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Covian F.G.

in

Allaya M. (ed.).
L'économie de l'olivier

Paris : CIHEAM
Options Méditerranéennes : Série Etudes; n. 1988-V

1988
pages 149-152

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Francisco Grande COVIÁN

Departamento de Bioquimica
Universidad de Zaragoza - Spain

The olive tree has been cultivated for the last 6,000 years or so and its fruit and the oil obtained from it have been an important part of the diet in the Mediterranean area for at least 4,000 years.

The fatty acid composition of olive oil glycerides is characterized by high oleic acid content (monoenoic 18 carbon fatty acid, with a single double bond located between carbons 9 and 10 -- C 18:1, n-9) which represents two thirds or more of the total fatty acids. Because of the variability in fatty acid composition of the oils obtained from different varieties of olive trees in different places, the following figures are given only as indications: saturated fatty acids, 12-14 %; monoenoic fatty acids (mainly oleic), 70 %; linoleic acid, 10%.

The olive oil content of linoleic acid (C 18:2, n-6), an essential fatty acid, is lower than that of other vegetable oils such as corn oil, soybean oil, and safflower oil. It is important to note, however, that the olive oil content of linoleic acid is sufficient to meet the essential fatty acid requirements of humans when olive oil is used as the main dietary fat. A diet whose olive oil content corresponds to 20 % of its total energy, will provide an amount of linoleic acid equivalent to 2 % of the total energy which is the currently recommended intake. This would be the case of a 2,700 Kcal diet with 60 g of olive oil.

The unsaponifiable fraction of olive oil deserves consideration from the nutritional point of view. In addition to plant sterols, triterpenoid alcohols, polyphenols and carotenoid pigments, it contains a significant amount of tocopherols. Virgin and refined olive oil contain around 137-297 mg of tocopherols per kg. It is generally believed that the ratio of vitamin E to polyunsaturated fatty acids, and the presence of other antioxidants, are adequate to satisfy vitamin E requirements and to protect unsaturated fatty acids from oxidation. These chemical characteristics of olive oil are important not only from the nutritional point of view but also from that of its stability when used in cooking and for its shelf life.

The main nutritional role of olive oil, as with all other dietary oils, is its contribution to the energy value of the diet. Because fat has an average caloric value of 9 $Kcal.g^{-1}$ compared to 4 $Kcal.g^{-1}$ for carbohydrates and proteins, the amount of fat in the diet is an important determinant of what is called the "energy density" of the diet.

The contribution of fat to the total energy of the human diet shows remarkable differences among different populations. In the industrial countries of the West, fat accounts for some 45 % of the total energy intake whereas in most developing countries it accounts for 20 % or less of the total energy intake.

For reasons to be discussed later on, it is currently recommended that the fat content of the diet should not exceed 30-35 % of its total energy value. Because fat contributes to the palatability of the diet, low fat content diets are not acceptable to many people in the West. Moreover, it may be difficult to satisfy the energy requirements of active individuals with diets of low fat content, without unduly increasing the bulk of meals.

Much of current interest about the role of fat in human nutrition over the last 30 years has been promoted by observations showing a relationship between fat intake and the prevalence and mortality of certain diseases. Coronary heart disease, the leading cause of death among males in industrialized countries, is less common in other parts of the world and the difference appears to be related to the consumption of certain kinds of fat. The differences in coronary heart disease mortality show a very high, significant correlation with the contribution of saturated fatty acid glycerides to the total energy content of the diet. Thus, in the well-known Seven Countries Study, Keys has shown a correlation of $r = 0.57$ between the ten year coronary death rates and the percentage of diet calories derived.

Using statistical data from 27 countries (including Eastern European countries), Szostak *et al.* (1985) found a correlation of $r = 0.64$ between the intake of animal fat (in grams) and coronary mortality for men between 65-74 years old. A negative correlation ($r = -0.57$) between coronary mortality and intake of vegetable fat (margarine excluded) was found in this study. Unfortunately, no separation was made of monoenoic and polyenoic fats in this study.

