples representing both hard spring wheat and soft winter wheat were analyzed for total and inorganic iron. A modification of the technic of Elvehjem, Hart, and Sherman,<sup>1</sup> which employs a longer extraction period, was used to determine the inorganic iron, whereas the total iron was determined on ashed samples by the thioglycolic acid method.<sup>3</sup> The total iron of the 11 samples ranged from 2.90 mg. to 4.87 mg. of iron per 100 gm. of wheat. The inorganic iron showed

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<sup>1</sup> Elvehjem, C. A., Hart, E. B., and Sherman, W. C., *J. Biol. Chem.*, 1933, **103**, 61.

<sup>2</sup> Rose, M. S., Vahlteich, E. M., and MacLeod, G., *J. Biol. Chem.*, 1934, **104**, 217.

<sup>3</sup> Hanzal, R. F., *Proc. Soc. Exp. Biol. and Med.*, 1933, **30**, 846.

about the same amount of variation, the range being from 2.46 mg. to 4.04 mg. of iron per 100 gm. of wheat. The percentage of inorganic iron with respect to the total iron varied from 73% to 88%, the average being 81%. This figure agrees fairly well with the value suggested by Shackleton and McCance.<sup>4</sup>

Two of the samples of wheat were also used for a biological assay. Albino rats were made anemic by employing an exclusive milk diet. As soon as values below 4.0 gm. of hemoglobin per 100 cc. of blood were attained, the experimental diets were started. Three groups of experimental animals received 0.25 mg. of iron per day. One group of 5 animals received 0.25 mg. of iron per day furnished by  $\text{FeCl}_3$ ; a second group of 6 animals received Trumbull wheat (soft winter wheat) in quantities to supply the same amount of iron per day; and the third group of 6 animals received Nabob wheat (soft winter wheat) in quantities to supply 0.25 mg. of iron per day. All of the animals were given adequate supplements of copper and manganese along with as much milk as they would drink. The hemoglobin levels were determined at weekly intervals for a 4-week period. The actual hemoglobin increase is calculated by subtracting the initial hemoglobin concentration from the final hemoglobin concentration. In each group of experimental animals the actual increase in hemoglobin concentration for the 4-week period was between 9.1 and 10.1 gm. of hemoglobin per 100 cc. of blood.

The actual increases in hemoglobin concentration for each group of experimental animals are not significantly different. The results show that the iron of wheat is well utilized for hemoglobin formation. If it can be assumed that the iron of  $\text{FeCl}_3$  is all available, then it appears from these animal experiments that the iron of wheat is practically all available.

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<sup>4</sup> Shackleton, L., and McCance, R. A., *Biochem. J.*, 1936, **30**, 582.