

Hypolipidemic and Antiatherogenic Effects of Satureja Khuzestanica Essential Oil in Alloxan-Induced Type 1 Diabetic Rats

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Article information	Abstract
<p>Article history: Received: 4 June 2011 Accepted: 20 Aug 2011 Available online: 30 Dec 2012 ZJRMS 2013; 15(8): 26-29</p> <p>Keywords: Diabetes Serum Lipids Satureja khuzestanica Essential oil</p> <p>*Corresponding author at: Department of Biochemistry, Razi Herbal Medicine Research Center, Lorestan University of Medical Sciences, Khoramabad, Iran E-mail: hassan_a46@yahoo.Com</p>	<p>Background: The prevalence of diabetes is increasing around the world. Oxidative stress is one of the risk factors in diabetes. The purpose of this study is to examine the protective effects of the essential oil of <i>Satureja khuzestanica</i> on the level of serum lipids and atherogenic indices in the male rats with diabetes.</p> <p>Materials and Methods: This experimental study was conducted on thirty male rats randomly divided into three groups including: 1- control group, 2- rats with untreated diabetes 3- rats with treated diabetes (through orally intake of water containing 500 ppm of the essential oil of <i>Satureja khuzestanica</i>). The second and third groups also developed diabetes through injection of alloxan tetrahydrate (120 mg/kg). After eight weeks of treatment, their blood sample was taken, and then the levels of glucose, lipids and atherogenic indices of the serum were measured.</p> <p>Results: The levels of glucose, triglyceride, cholesterol, low density lipoprotein (LDL), very low density lipoprotein (VLDL) and atherogenic indices of plasma in treated diabetic group were significantly decreased. The amount of high density lipoprotein (HDL) was significantly increased in the treated group.</p> <p>Conclusion: The results obtained from this study showed that the essential oil of <i>Satureja khuzestanica</i> has beneficial effects on the level of serum lipids and atherogenic indices of rats with type 1 diabetes.</p>

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Introduction

Diabetes is the most prevalent human metabolic disease. Only in America 20.8 million people (equivalent to 7 percent of the population) suffer from this disease. Diabetes is associated with various problems many of which are life threatening [1]. Hyperglycemia causes non-enzymatic glycosylation of enzymes and proteins including those involved in the removal of free radicals and lipid metabolism; thus, free radicals increase. Increased free radicals intensify clinical symptoms of diabetes such as nephrotoxicity, etc [2].

Recent researches have indicated that diabetes increases oxidative stress markers [3]; on the other hand, many researchers have reported that oxidative stress especially free radicals of oxygen species play a pivotal role in the development of diabetic nephropathy and insulin resistance, so that they can greatly induce and stimulate other mechanisms of injury in diabetes [4].

Increased insulin resistance causes impaired metabolism of sugars and lipids. With an increase of insulin resistance in diabetes, the ability of antioxidant enzymes can also be reduced. Therefore, given the increase of oxidative stress markers in diabetes, the use of antioxidants is useful in the treatment and the reduction of clinical symptoms of diabetes and its being controlled [5, 6].

Also many scientists believe that oxidative stresses have a key role in the pathogenesis of various problems of diabetes. On the other hand, several studies indicate the fact that the use of antioxidants in patients with diabetes reduces the problems caused by this disease [7, 8]. Accordingly, we are observing increased demands of patients and researchers' and practitioners' interest in using natural and herbal medicines instead of synthetic chemical drugs [9-14]. A study has shown that polyphenols, as known antioxidants, have anti-diabetic effects and reduce the level of blood glucose. [9, 11]. Therefore, finding medicinal plants (herbs) rich in natural antioxidants and using them in general health and disease prevention and treatment is of great importance [15].

A plant used in this study is known with the scientific name of *Satureja khuzestanica* which is grown naturally in the provinces of Khuzestan and Lorestan and it is called *Satureja Khuzestanica* in the local dialect. *Satureja* as belonged to the Labiatae family has anti-microbial, anti-inflammatory and analgesic properties. It has also anticoagulant nature and makes the blood coagulation more prolonged [16].