The analysis by Keys of the data from the Seven Countries Study shows a high negative correlation between the ratio of oleic acid, the fatty acid characteristic of olive oil, to saturated fatty acids, and mortality from coronary heart disease, and with total mortality.

It has long been known that the biochemical characteristic of the atherosclerotic lesion consists of the deposit of lipid material, including cholesterol, in the vascular wall. In fact, the proportion of cholesterol in the lipid deposit increases with the severity of the lesion. In the last three decades, it has been repeatedly shown that incidence and mortality of coronary heart disease have a close correlation with plasma total cholesterol level. In the Seven Countries Study, the ten year coronary death rate for men 40-59 years old showed a significant correlation of $r = 0.89$, with the mean plasma total cholesterol level. Total cholesterol levels are currently considered as one of the main "risk factors" in the development of the atherosclerotic process and in clinical complication coronary heart disease.

The so-called "dietary hypothesis" of atherosclerosis postulates that the role of dietary fat in the development of atherosclerosis is mediated by its effect on the total cholesterol plasma level. But the effect of different food fats is different and it is important to know whether the effect of dietary fat is determined by its composition in terms of fatty acids.

Studies to this effect, performed in our laboratory of the University of Minnesota on metabolically healthy middle-aged men, under strictly controlled conditions, have shown that the effect of the fatty acid composition of the diet on the plasma total serum cholesterol levels is described by the Keys, Anderson and Grande equation: $\Delta Chol. = 2.7\Delta S - 1.3\Delta P$ where $\Delta Chol.$ represents the change in serum cholesterol, expressed as $mg.dl^{-1}$, and ΔS and ΔP the changes in the content of saturated and polyunsaturated fatty acids, respectively, expressed as a percentage of the total diet energy.

This equation means that the increase in the content of saturated fatty acids of the diet in an amount corresponding to 1 % of the diet energy, is associated with an increase of 2.7 $mg.dl^{-1}$ of total serum cholesterol. A similar addition of polyunsaturated fatty acids causes a decrease of total plasma cholesterol of 1.r $mg.dl^{-1}$. Please note that these changes refer to the addition of fatty acid glycerides with removal of an isocaloric amount of mixed diet carbohydrates, and that the energy balance was rigourously maintained throughout the experiments.

The effect of monoenoic fatty acids such as oleic acid, the main component of olive oil, does not appear in the equation because the exchange of oleic acid glycerides for an isocaloric amount of carbohydrates does not produce any statistically significant change in total plasma cholesterol concentration. This result has often been erroneously interpreted. The addition of a certain amount of oleic acid glycerides, with simultaneous removal of an isocaloric amount of saturated fatty acid glycerides, will cause a reduction of plasma cholesterol of 2.7 $mg.dl^{-1}$ because of the elimination of the cholesterol raising effect of the saturated glycerides.

It follows from the equation that the most effective way of reducing plasma total cholesterol level is the removal of saturated fat. On the other hand, diets containing oleic acid glycerides will produce plasma cholesterol levels similar to those caused by an isocaloric carbohydrate diet.

In the last few years it has been observed that the two main fractions of plasma cholesterol, that transported by the low density lipoprotein (LDL-Chol.) and that transported by the high density lipoprotein (HDL-Chol.) behave differently in regard to their role in the development of atherosclerosis. The positive correlation between total cholesterol and incidence on mortality of coronary heart disease depends mainly on the low density lipoprotein cholesterol (LDL-Chol.) which in humans represents about 60 % of the total plasma cholesterol. The cholesterol fraction transported by the high density lipoprotein shows a negative correlation with coronary risk. For equal levels of total cholesterol, individuals with higher levels of HDL-Chol. have a lower coronary risk than those with low HDL-Chol. levels. Subjects with genetically determined high level of HDL-Chol. appear to be remarkably free of coronary heart disease (Glueck *et al.*, 1975). It is therefore believed that HDL-Chol. has a "protective effect" with regard to the development of atherosclerosis.

