

# DIET AND HYPERCHOLESTEREMIA

A Comment

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CONCERN with the amount of serum cholesterol, its relation to dietary fat and to cholesterol, and the association of hypercholesteremia with atherogenesis is widespread. It is reflected in the divergent opinions expressed both in scientific and in lay journals and in the recent report<sup>1</sup> of a Joint Committee of the American Heart Association and the American Society for the Study of Arteriosclerosis. The latter report reviews primarily the problem of a diet that is good for the general population. It suggests that from 25 to 30 per cent of calories be obtained from fat, with the further provision that the fat be sufficient "to meet caloric and essential fatty acid demands." Most physicians are less concerned with diets for general consumption than with diets for their individual patients who have definite elevations of serum cholesterol concentration (more than 300 mg. per 100 ml. as determined by most methods) and also may present family or personal histories either of xanthoma or of premature arteriosclerosis or of both diseases. The purpose of this paper is to summarize present-day dietary approaches to the control of hypercholesteremia.

Two dietary programs are currently employed. One is the strictly low-fat diet and the other is a diet containing a minimum of animal fat along with sufficient vegetable oil to provide a normal *total* fat intake. These two distinctly different approaches, unfortunately, are sometimes misinterpreted as being interchangeable. Misunderstanding may be fostered by commercial advertisements that seem to lead one to believe that control can be established simply by taking vegetable oil, as a medication, with the implication that the oil is substantially noncaloric.

The low-cholesterol diet can be dismissed from separate consideration because such a diet is intrinsically low in animal fat. Furthermore, the ingestion of cholesterol without fat has no appreciable effect on the concentration of serum cholesterol.

## Fats and Serum Cholesterol

The various kinds of fat are distinguished, in part, by the amounts of iodine that they can absorb; these values are a convenient measure of saturation or hydrogenation and are known as "iodine values." Animal fats, the popular hydrogenated shortenings and tropical nut oils such as coconut oil or cocoa butter, are relatively highly saturated and have low iodine values. Commercially available vegetable oils contain a large proportion of unsaturated fatty acids,

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primarily linoleic, and have high iodine values. Some of the unsaturated fatty acids are required for the proper nutrition of rats and other mammals. Because they are not synthesized by the organism, and must be supplied in the diet, they often are referred to as "essential fatty acids."

The saturation of an individual fat determines the effect on serum cholesterol when the fat is taken by human beings as the only source of dietary fat. Saturated fats, such as those present in dairy products—meats, eggs, margarines and hydrogenated shortenings—tend to increase the amount of serum cholesterol; relatively unsaturated vegetable oils tend to decrease the amount of serum cholesterol. When saturated and unsaturated fats occur together in the diet, the hypercholesteremic tendency of each gram of saturated fat can be counteracted by about 3 gm. of unsaturated fat. These facts have been determined by special "formula" diets<sup>2,3</sup>. Valuable as they are in tests, such formula diets are unpalatable and impractical for common use.

### The Normal Diet

The normal American food pattern or diet provides 47 per cent of total calories as carbohydrate, 12 per cent as protein and 41 per cent as fat.<sup>4</sup> In relation to a daily intake of 2,000 calories, this diet means 235 gm. of carbohydrate, 60 gm. of protein and 90 gm. of fat. Such a diet contains per day the following basic food stuff: two servings of meat, 1 pint of milk, 1 egg, 6 slices of bread with butter or margarine, a cereal, fruit, a vegetable, and a dessert. One fifth of the fat comes from dairy products; one third from table fat (butter or margarine) and cooking fat (lard or commercial shortening); one third from meat; and the rest from eggs, fruits, cereals, and vegetables.<sup>5</sup> In this normal diet, 85 per cent of the fat is saturated and 15 per cent is unsaturated (Fig. 1).

### The Low-Fat Diet

The low-fat diet *omits* as much of all fats as possible from all food sources. It provides only from 10 to 15 per cent of the total calories as fat. These calories are obtained by eating from 30 to 40 gm. of fat daily, from 15 to 30 gm. of which is relatively saturated animal fat. In effect, the low-fat diet reduces the saturated-fat intake to an amount that does not affect the concentration of serum cholesterol. The low-fat diet eliminates fat-containing dairy products, table and cooking fats, egg yolks, and nuts. Intake of meat fat is reduced by avoiding pork and by using instead lean beef, and by frequent use of veal, poultry, and fish. A 2,000-calorie daily diet, then, would be comprised of 360 gm. of carbohydrate, from 60 to 70 gm. of protein, and 30 gm. of fat.

The low-fat diet we use includes 30 gm. of fat daily (Fig. 1). This is mostly saturated fat and substantially all of it is eaten at *one* meal. The reason for this "one fat meal" is that metabolism of ingested fat given at frequent intervals, may be delayed, and favors accumulation of the fat in the serum.<sup>6</sup> Moreover, by con-

centrating the day's fat in one meal, the patient is assured of having one satisfying meal a day, and is more likely to follow the diet. This regimen can be followed at home or at work with little difficulty.

