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Effects of Rosemary (*Rosmarinus officinalis*) on Lipid Profile of Diabetic Rats

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Abstract

The purpose of this study was to determine the hypoglycemic activity of the aqueous extract perfusion of rosemary (*Rosmarinus officinalis* Linn.) in normal and streptozotocin-induced diabetic rats. The sugar level and lipid profile were investigated in plasma of normal and streptozotocin-induced diabetic rats treated with rosemary for four weeks. Diabetic rats exhibited an increase in the levels of sugar, total cholesterol, triglycerides and low density lipoprotein cholesterol (LDL-cholesterol), and a decrease in the level of high density lipoprotein cholesterol (HDL-cholesterol). The administration of rosemary shows a decrease by 20% in sugar level, 22% in total cholesterol, 24% triglycerides, and by 27% in LDL-cholesterol, and an increase by 18% in HDL-cholesterol. The findings of this study indicate that the administration of rosemary resulted in a better lipid profile and decreased blood sugar level in both normal and diabetic rats.

Keywords: Rosemary, *Rosmarinus officinalis*, streptozotocin, rat, diabetes, lipid profile, antioxidant; antidiabetic.

1. Introduction

Diabetes mellitus (DM) is a serious health problem being the third greatest cause of death all over the world, and if not treated, it is responsible for many complications affecting various organs in the body. Diabetes mellitus results in hyperglycemia and is characterized as type 1 in absolute insulin deficiency or type 2 in insulin resistance due to receptor insensitivity to endogenous insulin (ELHilaly *et al.*, 2007).

Proper nutrition is essential for anyone living with the diabetes in particular in type 2 diabetes mellitus. Control of blood glucose levels is only one goal of a healthy food plan for people with diabetes. A diet for those with diabetes should also help achieve and maintain a normal body weight as well as prevent heart and vascular disease, which are frequent complications of diabetes (Melzig and Funki, 2007). Diabetes remedy that is gaining popularity today is herbal treatment, with a variety of plant-derived preparations being promoted as capable of controlling blood sugar levels, in fact, herbal treatment for diabetes is not new. Plants and plant extracts were used to combat the disease as early as 1550 B. C., with as many as 400 before the development earlier this 21st century of effective medications to control diabetes (Tapsell *et al*., 2006).

Hyperlipidemia is a complication associated with diabetes mellitus (Miller *et al*., 2002) due to qualitative and quantitative abnormalities in lipoproteins. Chronic hyperglycemia in diabetes leads to over production of free radicals and these contribute to the development of diabetic nephropathy (Sharma *et al*., 2006). Atherosclerosis and coronary heart disease are the major health problems (Braunwald, 1997; Breslow, 1997; Law, 1999). A number of epidemiological investigations have shown a clear association between dietary saturated fat and atherosclerosis (Shekelle *et al*., 1981; Posner *et al.*, 1991).

Moreover, many studies have shown that elevated total or low density lipoprotein (LDL) cholesterol in the blood are powerful risk factors for coronary heart disease (Law, 1999), whereas high HDL-cholesterol: LDL-cholesterol ratio may protect against coronary heart disease (Sheten *et al.*, 1991; Castelli *et al.*,1992).

The use of herbs as medicines has played an important role in nearly every culture, including Asia, Africa, Europe and the Americas (Wargovich *et al.*, 2001). Herbal medicine is based on the premise that plants contain natural substances that can promote health and alleviate illness. Several herbs can help to reduce blood sugar, high blood cholesterol, provide some protection against cancer and stimulate the immune system. Furthermore, a diet in which culinary herbs are used generously to flavor food provides a variety of active photochemical that promotes health and protective against chronic diseases. Additionally, several commonly used herbs have been identified by the National Cancer Institute in USA as possessing cancer-preventive properties. These herbs include members of the *Allium* sp. (garlic, onions and chives), members of the *Labiatae* (mint) family (basil, mints, oregano, rosemary, sage and thyme), members of

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Zingiberacae family (turmeric and ginger), (Steinmetz and Potter, 1991).

