Recent Findings on Dietary Lipids: Relationships with Coronary Heart Disease

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Population studies from all over the world have consistently shown a highly significant correlation between daily consumption of saturated fats, elevated serum, cholesterol and mortality from coronary heart diseases (CHD). The diet appears to be a prominent player in the entire process leading to CHD. For example, when the dietary consumption data from 30 different countries were assessed (Norody *et al.*, 1990), nutrients such as animal proteins, cholesterol, meat, sugar, eggs, total fat, total calories and animal fats were found to be significantly correlated with the incidence of CHD. On the other hand, vegetable fats showed no correlation with CHD. In recent years, the Greenland Eskimos, whose traditional diet is low in saturated fatty acids but high in cholesterol and long-chain polyunsaturated fish fatty acids of the (n-3) family, were noted for their low incidence of CHD (Dyerberg *et al.*, 1978). Much interest has since been generated in the role of the (n-3) fatty acids and their ability to lower mortality from CHD. However, the contention that fish fatty acids lower LDL-cholesterol has been challenged and to some extent shown to be misleading (Harris, 1989). On the other hand the (n-3) fatty acids can lay a true claim for their ability to lower serum triglycerides. The recognition of serum triglycerides as an additional risk factor to serum total cholesterol and LDL-cholesterol, although well recognized, is often poorly understood. While the (n-3) fatty acids from fish consumption have been thoroughly investigated, most researchers have overlooked other mitigating factors associated with high intakes of both fish and fish oils. In a large number of these studies, the fish oils were also rich in the monounsaturated fatty acids. This simple oversight has resulted in the masking of the beneficial effects of the monounsaturates. Fortunately there now seems to be a growing awareness of the need to consider the diet in totality rather than as individualized compartments.

SERUM CHOLESTEROL – HYPER- AND HYPO-CHOLESTEROLEMIA

Serum cholesterol levels are recognized as strong indicators of, or risk factors for, coronary heart disease. Hypercholesterolemia is presently defined largely as a function of LDL-cholesterol levels higher than 160 mg/dL or serum cholesterol greater than 200 mg/dL. These serum total cholesterol and LDL- cholesterol levels are based on the potential beneficial effects of regulating cholesterol levels in patients with CHD. Interestingly, this risk factor is modifiable through dietary manipulations.

While both the lay person and the medical profession are concerned with hypercholesterolemia as a result of the tremendous publicity the subject generates, we have unintentionally overlooked 'the other side of the coin', namely hypocholesterolemia. Hypocholesterolemia is defined as the incidence of abnormally low levels of serum cholesterol in man, often less than 100 mg/dL. In recent years, several research clinics have been struck by a relationship between these extremely low serum cholesterol levels and mortality. This aspect is therefore worthy of further examination as illustrated by the following published evidence in leading medical journals.

The work of Oster *et al.* (1981) and that of Rudman *et al.* (1988) on hypocholesterolemia merits discussion. Oster recorded that mortality during hospitalization in patients with serum cholesterol <120 mg/dL was 32% higher than that of the average hospital population. When the serum cholesterol level dropped to <80 mg/dL, mortality increased to 57%. The causes of death in these patients with hypocholesterolemia were recorded as: heart diseases (36%), malignancies (33%) and liver disease (33%). Similarly Rudman found that patient death rate increased from 14% to 63% when serum cholesterol was <150 mg/dL.

Unfortunately, the medical profession does not readily recognize the pathogenesis of hypocholesterolemia: hence the numerous dietary guidelines that suggest maximum levels for serum and LDL cholesterol but never minimum levels for healthy living. Hypocholesterolemia is often associated with liver disease Podolsky *et al.* (1987) wherein the level of the enzyme responsible for transfer of fatty acids from lecithin to cholesterol (LCAT) is reduced, leading to a lower rate of cholesterol esterification in plasma.

Although increased LDL receptor activity is acknowledged to be beneficial in the regulation of serum and LDL cholesterol, Peterson *et al.* (1985) have associated certain types of malignancy with elevated LDL-receptor activity. In a group of 30 patients, low serum cholesterol was inversely related to LDL receptor activity of leukemia cells. Chemotherapy not only reduced the number of leukemia cells, but also increased serum and LDL cholesterol levels. Recently, patients with AIDS (Grunfeld *et al.*, 1989) were observed to have lower serum cholesterol levels (157 mg/dL) than the average population (190 mg/dL).

Dietary guidelines for the population have advocated the modification of various risk factors associated with coronary heart disease, including dietary means to reduce serum and LDL cholesterol. The lay person hence presumes that the modification of these risk factors will either reduce or eliminate CHD. However, as if to add to the existing complexities, it is only fair to warn the reader that coronary heart disease can also occur in spite of the lack of all known risk factors and even when serum and LDL cholesterol levels are normal.