### The Vegetable-Oil Diet

This diet *substitutes* vegetable oil for most of the fat that would be eaten in a normal diet. In the vegetable-oil diet, as in a normal diet, about 40 per cent of the calories is derived from fat; from 5 to 10 per cent of the calories comes from animal fats, and from 30 to 35 per cent from unsaturated vegetable oils. As with the low-fat diet, the consumption of animal fat is restricted to from 15 to 20 gm. daily, but there also is provided from 60 to 100 gm. of vegetable oil (Fig. 1). The intake of carbohydrate and of protein corresponds to that of a normal diet.

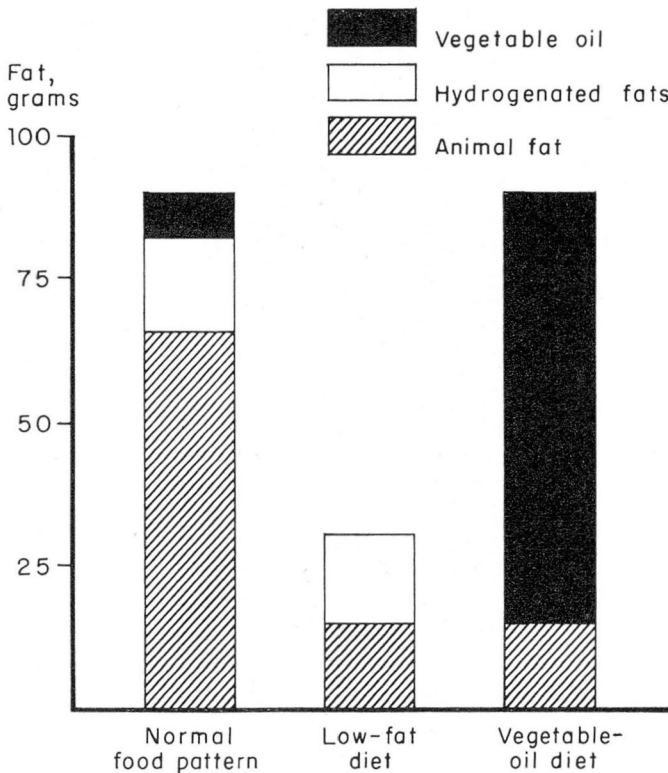


Fig. 1. Chart showing amounts and kinds of fat in normal, low-fat, and vegetable-oil 2,000-calorie diets.

The vegetable-oil diet is basically a low-fat diet with the addition of vegetable oils, such as corn, soya, peanut, or cottonseed oil. It is effective in decreasing the amount of serum cholesterol, because it curtails intake of saturated animal fats below the hypercholesteremic concentration, and increases the intake of unsaturated vegetable oil to the extent that it exerts a hypocholesteremic effect. The diet is prepared by substituting an unsaturated vegetable oil for the meat, dairy, and table fats of the normal diet.

It is important to recognize that this regimen requires the *substitution* of one kind of fat for another. The *addition* of a few tablespoons or capsules of vegetable oil, however prepared, to a basically normal food pattern will not alter the proportion of saturated to unsaturated fats sufficiently to affect the amount of serum cholesterol.<sup>7</sup> It would take almost a pint of vegetable oil each day to counteract the effect of the usual amount of dietary saturated fat contained in the normal diet. A sufficient intake of one of the unsaturated oil preparations can depress the amount of serum cholesterol in persons who simultaneously restrict their intake of animal fat. The calories supplied by the oils used medicinally necessarily supplant calories obtained from food; this means that a large portion of appetizing food is sacrificed.

Because it seemed to us that a vegetable oil regimen can be successful in practice—if it is practical and acceptable, closely corresponds to a normal American food pattern, provides a flexible diet, and can be readily prepared from easily available foods—we have undertaken a study of vegetable-oil diets in which these oils are used as food rather than as medication. Among the oils under study is a preparation of cottonseed oil.\* This modified cottonseed oil can be made into a spread for bread, can be used as shortening in baked goods, and will emulsify in a blender with nonfat milk solids to yield reconstituted “milk,” “cream,” or “ice cream” of any desired fat content.

The clinical part of the study has been conducted in collaboration with Harriet P. Dustan, M.D., and Roland E. Schneckloth, M.D., over periods of from three to 18 months, in 30 patients with hypercholesteremia and hyperlipemia, several of whom have xanthomatosis and some of whom have myocardial infarcts. It has also involved short-term, carefully controlled tests in seven normal persons and 18 of the above-mentioned patients. Many of the patients had followed low-fat diets for from three to 15 months before changing to the vegetable-oil diets.

