COMPARATIVE STUDY ON THE EFFECT OF PALM OIL AND ANIMAL BUTTERFAT ON HYPERLIPIDEMIC RATS WITH SPECIAL REFERENCE TO ITS EFFECT ON REPRODUCTIVE ORGANS

THESIS

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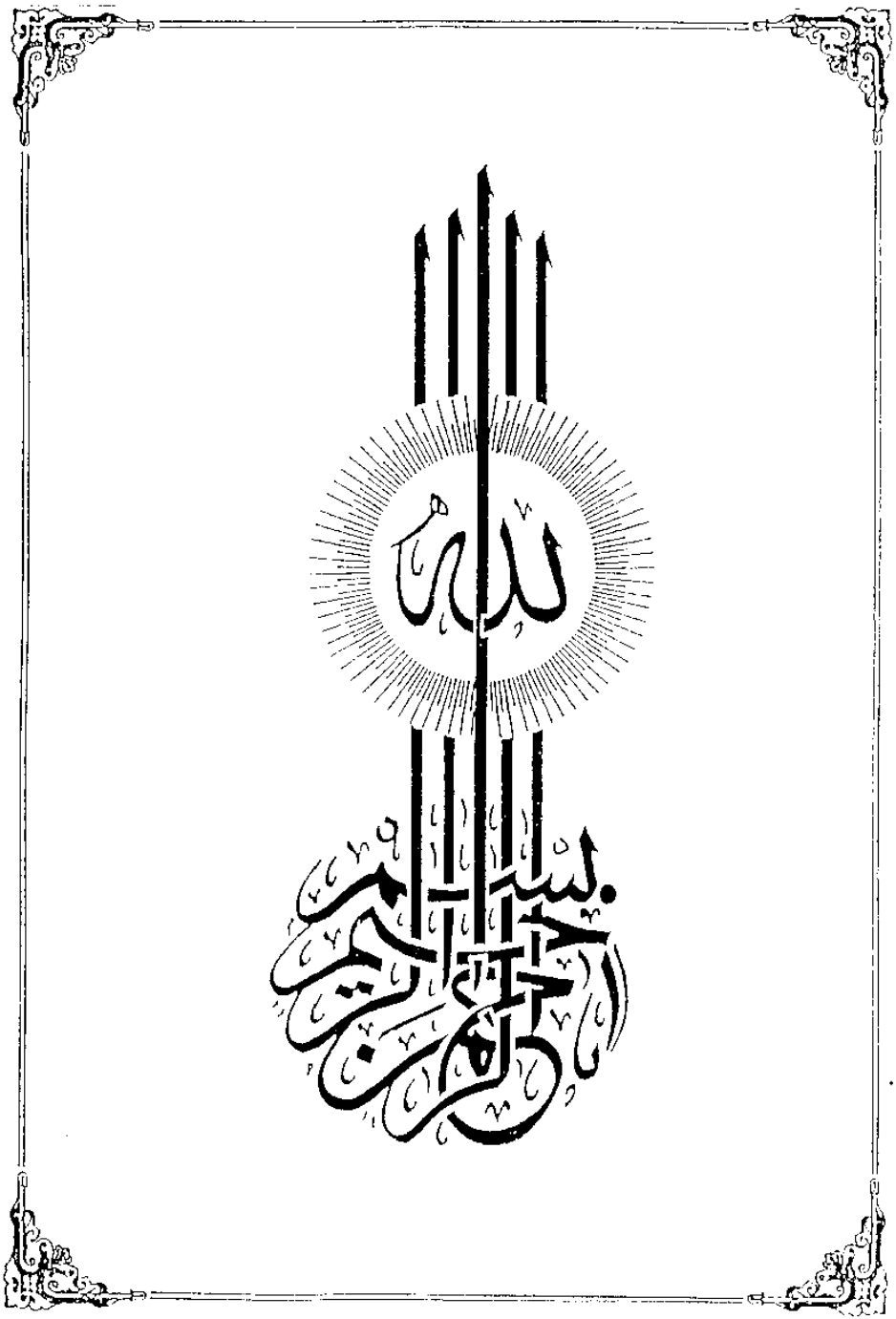

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Abstract

The present study compares the effect of three different fats on the serum of hypercholesterolemic rats and their reproductive organs. Fats used are butterfat, palm oil and its hydrogenated form. Butterfat elevated serum total cholesterol, serum triglycerides, serum total lipids and reduced the high density lipoprotein at both dose levels after 8 weeks of feeding. The palm oil and its hydrogenated form have the same effect with variable degrees. All tested fats exhibited a dangerous effect on the sperm motility and affected the testicular and ovarian tissues which may lead to infertility of hypercholesterolemic rats. Elevation of lipids is due to the high content of saturated fatty acids in the studied fats.

