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Full Length Research Paper

Effect of rosemary (*Rosmarinus officinalis*) on lipid profiles and blood glucose in human diabetic patients (type-2)

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Investigation of the effect of oral administration of rosemary (*Rosmarinus officinalis*) as powder on lipid profiles and blood glucose in healthy and type-2 diabetic human patients was done. Forty-five type-2 diabetic patients and 15 non-diabetic persons of age 40 years or older participated in the study. Patients selected in this study had fasting blood glucose in the range 160-300 mg/dl, and high lipid profiles levels. In addition, patients were allowed to take their routine diet and usual diabetic medicine but not any other health medication. All participants were told to take 3 g of rosemary per day for 4 weeks. Plasma lipid profiles and blood glucose were measured before and after rosemary administration. Significant effect of rosemary is obviously noticed in diabetic patients. Lipid profiles (low density lipoprotein LDL, triglycerides and cholesterol) decreased by 31-35%, and blood glucose decreased by 21%. In addition, high density lipoprotein (HDL) in both diabetic and non diabetic persons increased by 22%. Rosemary showed favorable changes in lipid profiles and blood glucose levels in type-2 diabetic patients.

Key words: Type-2 diabetes, rosemary, dyslipidemia, blood glucose.

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders that share the common feature of hyperglycemia. The disease affects approximately 6.4% of the world's population with the highest prevalence in North America and Caribbean (10.2%) followed by middle East and North Africa (9.3%) (International Diabetes Federation, 2010). It is categorized as absolute (type 1) or relative (type 2) deficiencies in insulin secretion or receptor insensitivity to endogenous insulin, resulting in hyperglycemia (ELHilaly et al., 2007). Diabetic patients must have restrictive measures of diet to control blood glucose levels, normal body weight and prevent heart and vascular disease as well, (Melzig and Funki, 2007). Fruits, vegetables, herbs and spices are a promising alternative diet which were found to limit harsh metabolic disorders correlated to lipidemia (Miller et al., 2002) and cardiovascular diseases (Creager et al, 2003). Generally, these plants have a variety of high antioxidant concentrations that inhibit the

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Table 1. Effect of rosemary consumption on fasting blood glucose and lipid profiles

Test	Diabetic patients			Healthy persons		
	Before consumption	After consumption	Change (%)	Before consumption	After consumption	Change (%)
FBG	95.5±11.60	86.7±7.10	- 9	202.6±28.2	159.12±9.2*	-21
Triglycerides	170.7±13.6	145.4±6.23	- 15	240±17.1	163.8±9.8**	-32
Cholesterol	191.3±11.20	158± 12.10	-17	272±9.5	176±8.4**	-35
LDL	127.7±15.10	102.7± 10.70	-19	232.5±28.6	160.1±9.8**	-31
HDL	45.6± 3.2	57.3± 3.22	+20	37.2± 7.3	49.2±6.3*	+22

> Values equal means ± SD (mg/dl); * Significant ($P<0.05$); ** Highly significant ($P<0.01$).

oxidation of metabolites in biological pathways (Linda et al., 2006).

Rosemary (*Rosmarinus officinalis*) is an evergreen perennial aromatic shrub growing as decorating plant in gardens and used commonly as spice in food processing. Its effects are attributed to the different chemical constituents including monoterpenes, diterpenes and the phenolics derivatives -mainly caffeic acid known as rosmarinic or carnosic acid and gallic acid. Among these bioactive constituents, the pharmacologic properties have been suggested to be highly attributed to rosmarinic acid, the predominant secondary metabolite in rosemary. Biochemically, rosemarinic acid is an ester of caffeic acid, hydroxydihydrocaffeic acid, chlorogenic acid and their hydrolyzed metabolites (El Deeb, 1993; Herrero et al., 2010; Rababah et al., 2004; Wang et al., 2004). Rosmarinic acid has been suggested to have anti-atherogenic activity by preventing the oxidation. (Dubois et al., 2008; Furtado et al., 2010; Hadafi et al., 1998; Moon et al., 2010; Park et al., 2008; Shetty, 2007; Vanithadevi and Anuradha, 2008).

Ethanolic extract of rosemary leaves showed protective and anti mutagenic effects in rats and potential effect on glucose homeostasis in rabbits (Fahim et al., 1999; Bakirel et al., 2008). In recent study, Labban et al. (2014) found that 10 g of rosemary leaves powder for four weeks significantly improved lipid profiles and glucose level in human selected randomly. However, the present study aims to investigate the effect of powder consumption of whole rosemary (leaves and stems) on lipid profiles and blood glucose levels in human type- 2 diabetic patients.

