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# Effects of olive oil on lipid profiles and blood glucose in type2 diabetic patients

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**Abstract**
Diabetes is often associated with dyslipidemia. Olive oil is known to improve several cardiovascular risk factors. We studied the changes produced in the lipid profile after consumption of olive oil in type 2 diabetic subjects. We studied 45 individuals of both sexes with type 2 diabetes and 15 healthy subject of age 40 years or older. Only subjects not taking medicine for other health conditions and whose fasting blood glucose levels were in the range of 160- 320mg/dl and with high lipids level were included in the study. The study was conducted for 4 weeks. The subjects were allowed to take their routine diet and usual diabetic medicine. They were told to take 30 ml of olive oil per day. Diabetics showed marked dyslipidemia. Four weeks of consumption of olive oil significantly lowered the levels of fasting blood glucose, triglycerides, total cholesterol, and low density lipoproteins in both groups. Reduction was more profound in diabetics than in healthy controls. Meanwhile, high density lipoproteins increased in both groups. Olive oil improved lipid profiles and blood glucose levels in type 2 diabetics.

***Key words:*** *cinnamon, olive oil, diabetes, lipid profiles*

## Introduction

A high consumption of fat, especially saturated fat, increases the risk of coronary artery disease (CAD), which is the main cause of early death in patients with type 2 diabetes. Type 2 diabetes is a central component of the metabolic syndrome, which consists of a cluster of risk factors for CAD, abdominal obesity, insulin resistance, hypertension, and dyslipoproteinemia with elevated triglyceride and low HDL-cholesterol concentrations. Postprandial lipoproteins are thought to be particularly atherogenic.[1,2,3] An abnormal metabolism of postprandial lipoproteins is a common finding in type 2 diabetes.[4] Consequently, the exaggerated postprandial triglyceride responses may, at least in part, be responsible for the increased morbidity from CAD in type 2 diabetes. Furthermore, postprandial lipemia determines plasma HDL-cholesterol concentrations.[5] The negative correlation between HDL cholesterol and CAD seems to originate in the highly positive correlation between postprandial triglyceride concentrations and CAD.[6]

Researchers have discovered that the over consumption of refined vegetable oils leads to diabetes. As far back as the 1920s Dr. S. Sweeney produced reversible diabetes in all of his medical school students by feeding them a high vegetable oil diet for 48 hours. None of the students had previously been diabetic. More recently researchers have been able to cause test animals to develop diabetes by feeding them diets high in polyunsaturated fat.[5] Simply restricting fat intake in diabetic animals has shown to reverse Type II diabetes.[7] Likewise , clinical studies with humans on low fat diets also show reversal of the disease. Many studies have shown low-fat diets to be effective in controlling diabetes.[8] 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.[9] 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.[10] Moreover, MUFA-rich diet prevents central fat redistribution and the postprandial decrease in peripheral adiponectin gene expression and insulin resistance induced by a carbohydrate-rich diet in insulin-resistant subjects.[11] In this study, we demonstrate that olive oil affects blood glucose and lipid level.

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## Materials and Methods

### *Data collection*

A pre/post test randomized study was designed and utilized to show the impact of olive oil on blood glucose and lipids levels among type 2 diabetic. Then a comparison between the effects of olive oil on blood glucose and lipids levels on normal and diabetic patients were made. The study was conducted in Al Mafraq Governmental Hospital in Jordan.

Fourty-five individuals with type 2 diabetes of both sexes (25 males and 20 females) and 15 healthy subject (10 males and 5 females) of age 40 years or older were recruited for participating in the current study. Only diabetic subjects, who were not taking medicine for other health conditions and whose fasting blood glucose were in the range of 160-320mg/dl, and high lipids level were included in the study. The study was approved by Medical Ethical Committee of the Zarqa Private University.

The study was conducted for 4 weeks. Fasting Blood Glucose and lipids level were measured at baseline starting day and at the end of week 4. The subjects were allowed to take their routine diet and usual diabetic medicine. The subjects were told to take 30 ml of olive oil per day immediately after breakfast, lunch and dinner for 4 weeks. 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.

