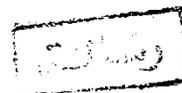


Ain Shams University
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EFFECT OF DIETARY FAT, SOURCE OF CARBOHYDRATE AND LEVEL OF CALCIUM ON SERUM CHOLESTEROL IN RATS



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INTRODUCTION

INTRODUCTION

Diet is one of the major environmental factors that affect serum lipids and lipoproteins. Diet is believed to play a major role in atherogenesis because lipids and other dietary constituents affect serum cholesterol concentration and hypercholesterolemia is a well established risk factor for atherosclerosis (*Srinivasan et al. 1984*).

Numerous studies have investigated the relative importance of dietary factors on plasma cholesterol levels and the association between dietary variables with elevated LDL cholesterol and increased risk for atherosclerosis and cardiovascular disease (*Fernandez and McNamara 1991*).

Among dietary components that elevate serum lipids, saturated fat and cholesterol contents are considered important. The type of fat in the diet greatly influence blood lipid concentration. Polyunsaturated fatty acid diets are generally considered to be hypocholesterolemic compared with saturated fatty acids diets (*Marzuki et al. 1991*).

Coronary heart disease (CHD) is in most instances due to obstruction of coronary vessels by atherosclerosis or thrombosis, singly or in combination. It is possible to recognize seven dietary

factors that are implicated in these processes. Two are promoters of the development of CHD, cholesterol raising atherogenic saturated fatty acids (SFA) and thrombogenic SFA. Five are protective, polyunsaturated fatty acids (PUFA) of n-6 (linoleic acid series), PUFA of n-3 (linolenic acid series), monounsaturated fatty acids (MUFA), dietary fiber and antioxidants. A diet high in SFA is associated with high level of serum cholesterol which in turn are related to high incidence of CHD (*Ulbricht and Southgate 1991*).

Reducing the intake of saturated fat exerts approximately twice the beneficial impact on circulating cholesterol as does an equivalent increase in polyunsaturated ^{fat} (*Hayes et al. 1991*).

Most of the dietary studies concerning atherosclerosis have emphasized the role of fat in the diet. Unfortunately little work has been carried out with dietary carbohydrate, ignoring the fact that they are readily converted into fat in the body and may contribute to serum lipids (*Antar and Ohlson 1965*).

Srinivasan et al. (1984) stated that the specific influence of the type of dietary carbohydrate on serum lipids and lipoproteins remains controversial. However *Lopez et al. (1966)* showed that the source of carbohydrate in the diet has a significant influence on lipid

metabolism in man. They showed that when the amount of sucrose is increased and the quantity of complex carbohydrates decreased, the concentration of cholesterol and more particularly triglycerides rises. When the reverse type of diet is fed, that is a larger quantity of complex carbohydrates and smaller quantity of sucrose, lipids have been observed to decrease.

On the other hand, calcium has been reported as hypocholesterolemic in several species including humans (*Yacowitz et al 1967*).

Excess dietary calcium has been shown to decrease plasma cholesterol concentration in many animal species including rabbits, rats, goats, and humans. Excess calcium has also been shown either to increase or to have no effect on plasma triglyceride concentration in rabbits (*Iacono and Dougherty 1979*).

This shows that the effect of dietary components on blood cholesterol concentration still needs further investigation. Very few reports have reported the effect of type of carbohydrate on blood cholesterol. There is a little and conflicting reports on the effect of calcium on blood cholesterol. Almost no information on the effect of type of fat, source of carbohydrate in combination with various levels of calcium on blood cholesterol concentration is available.

***REVIEW OF
LITERATURE***

REVIEW OF LITERATURE

Effect of Dietary Fat on Blood Lipids:

Fat is the most important dietary determinant of cholesterol concentration in plasma. Saturated fatty acids are considered to increase plasma cholesterol concentration twice as much as polyunsaturated fatty acids decreased cholesterol concentration. Few data are available concerning the effect of diets that approximate reasonable human intake of fat and cholesterol in experimental animals.