Compounds found in the essential oil of *Satureja khuzestanica* have been analyzed by chromatographical

and mass spectrophotometric methods the results of which have been already published in the major journals by the authors [17]. Carvacrol is one of the most important compounds found in the *Satureja* which has antioxidant properties. Given the useful properties of *Satureja*, antioxidative activity and supportive effects of *Satureja khuzestanica* essential oil on the level of serum lipids and the atherogenic indices in type 1 diabetic male rats were examined under alloxan effect.

Materials and Methods

Satureja khuzestanica was collected from farms located in Khorram Abad city in the province of Lorestan. Aerial parts of the plant were collected at flowering (blooming) stage and were dried in the shade after washing and then, its oil (essence) was extracted using Soxhlet (COD) device (0.9%). Thirty male rats of Sprague race were purchased from Pasteur Institute of Tehran and were randomly divided into three groups:

1-control group, 2-untreated diabetic group, 3- diabetic group treated with the essential oil of *Satureja khuzestanica* (orally by water containing 500 ppm of the essential oil of *Satureja khuzestanica*) [18].

The second and third groups got diabetes through intraperitoneal injection of alloxan tetrahydrate (120 mg/kg) [19]. Forty-eight hours after the induction of diabetes, their blood sample was taken (from the back of ocular sinus), blood sugar test was performed and rats with more than 80 mg/dl blood sugar were considered as the diabetic rats and selected for the treatment. Rats were anesthetized after eight weeks of treatment and their blood sample were taken. Then fasting blood glucose, cholesterol, triglyceride and HDL levels of serum were measured using the kits purchased from ZiestChemie Diagnostics Company. The levels of VLDL and LDL were measured using following calculation method: (VLDL-C=plasma triglycerides/5, LDL-C=Total Cholesterol-HDL-C=Triglycerides) Furthermore, different concentrations of the essential oil were prepared from *Satureja khuzestanica* in order to evaluate the antioxidant capacity of the essential oil of *Satureja khuzestanica*. Then 3 test tubes were prepared for each concentration and 1ml of phosphotungstic acid and 0.1ml of *Satureja khuzestanica* essential oil sample were added to the each tube leaving all three for 90 min at the boiling temperature.

After cooling, sample absorbance was read at the wavelength of 695 nm against a blank. The standard curve of the total antioxidant capacity of ascorbic acid was drawn using this method and considering absorption at a wavelength of 695 nm based on the concentration of ascorbic acid in the range of 0.01-5 nmol. Then, total antioxidant capacity of *Satureja khuzestanica* essential oil was also calculated based on nmol ascorbic acid per each gram of the essential oil [21]. The obtained results have been expressed as mean±standard deviation. Significance of the results and the difference between groups were

statistically evaluated using SPSS-13 software and Mann-Whitney *U* test.

Results

The results so achieved indicate that *Satureja khuzestanica* essential oil reduced fasting blood glucose, triglyceride, cholesterol, VLDL, LDL and atherogenic indices of serum (plasma) in treated diabetic groups compared to the untreated diabetic group which is statistically significant. Also these results show that the *Satureja khuzestanica* essential oil has increased HDL levels in the serum of treated groups compared to the untreated one which is statistically significant as well (Table 1). The total antioxidant capacity of *Satureja khuzestanica* essential oil is equal to 3.2±0.4 nmol ascorbic acid per each gram of the essential oil.

Table 1. Effect of *Satureja khuzestanica* essential oil on fast blood sugar (FBS), triglyceride, cholesterol, VLDL, LDL, HDL and atherogenic indices of serum (plasma) in treated diabetic groups compared to the untreated diabetic group.

Parameters	Control	Untreated diabetes	Treated diabetes
Fasting blood Glucose(mg/dl)	81.0±28.0*	365.0±64.0	287±47*#
Triglyceride (mg/dl)	67.0±16.66*	102.0±25.01	72.0±22.78*
Total cholesterol	71.0±16.10*	118±25.14	87.83±24.14*#
LDL (mg/dl)	19.60±3.87*	70.85±12.24	38.43±9.94*#
VLDL (mg/dl)	13.40±3.33*	20.40±5.0	14.40±4.56*
HDL (mg/dl)	34.666±8.90*	29.75±10.92	33.54±9.64*
Total cholesterol/HDL (atrogenic index)	2.05±0.54*0	3.97±0.75	2.56±0.62*
LDL/HDL(atrogenic index)	0.57±0.08*	2.38±0.67	1.15±0.27*#