**Biochemical analysis**

Biochemical analysis done by collection of blood samples approximately 10ml blood samples were taken before breakfast from the cubital vein directly into lithium heparin vacuum tubes for measurements of fasting blood glucose level, triglyceride, total cholesterol, HDL and LDL. The samples were centrifuged within 1hour at 1000xg for 10 min at 4ºC, and the plasma transferred into separate labeled tubes and transferred immediately in cold boxes filled with ice to the central laboratory of the Mafraq Hospital. All biochemical measurements were carried out by the same team of laboratory technicians using an auto analyzer (Dimension RXL clinical chemistry system, Dade Behring, USA). The samples were taken a t the starting day and at end of week 4.

Prior to implementation of the training program, an official permission was obtained from the supervisors of the selected units. This was intended to facilitate data collection and to explain the purpose of the study. At the beginning of the study, participants' were invited to participate in the project. The researcher explained the study purpose and procedures for the randomly selected sample. Potential subjects were further informed that the participation was voluntary and that study findings would be presented group wise and no individual would be recognized.

**Statistical Analysis**

Collected data were tabulated and statistical analyses were done using descriptive statistic, means, and standard deviation (SD) of the means were calculated utilizing the computer data processing (SPSS, version 12). A probability value ($P$) of $<0.05$ was considered to be statistically significant.

**Results**

At baseline, diabetic patients showed markedly elevated levels of fasting blood glucose (FBG), triglyceride (TG), total cholesterol (Ch), low density lipoprotein (LDL) and lower levels of high density lipoprotein (HDL) when compared with healthy control group, as shown in (Table 1).

**Table1:** Blood glucose levels and lipid profiles of the study participants at the baseline (zero time).

| Test | Healthy controls Mean± SD(mg/dl) | Diabetic patients Mean± SD(mg/dl) |
|---|---|---|
| (FBG) | 90.5± 10.70 | 216.67±26.9 |
| Triglyceride | 180.5±10.65 | 250±15.2 |
| Cholesterol | 185.7± 11.20 | 230±8.5 |
| HDL | 45.2± 5.2 | 35.2± 5.1 |
| LDL | 123.7± 12.30 | 210.5±27.1 |

**Table 2:** Blood glucose levels and lipid profiles of the study participants after consuming olive oil for 4 weeks

| Test | Healthy controls Mean± SD(mg/dl) | Diabetic patients Mean± SD(mg/dl) |
|---|---|---|
| (FBG) | 85.3± 4.70 | 182.17±6.3* |
| Triglyceride | 155.5±6.65 | 170.6±9.2** |
| Cholesterol | 150± 10.20 | 172±8.5** |
| HDL | 59.4± 6.20 | 48.5±4.2* |
| LDL | 108.7± 12.30 | 165.8±9.3* |

* Significant, ** highly significant

**Table 3:** The % reduction of blood glucose and lipid profile for the study participants after consuming olive oil for 4 weeks

| Test | % of reduction after olive oil consumptions | |
|---|---|---|
| | Healthy controls | Diabetic patients |
| (FBG) | 6 | 16 |
| Triglyceride | 14 | 32 |
| Cholesterol | 19 | 26 |
| HDL | 24 (increase) | 27 (increase) |
| LDL | 13 | 22 |

After four weeks of consumption of olive oil, the levels of FBG, TG, Ch and LDL were significantly reduced in both groups (Table 2). Reduction of these parameters in diabetics was more profound than that in healthy controls. Meanwhile, significant increases in levels of HDL were recorded in both diabetic patients and healthy controls.

Table 3 shows the reduction percentage of FBG, TG, Ch and LDL in both control and diabetic patients. Also increase in the percentage of DHL in diabetic patients as well control.

**Discussion**

In this 4-week diet intervention, olive oil resulted in a significant improvement of hyperlipidemia in patients with type 2 diabetes. Participants also experienced reductions in blood sugar and increases in HDL-cholesterol.

