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Research Article

Olive Oil: Benefits on the Risk of Coronary Heart Disease

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Abstract: Olive oil is known to improve several cardiovascular risk factors. Olive oil has been associated with reduced level of plasma cholesterol and triglycerides, possibly due to its high monounsaturated (MUFA) lipid profile. This study evaluated the effects of olive oil intake on blood lipid levels of healthy normolipidemic subjects (20-50 y/o). Sixty subjects were recruited and were divided into two groups control group (30) and study group (30). Subjects asked to replace their soybean oil (PUFA rich oil) with olive oil except the control group. The study was conducted for 12 weeks. The subjects were allowed to take their routine diet. They were told to take 20 ml of olive oil per day. The levels of total Cholesterol, HDL-Cholesterol, LDL-Cholesterol and triglycerides were assayed at base line and after three months. Blood pressure and heart rate were also evaluated. Twelve weeks of consumption of olive oil significantly lowered the triglycerides, total cholesterol, and low density lipoproteins (bad cholesterol). Reduction was more profound in study group than in controls. While systolic and diastolic blood pressures were significantly reduced in study group meanwhile, high density lipoproteins (good cholesterol) increased in both groups.
Keywords: Olive oil, Soybean oil, Cholesterol, Lipoprotein, Blood pressure.

INTRODUCTION

Lipids role in the etiology and management of coronary heart disease (CHD) and obesity has been of concern for decades [1]. Until recently, low-fat, and often, very low-fat, high-carbohydrate diets, were widely recommended address these problems. However, there is strong support that moderate-fat diets can be effective [2].

Oil is composed of fatty acids like saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) which are chains of hydrogen and carbon attached to a glycerin molecule. Dietary fats are closely related to coronary Artery Disease (CAD). Cholesterol, Saturated and Trans fats are harmful whereas MUFA, PUFA (especially omega-3 PUFA) are beneficial for the heart. A heart healthy oil should be cholesterol and trans fats free, low in saturated fats, high in MUFA and PUFA, should have ideal n-6 to n-3 ratio(<4:1) and high smoking point [3].

Olive oil is considered as the pillar of the Mediterranean diet, since it improves the major risk factors for cardiovascular disease, such as the lipoprotein profile, blood pressure, glucose metabolism and antithrombotic profile. Endothelial function, inflammation and oxidative stress are also positively modulated. Some of these effects are attributed beside the monounsaturated fatty acids (MUFA) to the minor components of virgin olive oil [4]. Hydrocarbons, polyphenols, tocopherols, sterols, triterpenoids and other components, despite their low concentration, non-fatty acid constituents may be of importance because studies comparing monounsaturated dietary oils have reported different effects on cardiovascular disease. Most of these compounds have demonstrated antioxidant, anti-inflammatory and hypolipidemic properties [5].

The beneficial effects of olive oil on CHD risk factors are now recognized and often only attributed to its high levels of monounsaturated fatty acids (MUFA). Olive oil is, however, more than a MUFA fat. Olive oil is a functional food which besides having a high level of MUFA contains other minor components with biological properties[6]. The minor components of olive oil, which constituted only 1–2% of the total content of a virgin olive oil, are classified into two types: the unsaponificable fraction, defined as the fraction extracted with solvents after the saponification of the oil, and the soluble fraction which includes the phenolic compounds [6]. Components of the unsaponifiable fraction of olive oil by order of their increasing polarity are: hydrocarbons (squalene), tocopherols, fatty alcohols, triterpenic alcohols, 4-methylsterols, sterols,

other terpenic compounds, and polar pigments (chlorophylls and pheophytins) [6]. In this study, we demonstrate that olive oil affects blood pressure and lipid level.

Table-1:Fatty acid composition of experimental edible soyabean and olive oils [7]

S.no	Fats/Oil	SFA	MUFA	Linoleic Acid (Omega-6 PUFA)	Alpha-Linoleic Acid (Omega-3 PUFA)	n-6:n-3 ratio	Smoke point
1	Soybean	15	27	53	5	10.6:1	241°C
2	Olive oil	13	76	10	<0.5	20:1	225°C

MATERIAL AND METHODS

Data collection

A pre/post test randomized study was designed and utilized to show the impact of olive oil on blood pressure and lipids levels among healthy normolipidemic subjects.

