

## Effect of hydro alcoholic extract of artichoke on diabetes treatment and liver enzymes in diabetic adult male rats

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### ABSTRACT

**Background and aims:** Artichoke (*Cynara scolymus* L.) is a plant of the Asteraceae family. This plant is used in herbal medicine. This study was conducted to evaluate the effect of artichoke extract on insulin, glucagon, glucose, alkaline phosphatase (ALP), alanine amino transferase (ALT) and aspartate amino transferase (AST) in streptozotocin-induced diabetic rats.

**Methods:** In this experimental study, 40 adult male Wistar rats weighting 220-200 g were used. The rats were divided into 4 equal groups including, control, diabetic and 2 diabetic experimental groups. Two experimental groups respectively received 100 and 300 mg/kg of artichoke hydro ethanol extract as intraperitoneal for 6 days. Diabetes was induced by intraperitoneal injection of 60 mg/kg streptozotocin. At the end of the sixth day, blood was taken from the heart of animals. Afterward serum concentration of insulin, glucagon, glucose, ALP, ALT and AST were measured. Then, the parameters measured in the different groups were compared with a control group. Data were evaluated by ANOVA, Duncan test and Student's t-test.

**Results:** Results showed that artichoke extract significantly reduced the levels of glucagon, glucose, ALP, ALT, AST and increased insulin level compared to control and diabetic groups. It is worth noting that before the experiment, parameters tested were equal in all groups.

**Conclusion:** Artichoke reduces blood sugar so it has a role in treatment of diabetes. Additionally, this herb is effective in control of blood glucose by liver enzymes reducing.

**Keywords:** Artichoke, Insulin, Blood sugar, Liver enzymes.

### INTRODUCTION

Diabetes is a common metabolic disease with many side effects.<sup>1</sup> Diabetes increases blood glucose and impaired metabolism of proteins and lipids. Today, diabetes is regarded as one of the important problems in the world. Researchers predict that the number of people with diabetes in the world will reach 334000000 people by 2025.<sup>2</sup> The results show that fasting,<sup>3</sup> and herbal remedies such as pomegranates and walnuts

male flowers are effective in the treatment of diabetes.<sup>4-6</sup> *Cynara scolymus* L. is the scientific name of the artichoke. This plant contains protein, iron, phosphorus, potassium, sodium, calcium, vitamins A, B1, B2, B3 and C. In addition, artichoke has inulin, inulase, a bitter substance called Synaryn and many other antioxidant compounds.<sup>7</sup> Artichoke plant due to have various flavonoid compounds has anti-microbial,

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anti-allergic, anti-inflammatory and anticancer effects.<sup>8</sup> Artichoke aqueous leaf extract reduces serum total cholesterol, triglycerides, very low density lipoprotein (VLDL-C), Malondialdehyde and glycosylated hemoglobin.<sup>9</sup> One study indicates that artichoke extract can improve patient with hypercholesterolemia.<sup>10</sup> Artichoke plant reduces lipid peroxidation and its related parameters.<sup>11</sup> In one study, it was shown that artichoke extract as glibenclamide chemical drug reduces lipid profile in alloxan-induced diabetic rats but it cannot reduce blood sugar.<sup>12</sup> Moreover, Artichoke reduces alkaline phosphatase in severe liver damage such as damage caused by the immune response in rat.<sup>13</sup> Due to the increasing rate of diabetes and medication side effects and high costs required to treat, herbal treatments with fewer side effects and costs are taken into consideration. So, the present study was conducted to evaluate the effect of artichoke hydro alcoholic extract on serum insulin, glucagon, glucose, ALP, ALT and AST enzymes levels in streptozotocin-induced diabetic male rats.

## METHODS

This research is an experimental study that was conducted in 2013 in cooperation with the Biology Department of Islamic Azad University, Fars Science and Research Branch. The present study worked on 40 adult male Wistar rat weighting 220-250 g and the mean age of 90 days. The animals were kept at a temperature of 22±2 Celsius degrees. Animals throughout the experimental had access to water and food in sufficient quantities. The research protocol was in accordance with the international law for protection and welfare of animals and it was approved by the Ethics Committee of the university. The animals were divided into 4 groups of ten mice

including the control group, diabetic group and two experimental groups. To induce diabetes, mice were injected intraperitoneally 60 mg/kg Streptozotocin (STZ) produced by the American up john company.<sup>14</sup> Blood was taken from the tail of mice, after 72 h of streptozotocin injection. Then by using Glucodr devices, Super Sensor model, making South Korea, blood glucose samples were measured. To ensure that rats were diabetic, one week after STZ injection, bloodletting was repeated. Then, rats with serum blood glucose 300 mg/dl were considered as diabetic rats. In this study control group received no treatment. Experimental groups were treated respectively with 100 and 300 mg/body weight hydroalcoholic extract of artichoke intraperitoneally for 6 days. On the last day of experiment, blood samples were taken from the heart. Then, the serum concentration of ALP, ALT, AST, insulin, glucose and glucagon were measured.