At the beginning of this study type 2 diabetic participants showed marked dyslipidemia compared with healthy controls. This corresponds with the data collected by Abdel-Aal [12] showing that over 90% of patients with type 2 diabetes mellitus in Jordan had one or more types of dyslipidemia, the most common of which was high LDL-cholesterol and high triglycerides. In a sample of 5,000 individuals optimal total cholesterol (TC) level was observed in only 46% of men and 41% of women, and optimal triglycerides (TG) in 42% of men and 50% of

women. Only 3% of men and 12% of women had HDL-C > 60 mg/dl. Jordanian patients with coronary artery disease (CAD) had higher cholesterol, LDL-C, triglyceride and lower HDL-C levels than asymptomatic controls. This hyperlipidemia remains the strongest risk factor for CAD. Diabetic females were at higher risk for CAD versus non-diabetics with the same lipid profile. Therefore, aggressive treatment of hyperlipidemia was crucial to reducing the morbidity and mortality of cardiac events in diabetic and non-diabetic patients.[13] Type 2 diabetes is also associated with many other metabolic abnormalities such as central obesity, hypertension, and dyslipidemia, which contributes to a high rate of cardiovascular events.[14]

Our results showed that daily consumption of olive oil had positive effect on FBG and lipid profiles of healthy controls. Interestingly, the positive effect of olive oil consumption was much more profound in the diabetic group as levels of FBG, TG, Ch and LDL decreasing by 16-32%. 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.[15,16] 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[17] The olive oil phenolic content modulated LDL (-25%) and HDL (+7.7%) in a dose-dependent manner.[18] Puiggros *et al*[19] 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 peroxidation.[20] Higher concentrations of serum HDL cholesterol characterize subjects free from peripheral artery disease.[21]

In addition to lowering LDL, olive oil increased HDL in study groups by more than 20%. Again, the positive effect was more profound in diabetic participants. Previous studies showed that a high fat diet rich in polyunsaturated fatty acids (ketogenic diet) significantly reduced the body weight and body mass index of obese patients. Furthermore, it decreased the level of triglycerides, LDL-cholesterol and blood glucose, and increased the level of HDL-cholesterol these studies are agree with our study. Administering a ketogenic diet for a relatively longer period of time did not produce any significant side effects in the patients.[22] A diet high in olive oil was a good alternative to high carbohydrate diets for nutrition therapy of type 2 diabetics as it lowered VLDL-cholesterol by 35% and VLDL-triglyceride by 16% and had superior patient acceptance.[23] Lopez-Miranda[24] pointed out two positive consequences of the consumption of a Mediterranean diet. On the one hand it increased HDL-cholesterol plasma levels, and on the other hand, it decreased the susceptibility of LDL to oxidation.

Perona[25] defined changes in membrane fatty acids and signaling proteins induced by virgin olive oil (VOO) consumption in elderly persons with type 2 diabetes and normoglycemic controls. They showed that VOO consumption increased the monounsaturated fatty acid content in phospholipids and cholesterol esters in both groups. In contrast, saturated fatty acids were decreased only in phospholipids. The levels of G-protein subunits Gα and Gβ, and protein kinase C alpha (PKCα) were significantly lower in diabetics than in controls. However, whereas VOO consumption reduced Gαs, Gβ, and PKCα in both groups, reduction in Gαi was observed only in diabetics. These results indicated that long-term VOO consumption modifies the fatty acid composition of plasma membrane, which influences the association of G proteins and PKCα with the lipid bilayer. These combined effects probably account for the positive effects of VOO on glycemic homeostasis.

Our study show favorable changes in lipid profile and blood glucose of patients taking olive oil.

**Conclusion**

In summary, olive oil had positive effects on lipid profile and blood glucose level in both asymptomatic participants and type 2 diabetics. Most impressive is that these beneficial changes were more profound in diabetic patients than in asymptomatic participants. Further research should include a larger sample size and a longer term use.

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