It follows from this view that the dietary prevention of coronary heart disease should aim to reduce LDL-Chol. and to increase HDL-Chol. The polyunsaturated oils currently used in the prevention of coronary heart disease reduce both the fractions, as shown by my analysis of eight well documented publications between 1975 and 1982. This has promoted new interest in the study of the effect of monounsaturated fats on plasma cholesterol concentration and its distribution among the two main lipoproteins.

A number of recent experiments indicates that oils rich in monoenoic fatty acids, such as olive oil, do produce total serum cholesterol levels comparable to those obtained with polyunsaturated oils, with no decrease or increase of the HDL-Chol. fraction. Two of these experiments should be considered here.

The first was performed by Professor Jacotot in France with a group of Benedictine monks who were kept for six months on a control diet with a daily addition of 45 g of a mixture of polyunsaturated oils (soybean, peanuts, sunflower and canbra). For another six months, the monks had the same diet with an addition of 45 g of olive oil. Saturated fatty acids intake was practically the same for both situations. Monoenoic fatty acids intake (as a percentage of total energy intake) was 9.9 % for the oil mixture period and 15.2 % for the olive oil period. Polyenoic fatty acids were 9.7 % for the oil mixture and 3.3 % for the olive oil. The net change in fatty acid intake in going from the first to the second period was an increase of monoenoic fatty acids equivalent to 5.3 % of total calorie intake, with a reduction of the intake of polyunsaturated fatty acids equivalent to 6.4 % of total diet energy. These changes refer mainly to changes in oleic and linoleic acids.

Serum total cholesterol levels were the same with the two diets (198 $mg.dl^{-1}$). HDL-Chol. showed a significant increase from 35.5 $mg.dl^{-1}$ with the polyunsaturated diet to 48 $mg.dl^{-1}$ with the olive oil diet. As a percentage of the total cholesterol, HDL-Chol. rose from 19 to 24 %.

The second experiment was performed by Mattson and Grundy (1985) in the United States. Two varieties of safflower oil were compared, one rich in linoleic acid (72.8 % of total fatty acids), the other rich in oleic (73.4 % of total fatty acids). There was also a saturated diet containing palm oil. In each case the oils were incorporated as the sole fat in a formula diet in the proportion of 40 % of the total calorie intake. Total plasma cholesterol was 224 $mg.dl^{-1}$ for the saturated diet, 197 for the oleic acid rich diet and 191 for the linoleic acid rich diet. HDL-Chol. was 38 $mg.dl^{-1}$ for the oleic acid diet and 35 $mg.dl^{-1}$ for the linoleic acid diet. This difference did not reach statistical significance. It should be noted that the number of subjects in this experiment was smaller than that in Jacotot's experiment, the duration of the experimental periods was only four weeks, and there were several hyperlipidemic individuals among the subjects. These differences, and the fact that the oils were incorporated into a formula diet instead of being part of the usual diet, pose some problems when we attempt to compare these experiments. It is clear, however, that the results are very similar.

Similar results have also been reported by researchers in Greece, Italy and Spain, showing that olive oil is practically as effective as the polyunsaturated oils in reducing total cholesterol, with the advantage of not decreasing (and even increasing) the cholesterol fraction transported by the high density lipoprotein and the apoproteins of this lipoprotein.

One year ago Dr. Grundy stated: "In the fight against heart disease, olive oil may be a better weapon than the popular polyunsaturated oils". In this regard it is important to remember the low coronary mortality observed in places such as Crete where olive oil is the main dietary fat. In addition, as also mentioned by Dr. Grundy, it is unlikely that olive oil, because of its chemical composition, produces the undesirable effects attributed to the polyunsaturated oils rich in linoleic acid. At the same time, as noted at the beginning, the linoleic acid content of olive oil is enough to prevent the development of essential fatty acids deficiency in individuals using this oil as the main diet fat.