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Introduction

In the past fifteen years, palm oil production was increased and it has been rising too sharply and has pushed aside others oils and fats especially soyabean oil to gain larger market shares. The rapid growth of palm oil production can be expected to continue during the next eight years throughout South-East Asia, but especially in Malaysia and Indonesia due to the increase in the oil palm area, the ideal climate and the good soils available in these two countries. The oil palm produces edible oil in bigger quantities per unit of land than any other plant. The individuality of palm oil stems primarily from its high content of palmitic acid which is almost twice the quantity found in other common edible oils. Palm oil is widely used either on its own as frying oil or in blends with other oils and fats for a variety of margarines. The minor components of this oil consist of free fatty acids, mono and diglycerides. The unsaponifiable fraction is composed of carotenoids pigments which are responsible for the red colour of crude palm oil, tocopherols and tocotrienols which are natural antioxidants, sterols, alcohols and phosphatides. About 60% of the total production of palm oil is exported from Malaysia and used mainly in human food by non producing countries (Gunstone 1987). In Egypt, many people use palm oil in large quantities either in its refined state or its hydrogenated one.

Recently, some reports stated that this oil increases blood cholesterol level.

Murakami et al (1990) reported that no significant differences in the concentrations of total and

HDL cholesterol, triglycerides and total bile acids in serum could be detected among rats fed diets containing 20% palm oil, palm olein or soybean oil as a control for 28 days.

Berger (1990) found that palm oil feeding gave rise to higher serum cholesterol levels than corn oil, as expected from its composition of 50% saturated, 40% mono and 10% polyunsaturated fatty acids.

Zhang et al (1990) stated that palm oil produced significantly higher plasma cholesterol concentration than soybean oil, rapeseed oil, coconut fat and palm kernel oil in rats fed high cholesterol (1% w/w) and diets containing various fats of plant origin.

Hariharan et al (1992) studied the effect of palm oil on the lipid metabolism of rats fed diets containing oil at 5% and 20%. Triglycerides were higher in 20% oil fed groups.

Beside this oil, the majority of Egyptian population consume butterfat in large scale for its nice palatable taste.

Howard and Gresham (1968) reported that dietary fat contributes to the high incidence of coronary heart disease. Saturated fats and cholesterol containing foods, such as cream, eggs and butter should be omitted from the diet and substituted by vegetable oils to lower plasma cholesterol.

Lofland et al (1970) studied the effect of diets containing 5g/kg cholesterol and 250g/kg of either safflower oil, lard, butter or coconut oil on serum cholesterol of squirrel monkeys for two years. The diets containing safflower oil produced the lowest concentrations of serum cholesterol and the others gave rise to

higher concentrations. Moreover, Jain (1971) found that butterfat produced an increase in serum cholesterol.

Ney et al (1991) investigated the effect of different dietary saturated fats on the size distribution and chemical composition of HDL in fasted rats. Plasma total cholesterol levels were significantly higher in rats fed the palm oil and beef tallow diets than in rats fed the butterfat and coconut oil diets. Butterfat feeding resulted in lower plasma triglycerides and HDL-esterified cholesterol than did feeding the other saturated fats.

Several studies focussed on the effect of different dietary fat and cholesterol on reproductive organs in experimental animals. Thus while **Nolen (1972)** found that there was no evidence of any deleterious effects on the reproductive parameters nor any teratogenic effects due to either hydrogenated soybean oil or an unhydrogenated mixture of fats and oils.

Gupta and Dixit (1988) reported that cholesterol fed to male rabbits for 120 days reduced the production of secondary spermatocytes and hypercholesterolemia affects the testicular function.

Likewise, **Hanis et al (1989)** stated that hydrogenated fat adversely affected litter size, sperm morphology, regularity of oestrous cycle and prolonged the gestation period.

