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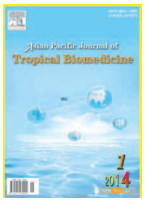

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# Impact of dietary oils and fats on lipid peroxidation in liver and blood of albino rats

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## PEER REVIEW

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**Comments**

This is a promising research work in which authors have studied the influence of dietary butter, margarine, olive oil, sunflower oil and corn oil on liver and blood lipid oxidation in albino rats by measuring MDA levels in blood and liver.

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## ABSTRACT

**Objective:** To investigate the effects of different dietary fat and oils (differing in their degree of saturation and unsaturation) on lipid peroxidation in liver and blood of rats.

**Methods:** The study was conducted on 50 albino rats that were randomly divided into 5 groups of 10 animals. The groups were fed on dietary butter (Group I), margarine (Group II), olive oil (Group III), sunflower oil (Group IV) and corn oil (Group V) for 7 weeks. After 12 h of diet removal, livers were excised and blood was collected to measure malondialdehyde (MDA) levels in the supernatant of liver homogenate and in blood. Blood superoxide dismutase activity (SOD), glutathione peroxidase activity (GPx), serum vitamin E and total antioxidant capacity (TAC) levels were also measured to determine the effects of fats and oils on lipid peroxidation.

**Results:** The results indicated that no significant differences were observed in SOD activity, vitamin E and TAC levels between the five groups. However, there was significant decrease of GPx activity in groups IV and V when compared with other groups. The results indicated that feeding corn oil caused significant increases in liver and blood MDA levels as compared with other oils and fats. There were positive correlations between SOD and GPx, vitamin E and TAC as well as between GPx and TAC (r: 0.743; $P<0.001$) and between blood MDA and liver MDA (r: 0.897; $P<0.001$). The results showed also negative correlations between blood MDA on one hand and SOD, GPx, vitamin E and TAC on the other hand.

**Conclusions:** The results demonstrated that feeding oils rich in polyunsaturated fatty acids (PUFA) increases lipid peroxidation significantly and may raise the susceptibility of tissues to free radical oxidative damage.

KEYWORDS

Vegetable oils, Butter, Margarine, Polyunsaturated fatty acids (PUFA), Lipid peroxidation, Malondialdehyde (MDA), Superoxide dismutase activity (SOD), Glutathione peroxidase activity (GPx)

## 1. Introduction

Lipids are an essential component of the diet as they are among the major sources of energy second to carbohydrates[1-5]. Lipids are required for the absorption and transport of lipid-soluble vitamins through the bloodstream[6-10]. As an important constituent of cell membranes, lipids also play specific roles in membrane signaling events. Thus cell development certain lipids are indicators of cellular events, and lipid concentration

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can represent physiological conditions of cells[11-13]. The incidence of cardiovascular disease is correlated with diets high in saturated fatty acids (SFA). Animal fats, which contain higher proportions of SFA, increase the risk of vascular system diseases. Numerous studies indicate that butter elevates the level of total cholesterol, low density lipoprotein (LDL) and triacylglycerols. It has also been reported that consumption of dietary butter contributes to hypercholesterolemia due to its high content of SFA[14]. Margarine made from corn or sunflower oils is much lower in SFA than butter. Substitution of margarine for dietary butter reduces total cholesterol and LDL levels[15]. By reducing serum cholesterol levels without any effect on high-density lipoprotein (HDL) cholesterol levels, olive oil rich in monounsaturated fatty acids shows protective effects against arteriosclerosis[16,17]. Recently, consumption of sunflower and corn oils has increased. These oils are quite rich in linoleic acid which is an essential PUFA. Although sunflower and corn oils reduce cholesterol synthesis and thus its level, they are considered as risk factors for the sensitivities to free radical formation because of their high contents of PUFA. It is we known that PUFA are more susceptible to lipid peroxidation than SFA[18-20].

In organisms, endogenous and exogenous free radicals can damage structures of lipids, proteins, carbohydrates and nucleic acids by interacting with them and can subsequently produce new free radicals[21]. Among all biomolecules, lipids are the most sensitive molecules to free radicals. Double bonds in fatty acids form peroxide products by reacting with free radicals and lipid radicals can be formed subsequently upon removal of electrons[22]. As a result of lipid peroxidation, malondialdehyde (MDA, a genotoxic harmful degradative byproduct of lipid peroxidation) can be formed in cell membranes. MDA shows both mutagenic and carcinogenic effects by changing membrane properties[23,24]. Organisms protect themselves from harmful effects of free radicals by antioxidant defense mechanisms. The antioxidant system involves both enzymatic and non-enzymatic antioxidants. The fast step in the enzymatic system is superoxide dismutase (SOD), which catalyzes the dismutation of superoxide anion ($O^{2-}$) to $H_2C_2$. The conversion of $H_2O$ to $H_2O_2$ by either glutathione peroxidase (GPx) or catalase forms the second step of enzymatic system. Superoxide dismutase and GPx enzyme activities and the balance between them are very crucial protection against oxidative stress[25-27]. Lipid-soluble vitamin E is a non-enzymatic antioxidant which plays a significant role in the protection of the cell membrane and against LDL cholesterol as well. It can reduce free radicals and it has the most action to break the chain reaction in lipid peroxidation[27-29]. The measure of total antioxidant capacity (TAC), which is the cumulative action of all the antioxidants present in plasma, provides an insight into the delicate balance *in vivo* between oxidants and antioxidants[30,31].

The objectives of this study were to demonstrate the influence of dietary butter, margarine, olive oil, sunflower oil and corn oil on liver and blood lipid peroxidation in albino rats by measuring MDA levels in blood and liver, and to assess the antioxidant activity in these animals by measuring SOD and GPx activities as well as, vitamin E and TAC levels in blood to determine the dietary oils most susceptible to lipid peroxidation.

## 2. Materials and methods

### 2.1. Fats and oils

Corn oil, sunflower oil, olive oil, butter and margarine were obtained from local market in Kingdom of Saudi Arabia. Fatty acids were transesterified into FAME using N-trimethylsulfoniumhydroxide (Macherey-Nagel, Düren, Germany) according to the procedure reported by Ramadan *et al*[32]. FAME were identified on a Shimadzu GC-14A equipped with flame ionisation detector and C-R4AX chromatopac integrator (Kyoto, Japan). The flow rate of the carrier gas helium was 0.6 mL/min and the split value with a ratio of 1:40. A sample of 1 μL was injected on a 30 m×0.25 mm×0.2 μm film thickness Supelco SPTM-2380 (Bellefonte, PA, USA) capillary column. The injector and flame ionisation detector temperature was set at 250 °C. The initial column temperature was 100 °C programmed by 5 °C/min until 175 °C and kept 10 min at 175 °C, then 8 °C/min until 220 °C and kept 10 min at 220 °C. A comparison between the retention times of the samples with those of authentic standard mixture (Sigma, St. Louis, MO, USA; 99% purity specific for GLC), run on the same column under the same conditions, was made to facilitate identification. Reagents and chemicals used in the study were of the highest purity available.

### 2.2. Experimental animal protocol

Fifty white albino rats of both sexes were used in this study. The animals were obtained from faculty of pharmacy, King Saud University (Kingdom of Saudi Arabia). All animals were kept under normal healthy conditions and fed on a basal diet for one week. The animals were randomly allocated into five groups (each group of 10) of approximately equal average body weight (100-150 g). Utmost care was taken to provide equal physical and environmental housing