Rosemary (*Rosmarinus officinalis* Linn.) and mint (*Labiatae*) family are common household plant grown in many parts of the world. They are commonly used as a spice and flavoring agent in food processing (Saito *et al*., 2004). Also, rosemary is used as an antispasmodic in renal colic and dysmenorrheal, in relieving respiratory disorders and to stimulate hair growth. Extract of rosemary relaxes smooth muscles of trachea and intestine, and has choleretic, hepatoprotective and antitumergenic activity. Moreover, rosemary constituents have a therapeutic potential in the treatment or prevention of bronchial asthma, spamogenic disorders, diabetes mellitus, peptic ulcer, inflammatory diseases, hepatotoxicity, atherosclerosis, ischemic heart diseases, cataract, cancer and poor sperm motility (Al-Sereiti *et al.*, 1999; Masuda *et al.*, 2002; Sotelo-Fleix *et al.*, 2002; Osakabe *et al.*, 2004).

The present study was designed to evaluate the effects of rosemary, on blood lipid profile and blood sugar of rats. Blood lipid profile includes, triglycerides, high density lipoprotein cholesterol (HDL), and low density lipoprotein (LDL).

2. Materials and Methods

2.1 Animals

Forty male albino rats weighing between 140 and 155 gm were procured from Department of Medical Technology, Zarqa Private University, Jordan. The animals were housed in a well ventilated 12 hrs light and 12 hrs dark cycles. The animals were divided into 2 equal groups: group I, normal rats as control, group II streptozotocin-induced diabetic rats treated animals (150 mg/kg intraperitoneally).

2.2 Rosemary extraction:

Fifty gm of rosemary were soaked in 150 ml hot water (88 ºC) in water bath for 3 hrs, filtered with capron silic cloth and the filtrate (which was 45 ml) was stored in dark bottles in refrigerator at (4 ºC). These procedures were repeated when needed. Each group of rats was orally administrated with 0.5 ml (1.11gm/ml) of rosemary extract daily.

2.3 Blood sampling

Blood was collected from group1 and group 2 three days after streptozotocin treatment (zero time) and also 4 weeks later after rosemary administrated. The blood was collected from eyes of all groups in heparinized tubes. Plasma was separated and kept in freezer till the time of assay.

2.4 Biochemical analysis

The following analyses were carried out: Glucose, total-cholesterol, Triglycerides, LDL-cholesterol and HDL-cholesterol using kits from Syrbio, France.

2.5 Statistical analysis

Statistical analyses were done utilizing the computer data processing (SPSS, version 14). A probability value (*P*) of <0.05 was considered to be statistically significant.

3. Results

Table 1 depicts the level of plasma glucose, total-cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol in both control and experimental rats at zero time, Rosemary has no significant influence on plasma glucose level and lipid profile of normal rats. Table 2 shows mean value of glucose and lipid profile after rosemary treatment for 4 weeks. There was a 20% reduction in glucose level, 22% in total-cholesterol, 24% in triglycerides, 27% in LDL-cholesterol, whereas HDL-cholesterol increased 18%. The differences were significant at (*P*<0.01) and (*P*<0.05), respectively.

Table 1. Depicts the level of plasma glucose and lipid profile at zero time without rosemary.

	Normal Rats Mean± SD (mg/dl)	**Diabetic Rats Mean± SD (mg/dl)**
Glucose	85. ±6.1	296.2±5.2
Total cholesterol	92.3±3.3	189.6±4.1
triglycerides	88±4.42	201.7±9.2
LDL-cholesterol	60.2±5.5	87.7±8.5
HDL-cholesterol	51.3±2.2	42.4±3.4

Table 2. Depicts the level of plasma glucose and lipid profile at the end of 4 weeks with rosemary.