In view of these contradictory findings, the present study was performed to compare the effect of palm oil and its hydrogenate, butterfat on lipid metabolism of hypercholesterolemic rats and to evaluate their effects on the reproductive system of both sexes.

Review of Literature

1) Effect of dietary fats on serum lipids :

Long time ago, a close relationship was observed between diet and serum cholesterol in human. The effects of dietary fats on the serum cholesterol level in man depend on the relative degree of saturation of their constituent fatty acids and also the amount of ingested cholesterol.

Although many factors affect the serum lipid levels in man, cholesterol and fat in the diet have a most crucial influence. It has been known that cholesterol given with fat in the diet would invariably elevate the serum cholesterol concentration in experimental animals and ultimately produce atherosclerosis (**Anistschow 1933**).

Laten, **Ahrens et al (1954)** showed that serum concentrations of free and esterified cholesterol and of phospholipids were significantly reduced when plant fats were substituted isocalorically for animal fats during a 4 month study. The change was a 20% decrease. Neutral fat levels showed no significant change. Body weights and caloric intakes were held constant throughout the experiment.

Beveridge et al (1955) reported that 28.4% of the total calories in the form of vegetable fat, caused an average decrease in total plasma cholesterol of 33mg/100 ml. The addition of 200 mg of cholesterol led to an average decrease of 27mg/100 ml. When 58.5% of the calories were supplied by animal fat in the form of butter, the plasma cholesterol values increased and then

dropped to the same concentration at the beginning of the experiment.

Bronte-Stewart et al (1956) stated that changes in the serum cholesterol levels coincided with changes in the intake of fat. Equivalent amounts animal fats in the form of butter, beef dripping, beef muscle, and eggs caused a rise in serum cholesterol. Marine animal oils had the reverse effect.

Likewise, Keys et al (1957) studied the effect of different fat such as butter fat, corn oil, sunflower oil and sardine oil on the serum cholesterol levels. They found that corn oil has the greatest cholesterol depressing effect of the fats tested.

Ahrens et al (1957) demonstrated that serum lipids can be lowered by ingestion of highly unsaturated oils. The lowest serum lipid levels were when corn oil, safflower-seed oil or cottonseed oil constituted the sole dietary fats. Higher levels were found with all other fats tested such as lard, coconut oil, butter, cocoa butter and beef tallow. Use of hydrogenated corn and cottonseed oils as sole dietary fats resulted in higher serum lipid levels than the unhydrogenated oils were fed.

Funch et al (1960) investigated the influence of arachis oil, butter and fat mixtures made into margarine on male rabbits fed diets containing 20% fat without added cholesterol. The butter diet induced hypercholesterolemia, a grossly fatty liver. The rabbits fed on margarines and arachis oil had a relatively low content of cholesterol and B-lipoprotein in the serum.

Pleshkov (1963) reported that a daily ingestion of sunflower oil (100 & 50g/day) in addition to a diet con-

taining up to 40g of animal fat leads to a rapid drop of the blood cholesterol level during the first month of ingestion. After the ingestion of sunflower was stopped, the blood cholesterol level again began to increase rapidly, therefore in order to maintain the lowered cholesterol level, it is necessery to take sunflower oil for a prolonged time. A considerably weaker effect is noted with a daily ingestion of 50g of cottonseed oil.

Brahmanker et al (1967) examined the influence of different fats such as butter, hydrogenated fats, corn, sesame and groundnut oils on plasma cholesterol, fibrinogen platelets and erythroyte sedimentation. In the saturated fat fed groups (butter and hydrogenated fats) these factors increased greatly, whereas there was only a mild increase in the animals receiving unsaturated fats (vegetable oils). The prolonged ingestion of high percentage of saturated fat might constitute the pathogenesis of atherosclerosis and coronary occlusion.

Moore (1969) studied the effect of butterfat, maize oil or various mixtures of the two on rabbits. After 40 weeks, he observed that the concentration of cholesterol in the plasma increased progressively as the butterfat content of the diet was increased and the maize oil content was decreased. The concentration of linoleic acid in the plasma cholesteryl esters was inversely related to the concentration of cholesterol in plasma.

Plech (1969) reported that there are no significant differences in the extent, degree of development and course of experimental atherosclerosis between rats fed with butter, margarine, Crisco fat or peanut oil. No correlation between the degree of saturation of fats con-