TECHNICAL PAPERS

Differences in Physiological Activity in Brown and White Fat as Revealed by Histochemical Reactions[1]

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Since the discovery by Hoffmann and Wertheimer (*5*) that fat consumes oxygen, subsequent investigations have disclosed that adipose tissue possesses a number of biochemical activities not previously suspected. Recent experiments by Schoenheimer (*7*), using isotopic compounds as markers, have shown that lipids of the fat depots are not static reserves but are constantly subject to a variety of highly complex chemical reactions of synthesis, degradation, and interconversion. These findings have stimulated renewed interest in the biochemistry and histology of this tissue, so long regarded as metabolically inert. In addition to the white or yellow adipose tissue which occurs in all mammals, many species possess gland-like masses of so-called brown fat in the interscapular, axillary, and inguinal regions. The function of brown adipose tissue is obscure, but evidence is accumulating which suggests that it is quite different from that of white fat. It is known to consume more oxygen than white fat (*1*). Indeed, computed as fat-free tissue, its respiration is as great as that of kidney, and it is as active in oxidizing succinate and pyruvate. It contains cytochrome C and cytochrome oxidase and is rich in ascorbic acid and diphosphothiamine, according to Hook and Barron (*6*). We have been interested in comparing the two types of fat with regard to their histochemical reactions for glycogen and lipase.

Glycogen is not found in the adipose tissues of rats in a normal nutritional state. It can, however, be demonstrated in the fat cells of animals being refed with carbohydrate after a period of fasting (*2*). We have found that it is also possible to cause the deposition of glycogen in adipose tissue by the injection of insulin. Whichever method is used, glycogen occurs in brown fat in much greater quantity than in white fat. Animals whose thyroid function has been abolished by thiouracil, and animals which have been castrated, deposit distinctly more glycogen in their brown fat depots than do normal animals under the same experimental conditions. Hence, the amount of glycogen laid down in brown adipose tissue appears to be under the influence of the ductless glands. Similar endocrine effects upon white fat are suspected, but the glycogen content of this type of fat is so small that significant quantitative differences have not been detected by histological methods.

The histochemical reaction of Gomori (*3*) for lipase was also applied to both types of fat, using as substrates Tween 40, Tween 60, and Product 81. Preliminary observations on the adipose tissues of well-nourished rats indicate that the subcutaneous white fat of the back is devoid of stainable lipase, while the subjacent interscapular brown fat contains a considerable amount of the enzyme uniformly distributed in the cytoplasm between the lipoid vacuoles. The previous observation of Gomori (*4*), that white fat has a negative histochemical reaction for lipase, is thus confirmed, while the occurrence of this enzyme in brown adipose tissue has been demonstrated histologically for the first time.

Further studies on the variations of lipase content in starvation and hibernation are being undertaken.

[1] This work was done in part under a grant from the American Cancer Society on the recommendation of the Committe on Growth of the National Research Council.

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High-Efficiency Counting of Long-lived Radioactive Carbon as CO_2[1]

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The recent availability of long-lived radioactive carbon (C^{14}) from the Manhattan District (*7*) in relatively large quantity has tended to emphasize the difficulties inherent in the available methods of measurement of this important isotope. It has been desirable to adapt the Geiger-Müller counter to this measurement. Ionization chambers are not simple instruments to use when connected with sensitive electrometer circuits. Henriques and Margnetti (*4*) have recently described an ionization chamber used with a Lauritzen electroscope which shows high sensitivity. However, the limiting sensitivity of any method of measurement is determined by the statistics of the backgrounds, which are fundamentally different in counters and ionization chambers. The advantage lies with the counter, as it counts only events, while the ionization chamber integrates the total ionization produced by each event of each kind (*2*). Counting C^{14} from some solid compound of carbon with thin-window β-counters is at best highly inefficient (*8*) because of the very low energy of the

[1] The research described in this paper was supported in part by Contract N5 ori-78, U. S. Navy Department. The author acknowledges his obligation to Prof. R. D. Evans, who instigated this investigation and made it possible; to Mr. R. G. Fluharty, who gave much help on the electrical circuits; and to all the members of the Radioactivity Center at M.I.T. for their time, advice, and cooperation.