MATERIALS AND METHODS

Data collection

A pre/post test randomized study design was utilized to show the impact of rosemary consumption on blood glucose and lipids levels among type-2 diabetic patients and non-diabetic persons.

Blood samples were collected in Al-Mafraq Governmental Hospital in Jordan. Forty-five patients recognized with type-2 diabetes of both sexes (25 males and 20 females) and 15 healthy subject (10 males and 5 females) of mean age 46 ± 6 years were recruited for the current study.

Diabetic patients who were encountered had fasting blood glucose in the range of 160-300 mg/dl, high lipids profile level, taking their routine diet and usual diabetic medicine but not any other medicinal drug health.

All participants were told to take two capsules (500 mg each) of whole rosemary (*R. officinalis*) powder three times daily after breakfast, lunch and dinner for a four week course. These capsules were prepared by the technician of the local pharmacy. Plasma lipid profile and blood glucose were measured before and after rosemary administration coarse. The study was approved by medical ethical committee of the Al-Ahliyya Amman University

Biochemical measurements

Approximately 7 ml samples of venous blood were taken into lithium heparin vacuum tubes for measurements of fasting blood glucose level (FBG), triglyceride (TG), total cholesterol (Ch), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) before and after rosemary administration coarse. The blood was centrifuged at 2000 xg for 10 min at 4°C, and then after, the separated plasma was carried immediately by cold boxes filled with ice to the Jerusalem Consulting Laboratory (Zarka-Jordan). Measurements were achieved by using Chemiluminescence imunoassay; Immulite 2000 (Siemens Medical Solutions Diagnostics, Deerfield , IL).

Statistical analysis

Statistical analysis was conducted using descriptive statistics; means, and standard deviation (SD) of the means utilizing SPSS (version 14). A probability value (*P*) of < 0.05 was considered to be statistically significant.

RESULTS AND DISCUSSION

Changes in lipid profile and glucose levels due to rosemary administration are estimated in both sexes randomly and illustrated in Table 1. Significant effect of rosemary is noticeably seen in diabetic patients. Before rosemary administration, higher levels of FBG, TG, Ch, LDL with lower levels of HDL in diabetic patients when compared with levels of healthy persons was seen. However, after four weeks of consumption of rosemary, levels of FBG, TG, Ch and LDL were significantly reduced in 21, 32, 35, and 31%, respectively, and 22% increase in HDL. Nevertheless, healthy persons had an improvement in HDL level 20% without affecting other parameters.

The significant decline in the blood glucose, triglycerides, cholesterol, LDL and increase HDL cholesterol caused by rosemary may be an indication of progressive metabolic control of rosemary. Hypoglycemia effect of rosemary may be attributed to several metabolic mechanisms such as increasing the insulin level (Vanithadevi and Anuradha, 2008) due to regeneration or stimulation of the *β*-cells of the pancreas (Alnahdi, 2012) or by inhibiting the intestinal absorption of glucose by inhibition of intestinal amylase enzyme (McCue and Shetty, 2004)) or by potent antioxidant properties. Accordingly, changes in lipid profile could be established by different metabolic mechanisms, that is, inhibition of pancreatic lipase, a reduction in the absorption of dietary fat supported by an increase in fecal fat excretion (Ibarra et al., 2011), changed LDL receptor activity and uptake of LDL-C by hepatocytes (Attar, 2006), changed rate of fatty acids oxidation in the liver and reduced rate of triglycerides biosynthesis (Attar 2006). In addition, may be attributed to the antioxidant properties that inhibit lipid peroxidation**.**

Chemically, most important constituents of rosemary are caffeic acid and its derivatives such as rosmarinic acid which has antioxidant effect (Decker, 1995; Al-Sereiti et al., 1999) and polyphenols glabridin (derived from licorice). Moreover Fuhrman et al. (2000) reported that rosemary contains a mixture of natural antioxidants. Generally, antioxidants change dramatically metabolism of glucose, lipid and proteins associated with cardiac diseases. Antioxidants were found to perform several cardio protective properties including the ability to prevent LDL from oxidative modification by monitoring the levels of triglycerides, HDL and LDL. HDL (Nofer et al., 2002) or accumulation of lipid peroxides on LDL was shown (Mackness et al., 1993). More or less, rosemary may exerts antioxidant effects indirectly by increasing levels of antioxidants agents such as glutathione reductase, vitamin C and *β* carotene (Labban et al., 2014).

In conclusion, the present data demonstrated that consumption of rosemary may lead to reduction in the risk of hyperglycemic and hyperlipidemic symptoms associated with heart diseases. However, additional investigation will be needed to purify the bioactive constituents in the rosemary.

Conflict of Interests

The author has not declared any conflict of interests.

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