THE EFFECT OF VARIOUS DIETARY FACTORS ON THE SERUM-CHOLESTEROL LEVEL AND ON THE FAECAL FAT CONTENT*

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A. The effect of some non-lipid dietary factors on the serum-cholesterol level

Carbohydrate. Two subjects were studied. Initially a 2,500-calorie, almost fat-free diet was administered; then supplements of sucrose were added to increase the caloric intake to 3,500 daily for 30 days and to 4,000 daily for a further 25 days. Moderate increases in the serum-cholesterol level occurred only during periods of rapid gain in weight. When saturated fats were substituted for sucrose at the same or at lower caloric levels, there were prompt and substantial increases in the serum-cholesterol level. These observations are consistent with the theory that the serum-cholesterol level rises when there is an increase in the fat transport load, e.g. at the time of rapid gain in weight, when there is increased lipogenesis from carbohydrate.

* Abstract of paper presented at a meeting of Research Forum, University of Cape Town, held at Groote Schuur Hospital, Cape Town, on 7 May 1958.

2. *Protein.* Three subjects were studied. Iso-caloric diets were maintained throughout the experimental period and the intake of protein was varied by feeding with different quantities of maize meal or skimmed-milk protein. Provided that the fat consumption was constant, changing the daily protein intake from 34 g. to 68 g. did not alter the serum-cholesterol level. When milk fat was isocalorically substituted for carbohydrate at these protein levels, the serum-cholesterol level rose promptly and substantially.

3. *Cellulose.* The effects of diets containing different quantities of crude fibre were studied in short-term experiments on 3 subjects. The diets were constant throughout the experiments with regard to calories, protein and quantity and quality of fat. In 2 subjects, changing the daily consumption of crude fibre from 6·1 g. to 14·5 g. by increasing the intake of maize meal did not affect the faecal fat content or the serum-cholesterol level. In a 3rd subject, the dietary fibre was increased to 24·5 g. daily by the addition of coarsely milled, hexane-extracted sunflower-seed hulls; this highly artificial fibre load produced a slight increase in the faecal fat content and a slight fall in the serum-cholesterol level.

B. Studies to determine the origin of the faecal fat

In 11 subjects studied on basal diets very low in fat (6·5 g. to 8·6 g. daily) for an average of 13 days each, the mean daily faecal fat content ranged from 0·8 g. to 5·4 g. with a mean of 2·25 g. (S.D. 1·12). This fat is presumably derived from a combination of synthesis by intestinal bacteria, desquamation of intestinal mucosal cells, and excretion *via* the biliary system or through the intestinal wall. There was no correlation between the faecal fat content and the dietary fibre intake, the latter varying among the subjects from 1·8 g. to 6·8 g. daily. In the 2 subjects described above, increasing the dietary calories from 2,500 to 4,000 did not materially influence the faecal fat content. In 15 subjects, the addition of saturated or unsaturated fat to the basal diet always produced an increase in the faecal fat content; in general, the greater the dietary load of fat, the greater was the faecal fat content. To determine whether this increase in faecal fat content was due to unabsorbed dietary fat or to increased excretion of body fat, a series of experiments was conducted in 5 subjects with intravenously administered emulsions of cottonseed oil (Lipomul I.V.—Upjohn). When the intravenous fat was administered instead of dietary fat, the faecal fat content fell towards basal levels; when it was administered in addition to the dietary fat, there was no further increase in the faecal fat content. These observations are consistent with the hypothesis that with ordinary diets the faecal fat is derived from unabsorbed dietary fat and not from active excretion of body fat. It was noted that in all these subjects the administration of intravenous cottonseed oil produced a decrease in the serum-cholesterol level, but when the emulsifying agents alone (soybean phosphatide and pluronic F68) were administered, without the cottonseed oil, the serum-cholesterol level always rose. This apparently is an example in man of the phenomenon described in experimental animals of 'cholesterol trapping' in the blood stream by emulsifying agents.

C. *Studies to determine the cholesterol-decreasing factor in certain unsaturated fats*

The following preliminary observations were reported:

1. The unsaponifiable fractions of pilchard oil and sunflower-seed oil failed to reproduce the cholesterol-decreasing effect of the fatty-acid fractions of the whole oil when eaten by 3 subjects.

2. In a series of individual experiments in the metabolism ward and in a group experiment on 30 men in an institution, natural and hydrogenated oils were compared. The hydrogenating of maasbanker oil so as to reduce its iodine value from 170 to 70, peanut oil from 89 to 55, and sunflower seed oil from 135 to 74, abolished cholesterol-decreasing action of these fats. There did not, however, appear to be a linear relationship between the iodine value of the fat and its effect on the serum-cholesterol level.

3. To test further the effect of altering the iodine value, a series of experiments was devised in which hens' eggs were 'unsaturated' so as to increase the iodine value from 72 to 100. This was done by feeding a flock of Black Australorp hens with a diet rich in sunflower seeds. Ten yolks daily of 'unsaturated' eggs and 'control' eggs were eaten by 2 subjects for 10 days; no difference was noted in their cholesterogenic effect. As has previously been shown, this effect of the 'unsaturated' eggs was not due to their cholesterol content and it was again shown that this effect could be abolished by frying the eggs in sunflower-seed oil.

Our results thus far do not support the theory that the action of all dietary fats on the serum-cholesterol level is determined simply by their degree of saturation. Further investigations are in progress in order to characterize more precisely the active factor or factors.