* indicates significant compared to the untreated diabetic group ($p<0.05$). # shows significant compared to the control group ($p<0.05$)

Discussion

The results of the study showed that *Satureja khuzestanica* essential oil reduced the levels of triglyceride, cholesterol, LDL, VLDL and biochemical atherogenic indices compared to the untreated diabetic group. Meanwhile, increased level of serum HDL in treated diabetic group was significant compared to the untreated diabetic group. Many research centers are now producing, isolating and using different antioxidants for the inhibition of vascular, serum and tissue complications of diabetes and today, antioxidants of natural origin are highly under consideration in these kinds of investigations. Perhaps other aspects of the injury mechanism of the problems resulted by diabetes and a better treatment for this disease can be achieved with this new insight. What is important in antioxidant capability is its ability to penetrate biological membranes and their speed in controlling and neutralizing free radicals in the shortest possible time after production of these free radicals [4].

However, if an antioxidant shows other properties such as anti-inflammatory effects, reducing fat and activating antioxidant enzyme system of the body, it could be theoretically more appropriate. At the present, many studies have been conducted using antioxidants such as alpha lipoid acid, green tea extract (Catkins), vitamin C, vitamin E and other materials such as vegetable oil extracts about their effect on diabetes; and their useful effects on the treatment or reduction of diabetic complications have been observed [22].

Many researchers have shown that some medicinal plants (herbs) like *Cassia auriculata*, Ginger rhizome and Chenkadali fruit may reduce serum lipids [23-26]. Many other researchers have also shown that some natural antioxidants such as lycopene, vitamin E and natural phenols can reduce serum lipids [26-28]. Consequently, the herbal medicines and antioxidants with serum lipid-lowering effects reduce problems such as cardiovascular complications resulted from hypercholesterolemia. Although the exact and complete mechanism of medicinal herbs and antioxidants in the reduction of fat and atherogenic indices has not been specified, but some mechanisms of action of some herbs and antioxidants on reducing serum lipids have been studied.

Based on the results obtained from research studies, herbal medicines and antioxidants can reduce fat absorption, the stimulation of cholesterol secretion by the bile and also may increase excretion of cholesterol through excrements. The researchers also showed that a number of medical herbs can inhibit lipoprotein glycosylation; enzymes and proteins involved in metabolism of lipids and lipoproteins and thereby reduce the serum lipids [29- 31]. Another study has shown that *Satureja khuzestanica* can reduce glucose and Malone dialdehyde levels in the serum of people with diabetes. In previous studies, the researchers have suggested that *Satureja khuzestanica* has antioxidant properties and may inhibit in vitro LDL oxidation. Furthermore, the most important ingredients in the essential oil of the *Satureja khuzestanica* include carvacrol, tannins, terpenoids and flavonoids which have been already reported by other investigators. Carvacrol is the most important and essential component of the *Satureja khuzestanica*. In addition, other researchers showed that carvacrol has an

effect of removing praxil radicals as well as anti-inflammatory and desirable antioxidant effects [34, 33]. However, the study results showed that the *Satureja khuzestanica* essential oil has a high total antioxidant capacity.

According to the results obtained from previous studies conducted by these authors [32, 17], and those of current study, *Satureja khuzestanica* has useful antioxidant properties. It also lowers serum lipids and atherogenic indices in rats with diabetes. Thus, given the beneficial effects of *Satureja khuzestanica* as an essence rich in antioxidants and a desirable antioxidant role, it is comparable with well-known antioxidants such as vitamin E. However, the beneficial effects and increased use of antioxidants and medicinal plants in the treatment and control of some diseases have led scientists to carry out further scientific researches in various aspects and to select valuable medicinal herbs which are traditionally and locally used in the treatment of diseases particularly in different regions of Iran. Given the useful antioxidant properties of *Satureja khuzestanica* and its beneficial effects on the fat loss and atherogenic indices, *Satureja khuzestanica* may be possibly effective in reducing the problems caused by diabetes especially cardiovascular diseases and problems associated with the oxidant agents such as diabetic nephropathy.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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