Sixty individuals of both sexes (40 males and 20 females) of age 20-50 year were recruited for participating in the current study. The study was conducted for 12 weeks. The subjects were told to replace their soybean oil (refined) by olive oil (Pomace) for the next three months in study group. While control group did not change the oil and they used the same soybean oil (refined) for the next three months. They were to use 20 ml of respective oil per day for three months. We observed cardiovascular parameters (i.e. Systolic and Diastolic blood pressures, pulse rate and lipid profile) on zero day and after three months of using respective oil. This study was conducted in the Department of Physiology, S.P. Medical College, Bikaner (Raj.) with the informed consent of the subjects. The research did not suggest any alterations in other aspects of the subject's medical care, diet, or exercise. Compliance was monitored by contact with the subjects.

Their body mass index (BMI) ranged from 18 to 25 $kg.m^2$, and body weight was stable (less than 3 kg variation in the prior 6 Months). Exclusionary criteria included regular use of Medication, except oral contraceptive, smoking, vigorous regular exercise, hypertension, blood cholesterol >220 mg/dL, diabetes, glucose intolerance, allergic to any of the vegetable oil and non cooperative subjects.

Biochemical analysis

Biochemical analysis done by collection of blood samples approximately 5ml blood samples were taken before breakfast from the cubital vein directly into lithium heparin vacuum tubes for measurements of triglyceride, total cholesterol, HDL and LDL. The samples were centrifuged within 1 hour at 1000xg for 10 min at 4ºC, and the plasma transferred into separate labeled tubes. All biochemical measurements were carried out by using an auto analyzer (Dimension RXL clinical chemistry system, Dade Behring, USA). The samples were taken at the starting day and at end of week 12. Prior to implementation of the training program, an official permission was obtained from the supervisors of the selected units.

Statistical Analysis

Collected data were tabulated and statistical analyses were done using descriptive statistic, means, and standard deviation (SD) of the means were calculated. A probability value (P) of <0.05 was considered to be statistically significant.

Results

The mean age of participants was 31.16 ± 9.53 years (mean ±standard deviation) in control group and in study group it was 31.83 ± 11.59 years (mean ±standard deviation) (Table-2).

After twelve weeks of consumption of olive oil, systolic and diastolic blood pressure was significantly reduced in study group, the levels of Ch, TG and LDL were significantly reduced in study group.($P<0.05$) (Table 3) The level of TG is significantly decreased in control group. (Table 4) Meanwhile, significant increases in the levels of HDL were recorded in both control and study groups. When we compare the Anthropometric and Biochemical parameters at post-intervention in control and study group there is a significant improvement in Systolic and Diastolic blood pressure. Level of TC, LDL is significantly decrease meanwhile significant improvement in the HDL level is observed. ($P<0.05$) (Table 5)

Table 2: Mean age of subjects under study

	Control group (soybean oil)	**Study group (olive oil)**
Mean ±SD	31.16±9.53	31.83 ± 11.59

Table 3: Comparison of Anthropometric and Biochemical parameters in study group (olive oil group)

Parameters		Base line Mean ± SD	Post intervention Mean ± SD
BMI (kg/m^2)		22.96 ± 2.49	23.3 ± 2.43
Blood Pressure(mmHg)	Systolic	135.06 ± 5.16*	129.73 ± 5.88*
	Diastolic	83.2 ± 2.32*	79.86 ± 2.28*
Pulse/ min		75.93 ± 2.76	75.33 ± 2.61
Lipid profile (mg/dl)	TC	185.66 ± 20.79*	173.3 ± 16.66*
	TG	120.46 ± 6.15*	114.8 ± 8.81*
	HDL	37.53 ± 3.15*	42.2 ± 3.75*
	LDL	124.04 ± 22.12*	107.94 ± 17.76*
	VLDL	24.09 ± 1.23*	22.96 ± 1.76*

HDL: high density lipoprotein; LDL: low-density lipoprotein; TC: total cholesterol; TG: triglyceride;
Mean values of each parameters followed by * in a column differs statistically (P<0.05)

Table 4: Comparison of Anthropometric and Biochemical parameters in control group (soybean oil group)

Parameters		Base line Mean ± SD	Post intervention Mean ± SD
BMI (kg/m^2)		23.55 ± 3.99	23.83 ± 4.05
Blood Pressure(mmHg)	Systolic	133.53 ± 3.09	132.93 ± 4.97
	Diastolic	82.06 ± 2.37	81.93 ± 3.54
Pulse/ min		74.2 ± 2.67	74.06 ± 3.48
Lipid profile (mg/dl)	TC	180.03 ± 3.48	179.33 ± 9.52
	TG	118.76 ± 4.99*	116 ± 5.55*
	HDL	37.16 ± 2.10*	38.7 ± 2.61*
	LDL	119.11 ± 9.92	117.9 ± 9.64
	VLDL	23.75 ± 0.99*	23.2 ± 1.11*