Greer et al. (1966) conducted 3 trials to study the effect of high and low levels of energy intake from two fat sources (soybean oil and tallow), on serum cholesterol levels and the incidence of atherosclerotic lesions in swine. The first trial involved an arrangement of two levels of feeding (high and low caloric intake), with three types of diets (low fat control diet, diet containing 15% tallow or 15% soybean oil). The control diet resulted in significantly lower serum cholesterol level than feeding diets with added fat. Pigs fed tallow diet had significantly higher serum cholesterol level than soybean oil fed diet. In another trial similar to the previous one with the addition of two levels of protein 18% and 12%, the results showed that fat source had no statistically significant effects on serum

cholesterol levels although pigs fed the tallow diet tended to have higher serum cholesterol levels than soybean oil fed pigs. In the third trial involved an arrangement of two fat sources 5% tallow or 5% soybean oil with or without the addition of 1% cholesterol, the pigs fed tallow diets had higher serum cholesterol levels than those fed soybean oil.

Also *Mattson et al. (1972)* studied the effect of a formula diet containing 0.106, 212 and 317 mg cholesterol/1000Kcal and 20.6g fat% with p/s ratio of 0.3 on the serum cholesterol in man. After 6 weeks, the cholesterol free diet resulted in a decrease in the serum cholesterol. When the subjects were receiving the formula diets containing various amounts of cholesterol, serum cholesterol levels increased. These results showed that dietary cholesterol had a major role in determining blood cholesterol level.

On the other hand *Hamilton and Carroll (1976)* concluded that the addition of 15% butter to the control low fat diet produced a significant elevation in plasma cholesterol in rabbits after 28 days, but addition of 15% corn oil has no significant effect.

Schwandt et al. (1982) designed an experiment to investigate the effect of moderately modified fat diet (p/s ratio 1.0, cholesterol content 250mg/day) on 30 healthy male volunteers who were divided into two groups. They were either given a modified fat diet or an

isocaloric control diet (p/s ratio 0.3, cholesterol content 370mg/day) for 3 months each in a cross - over design. The results showed that serum cholesterol and LDL cholesterol were significantly lower after 3 months of diet with high p/s ratio and low cholesterol content, and the HDL cholesterol fraction remained unaffected.

On the other hand, *Krichevsky et al. (1982)* compared the effect of dietary coconut and corn oil with those of cocoa butter and palm kernel oil on rabbits fed a semipurified diets containing 14% fat derived from the above oils and fats for 9 months. The study was focused to assess serum cholesterol, HDL-cholesterol, triglycerides and phospholipids at 3, 6 and 9 months. There were only a slight rise in total cholesterol levels in the corn oil fed rabbits, and the level was in the normal range. HDL-cholesterol level fell as total serum cholesterol level rose. Serum triglycerides and phospholipids level were the lowest in the rabbits fed corn oil. Also liver cholesterol level was the lowest in the rabbits fed corn oil or coconut oil. The corn oil diet was the least atherogenic and the coconut oil diet was the most atherogenic.

Another controlled study was set up by *Brussaard et al. (1983)* to evaluate the effect of low fat low PUFA diet on lipoprotein concentration and composition as compared with a moderate fat high PUFA diet in healthy persons. All volunteers were given a moderate diet high in PUFA during 2.5 week-control period. After the control

period, the subjects were divided into two groups, one of which continued on the controlled diet, while the other received the low fat low PUFA diet providing 21% of energy as total fat. During the control period average serum total cholesterol for all subjects decreased significantly from the habitual diet. During the test period, serum total cholesterol increased in the control group, but remained stable in the group which switched over to low fat low PUFA diet. HDL-cholesterol increased in the control group and decreased on the low fat diet. The main difference between the habitual diet of the participants and the moderate diet of the control period was a higher p/s ratio of the latter, this resulted in a decrease in serum cholesterol and triglycerides levels.

A study, undertaken by *Chi et al. (1982)*, stated that feeding cholesterol and lard to rats increased plasma cholesterol and triglycerides. The same trend was observed for liver total lipids and total cholesterol.

Philip (1982) studied the effect of different nutritional factors on cholesterol metabolism and concluded that rats fed stock diet containing 20% fat as a mixture of cotton seed oil and coconut oil for 46, 63 and 66 days gave serum cholesterol ranged from 61.8 ± 4.3 to 70.6 ± 9 mg/dl, and HDL-C ranged from 42.4 ± 4 to 48.4 ± 4.8 mg/dl and triglycerides concentration was 22.3 ± 4.5 mg/dl.