A recent medical case history (Anon, 1989) illustrates this: a patient who developed atherosclerosis in spite of the fact that none of the usual risk factors for CHD or atherosclerosis were present. These included low serum and LDL-cholesterol as well as borderline HDL-cholesterol. The relationship between CHD- related death rates and risk factor is further complicated by the data from the Multiple Risk Factor Intervention Trial, MRFIT (1982). When no risk factors were present, mortality (per 1 000) was 8.8, whereas with hypercholesterolemia, hypertension and smoking it was 8.2, 10.4 and 15.9 respectively.

These studies simply emphasize our folly in assuming that cholesterol alone is the essential component in the complicated process of CHD. Without doubt we should be aware of the risks associated with hypercholesterolemia. At the same time, any attempt to regulate blood cholesterol, especially through drug therapy, should be nominal and should certainly not to the extent of creating the risk of hypocholesterolemia. Our present knowledge does not yet allow the establishment of lower levels for serum cholesterol levels. As the understanding of CHD increases, without doubt other variables will be continuously added as risk factors.

FATTY ACIDS AND ANTIOXIDANT STATUS

Oxidation of the fatty acids in oils and fats has been traditionally inhibited by the addition of antioxidants such as BHA, BHT, THBQ or propyl gallates. The metabolic fate of these artifically added antioxidants has sometimes been the subject of much debate. In some countries, they may be added to foods only when cleared by the health authorities and always with a maximum permissible limit. Against this background, the naturally-occurring 'nutrient' antioxidants have gained prominence by their ability to inhibit lipid peroxidation which causes damage to cell membranes. Vitamin E, in the traditional form of tocopherols or the 'new' tocotrienols, are presently seen as important nutrient antioxidants with several potential applications in the biomedical field.

When foods are consumed and pass down the gastrointestinal tract, the gastrointestinal mucosa could become prone to lipid peroxidation. These peroxides often arise from the foods themselves and impinge on the mucosa, raising the possibility of lipid peroxidation therein but the mucosa is generally resistant to this bombardment of peroxides.

The work of Balasubramaniam *et al.* (1988) showed the presence of a surprisingly simple but effective lipids peroxide

inhibitor in the gastrointestinal mucosa of rat. Furthermore, the structure of this inhibitor was unlike that of the nutrient antioxidants including Vitamin E. In subsequent experiments, and for the first time ever, these workers clearly showed that both palmitoleic (C16: 1, n-9) and oleic (C18:1, n-9) acids exhibited an ability to arrest lipid peroxidation in the mucosa. Since the level of oleic acid is greater than that of palmitoleic acid in the rat mucosa, much of the inhibitory action must be ascribed to oleic acid.

Recent evidence suggests that the monounsaturated fatty acids have an ability to protect against CHD. In the light of these recent findings and the reported antiperoxidant properties of the monoenes we may yet again witness greater emphasis on the role of the monounsaturates in human nutrition.

COMMENTS ON PALM OIL

For some time now, the consumption of palm oil has been alleged to increase serum and LDL-cholesterol levels. However these allegations have never been substantiated scientifically and evidence in our hands suggests a different picture. A recent well–controlled study in a European population showed that palm oil does not increase serum cholesterol or LDL-cholesterol (Sundram *et al.*, 1990). In fact it showed a striking tendency to increase the levels of HDL-cholesterol, which is involved in reversing cholesterol from being deposited in the vessel walls. In another development in a sample Nigerian population (Kesteloot *et al.*, 1989) consuming palm oil as the predominant fat source, it was shown that low cholesterol levels were possible with this population. In the light of our present understanding regarding hyper and hypo cholesterolemia, it is of tremendous interest that palm oil neither raises serum cholesterol (hyper) nor shows any tendency to reduce it to 'hypo' levels.

Possibly connected with this observation is the high content of tocotrienols in palm oil. There is now concrete evidence that the tocotrienols regulate cholesterol synthesis in the liver (Qureshi *et al.*, 1986). This regulation is analogous to that of the synthetic lipid lowering drugs being tested to reduce cholesterol levels. Unlike such drugs, the tocotrienols are unlikely to produce any side effects nor reduce cholesterol to such an extent that the pathogenesis of hypocholesterolemia will exist.

Evidence for a superior nutritional quality of the monounsaturated fatty acids over the polyunsaturated fatty acids is continuosly mounting. The latest observation that should generate much interest is the finding that hydrogenated polyunsaturated oils (containing trans fatty acids) decrease the beneficial HDL-cholesterol relative to the monoenes (Mensink *et al.*, 1990). The high monoene content (39% oleic acid) in palm oil has yet to be expressed in the same magnitude. But this author's personal experience has shown that palm oil feeding increases HDL-cholesterol in both animal (Sundram *et al.*, 1990) and human models (Sundram *et al.*, 1990), a fact that has seldom being highlighted by the adversaries of palm oil. Coupled to this is the present observation of Balasubramaniam *et al.* (1988) showing the anti-peroxidation potential of both oleic and palmitoleic acids. Taken as a whole package, palm oil seems to have several components which are beneficial in the human diet, and vigorous research on these and other nutrutional aspects of palm oil is containing. The findings so far suggest that palm oil is indeed nature's package for an excellent choice.

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