	Normal Rats with Rosemary Mean± SD (mg/dl)	Diabetic Rats with Rosemary Mean± SD (mg/dl)
Glucose	78. 9±6.3	236.8±9.6*
Total- cholesterol	80.8±4.5	147.4±2.9*
triglycerides	71.7±6.3	152.7±9.1**
LDL-cholesterol	52.2±4.2	63.6±2.8**
HDL-cholesterol	62.15±8.2	49.5±4.3*

** highly Significant at(P <0.01)

* significant at (P <0.05)

4. Discussion

Oral administration of rosemary leaf extract caused significant declines in the blood levels of triglycerides, total cholesterol, LDL-cholesterol, but increased HDL-cholesterol. Moreover, it seemed that rosemary leaf extract had a hypolipidemic potential. This may be an indication of progressive metabolic control of rosemary leaf extract on mechanisms involved in elimination of the lipids from the body, this hypolipidemic properties have been confirmed in many plant species and plant products in medicinal use (Kono *et al.*, 1992; Naidu and Thippeswamy, 2002; Devi and Sharma, 2004). The most important constituents of rosemary are caffeic acid and its derivatives such as rosmarinic acid. These compounds have antioxidant effect (Al-Sereiti *et al.*, 1999). A variety of phenolic compounds, in addition to flavonoids, are found in fruit, vegetables and many herbs. The phenolic compounds (such as caffeic, ellagic, and ferulic acids, sesamol, and vanillin) inhibit atherosclerosis (Decker, 1995). In addition to a well documented role in reverse cholesterol transport, HDL-cholesterol has recently been recognized to have several other important cardio protective properties including the ability to protect LDL from oxidative modification (Nofer *et al*., 2002).

Yasser et *al.*, 2010 agree with our study, found that the rosemary extract has been targeting the hormone sensitive lipase (HSL) would be the common link between the two

metabolic effects. In fact, HSL has been extensively studied for its effects on the metabolic switch between glucose and free fatty acids (FFAs) as an energy source.

Fuhrman *et al.* (2000) reported that polyphenols glabridin (derived from licorice), rosmarinic acid or carnosic acid (derived from rosemary), as well as garlic (which contains a mixture on natural antioxidants) inhibited LDL oxidation in a dose-dependent manner. Moreover, several studies showed that plant extracts lowered LDL oxidation (Ramirez-Tortosa *et al.*, 1999; Doi *et al.*, 2000; Naidu and Thippeswamy, 2002). However, the present data demonstrated that consumption of rosemary can lead to reduction in the risk of hyperlipidemic symptoms and heart diseases. It can be concluded from presented results that rosemary was associated improvement in the lipid profile. Further studies are needed to purify the bioactive constituents of the extract and use the purified constituents for bioassay-directed experiments either in hyperlipidemic or non-hyperlipidemic organisms.

Suzuki *et al*. (2002) suggested that intake of vegetables and fruits rich in carotenoids might be protective factor against hyperglycemia. Flavonoids are functional constituents of many fruits and vegetables. Some flavonoids have antidiabetic properties because they improve altered glucose and oxidative metabolisms of diabetic states.

Platel and Srinivasan (1997) reported that vegetables are among numerous plant adjuncts tried for the treatment of diabetes mellitus, green leafy have shown the beneficial hypoglycemic influence in both experimental animals and humans.

On the other hand our data show that in all rosemary treated groups mean HDL-cholesterol level was increased as compared to the control group. In this respect, Tapsell *et al*. (2006) reported that the antioxidant properties of rosemary are of particular interest in view of the impact of oxidative modification of low-density lipoprotein cholesterol in the development of atherosclerosis. Herbs and spices have an important role in dietary flavonoids intake. Chamomile, onions, rosemary, sage and thyme have high flavonoids contents, but there is little evidence apart from epidemiological studies to support a direct cardiovascular health benefit from these herbs and spices.

Olmedilla *et al*. (2001) reported that basal diets containing goadaid reduced the levels of LDL-cholesterol, TC and TG. She observed also that HDL-cholesterol level was raised in diet with goadaid. Exposure to high fruit and vegetable content in diet increases antioxidant concentrations in blood and tissues and potentially protects against oxidative damage of cells and tissues.

Conclusions are that Rosemary is one of the dietary components that is known as safe and used every day in our food products. Our animal study confirms that rosemary extracts exert a hypoglycemic effect and improve the lipid profile. These effects should be studied further in human volunteers and diabetic patients.

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