Preliminary results will be reported in detail elsewhere, but, briefly, we have found that both the low-fat (one fat meal daily) and the vegetable-oil diets can reduce and maintain concentration of serum cholesterol at amounts less than those prevailing during periods of free dietary intake. Either of the diets may decrease the amount of serum cholesterol to within acceptable limits. When a maximum reduction seems to have resulted from the low-fat diet, the addition of vegetable oil often causes a further decrease (Fig. 2). A few patients whose serum lipid patterns represent severe “essential” hypercholesteremia (rather than mixed, presumably familial hyperlipemia and hypercholesteremia) do not respond well to either regimen.

\*Prepared under the supervision of Fred H. Mattson, Ph.D., Research and Development Department, Procter & Gamble Company, Cincinnati, Ohio.

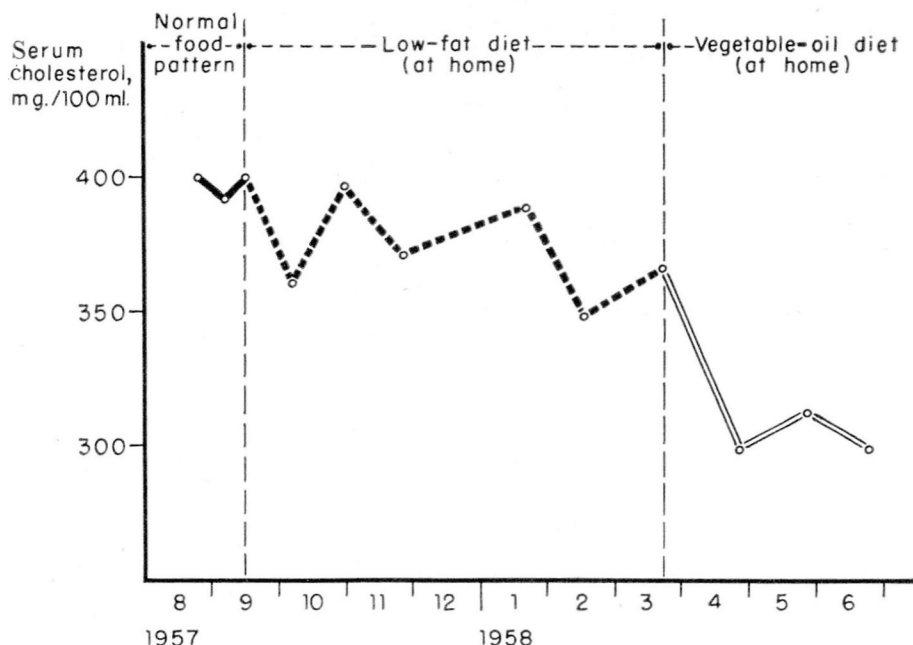


Fig. 2. Graph showing serum cholesterol values in a hypercholesteremic patient who received normal, low-fat, and vegetable-oil diets successively from August, 1957, into June, 1958.

### Summary

1. The normal, the low-fat, and the vegetable-oil diets are compared in regard to the amount and the nature of the fat content and the effect on serum cholesterol in hypercholesteremia.

2. The low-fat diet may depress the amount of serum cholesterol by the severe restriction of intake of saturated animal fat. The diet is easily followed when most of the daily fat intake occurs at one meal.

3. The vegetable-oil diet (in which vegetable oils are substituted for most of the animal fat in a normal diet) may cause depression of the amount of serum cholesterol below the lowest limit attained with a low-fat diet. This effect is attributable to the hypocholesteremic effect of unsaturated fat.

4. Attention is directed to the undesirability of regimens in which vegetable oils are used as medications only, or are added to diets in which animal fat is not restricted.

### References

1. Page, I. H.; Stare, F. J.; Corcoran, A. C.; Pollack, H., and Wilkinson, C. F., Jr.: Atherosclerosis and fat content of diet. *Circulation* **16**: 163-178, 1957.

2. Ahrens, E. H., Jr.; Insull, W., Jr.; Blomstrand, R.; Hirsch, J.; Tsaltas, T. T., and Peterson, M. L.: Influence of dietary fats on serum-lipid levels in man. *The Lancet* 1: 943-953, 1957.
3. Beveridge, J. M. R.; Connell, W. F., and Mayer, G. A.: Dietary factors affecting level of plasma cholesterol in humans: role of fat. *Canad. J. Biochem. & Physiol.* 34: 441-455, 1956.
4. McCann, Mary B., and Trulson, Martha F.: Our changing diet. *J. Am. Dietet. A.* 33: 358-365, 1957.
5. Mattson, F. H.: Personal communication, spring, 1958.
6. Wilkinson, C. F., Jr.: Spaced fat feeding: régime of management for familial hyperlipemia. *Ann. Int. Med.* 45: 674-680, 1956.
7. Perkins, R.; Wright, I. S., and Gatje, Barbara W.: Effect of safflower oil emulsion on serum cholesterol levels in young adult males; its use as supplement to normal diet. *J.A.M.A.* 166: 2132-2135, 1958.