Mean values of each parameters followed by * in a column differs statistically (P<0.05)

Table- 5: Anthropometric and Biochemical parameters at post-intervention in control and study group (Olive oil)

Parameters		Control group (Soybean oil) Mean ± SD	Study group (Olive oil) Mean ± SD
BMI (kg/m^2)		23.83 ± 4.05	23.38 ± 2.43
Blood Pressure(mmHg)	Systolic	132.93 ± 4.97*	129.73 ± 5.88*
	Diastolic	81.93 ± 3.54*	79.86 ± 2.28*
Pulse/ min		74.06 ± 3.48	75.33 ± 2.61
Lipid profile (mg/dl)	TC	179.83 ± 9.52*	173.3 ± 16.66*
	TG	116 ± 5.55	114.8 ± 8.81
	HDL	38.7 ± 2.61*	42.2 ± 3.75*
	LDL	117.9 ± 9.64*	107.94 ± 17.76*
	VLDL	23.2 ± 1.11	22.96 ± 1.76

Mean values of each parameters followed by * in a column differs statistically (P<0.05)

DISCUSSION

In this 12-week diet intervention, olive oil resulted in a significant improvement of blood pressure and lipid profile. Participants also experienced increase in HDL- cholesterol.

Our findings are consistent to Ferrara et al who showed highly significant improvement in systolic and diastolic blood pressure (p<0.001) of mild to moderate hypertensive patients after the consumption of olive oil [8].

Our results showed that daily consumption of olive oil had positive effect on blood pressure and lipid profile of healthy subjects. This supports the interest in the potential health benefits of olive oil which have increased since it was shown to improve the serum lipoprotein profile and to have beneficial effects on cardiovascular risk factors [9]. Daily supplementation on top of the normal diet, of at least 4 g of extra virgin olive oil in mildly hypocholesterolemic subjects was associated to favorable modifications of the plasmatic

lipid profile [10]. The olive oil phenolic content modulated LDL (-25%) and HDL (+7.7%) in a dose-dependent manner[11]. Puiggros *et al* .; [12] reported significant decrease in total cholesterol (-8.4%) with the olive oil-enriched diet. Olive oil consumption increased HDL, while decreasing LDL, LDL susceptibility to oxidation and lipid per oxidation [13].

Several intervention studies in humans showed that the replacement of SFA by MUFA in the diet lead to a decrease in blood pressure, both in men and women [14-15]. Moreover, an inverse relationship between arterial blood pressure and both the Mediterranean diet and olive oil consumption has been observed in population studies [16]. In hypertensive patients, olive oil was more effective in reducing systolic (SBP) and diastolic blood pressure [17,8] and the antihypertensive treatment, [8] than PUFA-rich diets. Ruiz-Guti´errez *et al*.; [18] compared the effect of two similar MUFA-rich diets (olive oil and high-oleic sunflower oil) in hypertensive women. These authors [18] reported that only the olive oil rich-diet induced a significant reduction of blood pressure, suggesting a role for the minor olive oil components on blood pressure levels. Supporting this hypothesis, Fit´o *et al*.; [19] reported a decrease in the SBP after high-phenolic olive oil consumption, in comparison with low-phenolic olive oil, in hypertensive stable CHD patients. This fact was particularly marked in those who were SBP "140mmHg at the beginning of the study. In Fito's study [19] a concomitant decrease in circulating oxidized LDL and lipid peroxides was also observed related with the phenolic content of the olive oil. The potential vasodilator activities of olive oil triterpenoids, such as oleanolic acid or erythrodiol, are currently a subject of interest. Although their presence in virgin olive oil is low, they are in high concentrations, up to 120 mg/kg, in pomace olive oil, a mixture of the refined product of the drupe after virgin olive oil extraction and virgin olive oil [20]. Ryan *et al.;* [21] showed that an olive oil diet attenuated the endothelial dysfunction present during the consumption of a baseline diet high in PUFA. The role of phenolic compounds from olive oil controlling endothelial dependent vasodilation has been recently depicted. Thus, the benefits of olive oil and its phenolic compounds on blood pressure could be mediated through their protective effect on the vascular endothelial function.

Our study show favorable changes in lipid profile and blood pressure of subjects taking olive oil.

CONCLUSION

In summary, olive oil had positive effects on lipid profile and blood pressure in asymptomatic participants. Further research should include a larger sample size and a long term use.

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