Hypolipidemic Effect of Extra Virgin Olive Oil in Diabetic Rats

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Abstract
Background: To evaluate the effect of monounsaturated fatty acid and phenolic compounds enriched extra virgin olive oil on correction of dyslipidemia in diabetic rats.
Methods: In this randomized control trial eighty albino rats of Sprague-Dawley strain weighing 200-250 grams were randomly divided into two groups of 40 rats each. Rats were made diabetic by injecting streptozotocin. Group 1 and Group 2 were given normal rodent diet and extra virgin olive oil supplemented diet respectively for 06 weeks. At the end of experimentation lipid profile was measured.
Results: There was significant increase of high density lipoprotein and significant decrease of serum total cholesterol, serum triglycerides and low density lipoprotein of Group II rats when it was compared with Group I (control).
Conclusion: Extra virgin olive oil can significantly improve lipid profile in diabetic rats.
Key Words: Diabetes mellitus; Dyslipidemia; Olive oil; Sprague-Dawley rats.

Introduction
Diabetes mellitus (DM) is documented as a group of heterogeneous disorders characterized by chronic hyperglycemia with disturbances in fat, carbohydrate and protein metabolism resulting from defects in insulin secretion, action or both. Abnormal lipid profile is often seen in patients with diabetes because insulin regulates several steps of lipid metabolism. Dyslipidemia in diabetics is often characterized by elevated fasting and postprandial levels of triglyceride (TG), a significant decrease in the high density lipoprotein (HDL). The reason for elevated plasma TG level is excessive production of very low density lipoprotein (VLDL). This over production of VLDL and TG in the liver has been proposed to be driven by high levels of serum free fatty acids (FFAs) in patients with insulin resistance. Increases in plasma TG concentration are usually associated with low HDL concentrations. It is now evident that hyperglycemia and dyslipidemia particularly high TG and low density lipoprotein (LDL) are risk factors for the development of microvascular and macrovascular complications in diabetic subjects. In diabetes, inculcation of benign therapeutics with minimal side effects are under consideration. Olive oil has been traditionally used for wide range of clinical diseases without unveiling underling mechanism. These diseased conditions include neurodegenerative diseases, diabetes, obesity, atherosclerosis, cardiovascular disease, metabolic syndrome and certain types of cancer mainly breast, colorectal and prostate cancers. Extra virgin olive oil (EVOO) is extracted from olive and is regarded as healthy dietary oil because of its high concentration of monounsaturated fatty acid (MUFA) and phenolic compounds, which have tangible health benefits. It has been reported that each 100 g of EVOO contains 73.7 g of MUFA and 50 mg of polyphenols.

Materials and Methods
This randomized control trial was conducted in the Department of Biochemistry and Molecular Biology, Army Medical College, Rawalpindi in collaboration with Centre for Research in Experimental & Applied Medicine (CREAM), Army Medical College and National Institute of Health (NIH), Islamabad from March 2010 to June 2011. This study was carried on eighty, 60-90 days old Albino rats of Sprague Dawley strain, weighing between 200-250g. Rats were obtained from the animal house of the NIH, Islamabad and were kept at its animal house. Rats were made diabetic by injecting streptozotocin (STZ) 40-mg/kg/body weight intraperitoneally dissolved in citrate buffer. On the third day, their fasting blood glucose was measured by taking blood from tail veins under aseptic measures. Rats with blood glucose level more than 126 mg/dl were considered as diabetic and were used in study. Extra virgin olive oil and normal rodent diet were prepared at NIH, Islamabad according to the requirements of rats according to the study. Each group of rats was fed with either normal rodent diet or normal rodent diet supplemented with extra virgin olive oil.

Results: There was significant increase of high density lipoprotein and significant decrease of serum total cholesterol, serum triglycerides and low density lipoprotein of Group II rats when it was compared with Group I (control).

Conclusion: Extra virgin olive oil can significantly improve lipid profile in diabetic rats.

Key Words: Diabetes mellitus; Dyslipidemia; Olive oil; Sprague-Dawley rats.
international standards for 06 weeks. In Group-2 (Diabetic Experimental Group) forty diabetic rats were fed with EVOO supplemented diet as per requirement, prepared at NIH, Islamabad, for 06 weeks. EVOO supplemented diet is the diet containing 100 grams EVOO per kilogram of pelleted diet. Rats were kept under standard conditions with a daily photo period of 12 hours light and 12 hours dark at 23 ± 2º C. Five animals were kept in one iron cage. All groups had free access to food and water. At the end of experiment, fasting blood samples were drawn through intracardiac puncture for measurement of lipid profile. Serum total cholesterol (TC), TG and HDL were measured by using commercial kits, in accordance with the instructions of the manufacturers, by applying the enzymatic colorimetric principle. LDL was calculated by using Friedewald formula \(LDL = TC - [HDL + TG/5]\). 

**Results**

Results of fasting lipid profile (TC, TG, LDL & HDL) of Group I and II rats revealed significant increase of HDL and significant decrease of serum TC, TG and LDL of group II rats when it was compared with group I (control). (Table-1)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control Group 1 (n=40)</th>
<th>Extra virgin olive oil Group 2 (n=40)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cholesterol (mg/dl)</td>
<td>155.50 ± 17.24</td>
<td>124.40 ± 13.79</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Triglyceride (mg/dl)</td>
<td>104.52 ± 13.62</td>
<td>83.61 ± 10.89</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>High Density Lipoproteins (mg/dl)</td>
<td>79.36 ± 7.47</td>
<td>99.20 ± 9.34</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Low Density Lipoproteins (mg/dl)</td>
<td>51.60 ± 7.33</td>
<td>41.28 ± 5.86</td>
<td>&lt; 0.05</td>
</tr>
</tbody>
</table>

The values are expressed as mean ± SD

**Discussion**

Currently available synthetic drugs for treatment of DM include insulin and various oral anti diabetic agents, which are often associated with side effects including hypoglycemia, anemia, GIT disturbances, weight gain, lactic acidosis, hepatic dysfunction and create problem of cost effectiveness. World Health Organization (WHO) has now encouraged the evaluation of plants effective in different diseases in order to minimize side effects. Drugs made from plant extracts are considered to be less toxic and proved free from side effects associated with synthetic drugs. EVOO is a potent plant extract. Its effects in animals and humans revealed successful management of diabetes and its complications.

The serum lipid profile levels are usually elevated in diabetics, which increase the risk of coronary heart diseases. It has now been well established that elevated levels of TC and LDL are cardiovascular risk factors, however, increased level of HDL maintains protective and anti-inflammatory properties. Therefore, benign medication with positive regulation for HDL and negative regulation for LDL and TG will be considered as therapeutic choice. EVOO improves lipid profile because of high concentration of MUFA and phenolic compounds both having a lipid lowering action and prevents LDL oxidation. Epidemiological studies also suggest that Mediterranean diet rich in olive oil decreases the risk of cardiovascular disease and improves its major risk factors. 

Studies comparing the effect of oil containing saturated fatty acids & MUFA in healthy persons found that MUFA rich oil significantly improved lipid profile. Evaluation of efficacy of groundnut oil on lipid levels of rats, propounded MUFA as central metabolite countering dyslipidemia. Experimental studies in rabbits, rats and diabetic humans show that MUFAs rich diets significantly improve lipid profile. Phenolic compounds are found to have beneficial effects on plasma lipoproteins, inflammatory markers and oxidative damage. Olive oil is found to have antihyperlipidemic, antithrombotic and antiatherosclerotic properties.

**Conclusion**

Medical nutrition therapies need an evaluation in management of dyslipidemias

**References**