FATS IN THE DIET

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Report to the Council

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The significant increase in life expectancy in the United States and the growing percentage of the total population in the over-65 age group have intensified interest in the nutritional problems of the aged. Although it is doubtful if fundamental distinctions exist between nutritional requirements in middle and in advanced age, the distressing incidence of arteriosclerosis, coronary thrombosis, and cerebral vascular accidents has nevertheless raised questions about the possible relation of these diseases to the dietary habits of older adults and to the composition of common foods.

Lipids are frequently designated as dietary culprits, and, in some circles, the terms "fat" and "cholesterol" have become synonymous with atherogenesis and diaster. How much is an optimal quantity of fat, and what should be its chemical nature? The fact that precise answers cannot be given to these fundamental questions emphasizes the urgent need for the reexamination of the role of lipids in nutrition.

There can be no doubt about the physiological importance of fats. The neutral fats are triglycerides of common fatty acids. The high caloric density of fat and its insolubility in water make it superior to both glycogen and protein for the storage of energy, in both animals and plants. Moreover, the deposition of fat in animals as adipose tissue insulates the body against rapid changes in environmental temperature and physically cushions organs and the body as a whole against external forces.

That fat is not a foreign material in the body is indicated by the elaborate enzymatic and hormonal mechanisms that control its chemical transformations. The interrelationship of these mechanisms with those concerned with the metabolism of sugars and amino acids suggests that the utilization of fat as a fuel is the usual, not the unusual, biochemical event. Actually, much evidence exists to support the view that the intermediate products of fatty acid metabolism serve as the primary fuel of resting muscle. It is significant also that fat is synthesized by mammary tissue and that it is quantitatively the most important source of energy in milk.

Fats are widely distributed among common foodstuffs. They add acceptability to meals; certain ones provide the essential fat-soluble vitamins, and their digestion and absorption make possible the intestinal absorption of these same vitamins.

Storage fat may originate directly from food fat or indirectly from the conversion of dietary carbohydrate to fat. During any 24-hour period starch, sucrose, lactose, and glucose are assimilated through the digestive tract and are either burned or become, temporarily, blood glucose, liver or muscle glycogen, or tissue fat. In a normally nourished individual a portion of the day's intake of carbohydrate is converted to fat. If the individual is in caloric balance, this fat is burned between meals and during the night, and none is left in the tissues. If the individual's caloric intake is excessive, his energy needs are satisfied without using all of the fat, and adipose tissues increase in amount.

Fat formed from food carbohydrates in animals is largely a mixture of the triglycerides of palmitic, stearic, and oleic acids. These fatty acids predominate in butter fat, the fat of milk, and in the fat obtained from adipose tissue of farm animals. Palmitic and stearic acids are saturated, whereas oleic acid is unsaturated, having one double bond in its carbon chain. Tissue fats of animals may contain variable amounts of the triglyceride of linoleic acid if the fat trilinolein is present in the diet. Linoleic acid, which is doubly unsaturated, either is not synthesized or is only slowly synthesized in animal tissues.

In contrast to palmitic, stearic, and oleic acids, which, although useful, are dispensable in the diet, linoleic acid may be an essential nutrient. It is an integral part of important tissue constituents such as lecithins and esters of cholesterol. From a practical viewpoint, it is the dietary precursor of arachidonic acid, the polyunsaturated fatty acid that is indispensable to many animal species. Although evidence for the essential role of linoleic and arachidonic acids in

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human diets needs further corroboration, prudence favors their provisional inclusion in the group of nutrients required by man.

The problem of the nutritive value of the triglycerides of common fatty acids is complicated by the fact that man uses appreciable quantities of triglycerides of other and unnatural fatty acids in his diet. This happens because of the commercial hardening of plant oils by the process of hydrogenation. This procedure not only forms saturated bonds from unsaturated bonds but also may transform the natural "cis" isomers to unnatural "trans" isomers. The latter have higher melting points but remain unsaturated. Other unnatural isomers may result from a shifting of the double bonds along the carbon chain. At the present time it is virtually impossible to describe chemically some of the commercial hydrogenated plant oils because of their complexity.

Some plant oils such as corn, cottonseed, safflower, soybean, and peanut oils are rich sources of trilinolein. As noted before, hydrogenation replaces a significant part of the linoleic acid with stearic acid and with unnatural, unsaturated fatty acids. Arachidonic acid occurs in small amounts in some animal fats. Olive oil, although unsaturated, is a poor source of linoleic acid; coconut oil, a plant fat, is saturated. Chicken fat is an unusual animal fat because of its relatively large content of linoleic acid; fish oils are highly unsaturated and are characterized by other polyunsaturated fats in addition to some trilinolein. These illustrations demonstrate the need of a more definitive terminology in describing the fatty acids in natural and in processed fats than is afforded by the general terms, animal or plant, hard or soft, saturated or unsaturated, and low iodine or high iodine number.

Considerable evidence exists to show that, under certain circumstances, sources of linoleic acid may lower elevated serum cholesterol levels in man. The evidence favors the concept that essential unsaturated fatty acids are required for the normal transport of cholesterol as lipoprotein and, possibly, phospholipid complexes. Clarification of the circumstances under which hypercholesteremia can be prevented, however, remains to be delineated. Valid experimentation has not yet determined the relative influence on serum cholesterol of surplus dietary calories, of an excess of the total dietary fat, of abnormal ratios of linoleic acid to other fatty acids in the diet, or of numerous other nutritive factors that may influence adversely the physical and chemical characteristics of lipids in the blood and in the walls of the vascular system. Until a clear-cut solution of the problem of the prevention of arteriosclerosis and of its sequelae is forthcoming, it seems wise to assume that a faulty diet may be one of the causative agents. Whether or not dietary fat is, in some fashion, the culprit remains to be proved. In the meantime, one may recommend the dietary control required to attain and maintain optimum body weight and the choosing of a varied diet containing adequate amounts of those foods, including fats, shown by experience and by experiment to have special nutritive value.

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