The data were analyzed by one way ANOVA, Duncan test and student's t-test, using SPSS-18 software. A *p*-value of <0.05 was considered as statistically significant.

## RESULTS

All the tested parameters were identical in all groups before the experiment. The results showed that artichoke hydroalcoholic extract reduced significantly serum concentration of glucagon, glucose, ALT, AST, ALP enzymes and increased serum concentration of insulin in the experimental groups compared to control and diabetic groups. Serum concentration of ALP, ALT, AST, glucose and glucagon increased and insuline decreased in the diabetic group compared with the control group. It is worth noting that the effect of artichoke was dosing dependent Manner (Table 1).

**Table 1:** Comparing the serum concentration of insulin, glucagon, glucose and ALT, AST, ALP enzymes in experimental groups with control and diabetic groups

Groups	Insulin (ng/ml)	Glucagon (ng/ml)	Glucose (mg/dl)	ALT (IU/L)	ALP (IU/L)	AST (IU/L)
Control	14.38±0.50	9.44±0.224	73.20±2.36	127.30±2.28	371.20±4.16	57.00±2.24
Diabetic	3.57±0.21 <sup>###</sup>	22.40±0.71 <sup>###</sup>	343.4±3.62 <sup>###</sup>	173.29±2.52 <sup>###</sup>	545.50±7.40 <sup>###</sup>	109.70±1.25 <sup>###</sup>
DEG 1	9.11±0.37 <sup>##</sup>	19.60±0.45 <sup>##</sup>	309.4±3.64 <sup>##</sup>	160.20±3.46 <sup>##</sup>	508.5±4.20 <sup>##</sup>	98.30±2.26 <sup>##</sup>
DEG 2	13.14±0.49 <sup>##</sup>	16.06±0.41 <sup>##</sup>	248.80±3.85 <sup>##</sup>	129.30±2.09 <sup>##</sup>	457.5±9.09 <sup>##</sup>	85.00±2.11 <sup>##</sup>

Mean±SD; \*P≤0.05, \*\*P≤0.0005 between each group with control group; <sup>§</sup>P≤0.05, <sup>##</sup>P≤0.0005 between each group with diabetic group; <sup>###</sup>P≤0.0005 between diabetic group with control group. DEG 1 (diabetic experimental group 1; received 100 mg/kg of artichoke); DEG 2 (diabetic experimental group 2; received 300 mg/kg of artichoke).

## DISCUSSION

Diabetes induced by streptozotocin alters the structure and function of the body including the liver cells.<sup>15</sup> The structure and function of the body and also the liver cells will be changed by diabetes induced by streptozotocin. Other research suggests that consumption of artichoke leaf extract (21 days) increases serum levels of ALP, ALT and AST in non-diabetic rats.<sup>16</sup> In addition, the findings suggest that 28-day administration of artichoke plants increases plasma antioxidant and superoxide dismutase activity.<sup>9</sup> Antioxidant compounds and superoxide dismutase enzyme prevent damaging effects caused by free radicals and oxidative stress. In diabetes, oxidative stress and free radicals increased. So probably artichoke reduces the harmful effects of free radicals and oxidative stress by antioxidant compounds and superoxide dismutase enzyme. Another study suggested that pomegranate juice reduced serum concentrations of ALT, ASP and ALP. Our research indicated that pomegranate juice and artichoke have similar antioxidant compounds such as vitamine C.<sup>17</sup> Artichoke significantly reduces blood sugar levels, serum lipids and lipoproteins in diabetic

rats. Moreover artichoke extract is effective in the regeneration of damaged pancreatic.<sup>18</sup>

Oral administration of artichoke reduces blood sugar and cholesterol in diabetic rats.<sup>19</sup> Artichoke reduces blood sugar and diabetes complications by glucagon decreasing, antioxidant properties, anti-lipid peroxidation, protection of cells against depletion of glutathione, inhibit the production of leukotrienes from unsaturated fatty acids, protein synthesis stimulation, mast cell stabilization and immunoactivity organization properties.<sup>20</sup> Antioxidant effect of artichoke created with chlorogenic acid, synaryn and luteolin activity.<sup>21</sup> Probably these compounds through protective effects on  $\beta$  cells reduce the harmful effects of free radicals and drug used to induce diabetes. In addition, chlorogenic acid, synaryn and luteolin increase glucose uptake in peripheral tissues (insulin-like activity), reduce the intestinal absorption of glucose by digestive enzymes inhibiting, repair the damaged cells and stimulate the  $\beta$  cell to insulin secretion.<sup>22</sup> So, in the present study, probably chlorogenic acid, the most active antioxidants found in artichoke leaf extract, is responsible for the hypoglycemic.<sup>23</sup>

Histological studies show that, artichoke significantly increases the bulk and volume density of pancreatic islet cells.<sup>24</sup> In diabetic rats treated with antioxidants, cell numbers significantly increased pancreas precursor cell differentiation in Langerhans islets.<sup>25</sup>

## CONCLUSION

Artichoke reduces blood glucose by controlling the normal function of the liver and increases insulin secretion from  $\beta$  cells. Moreover Artichoke reduces ALP, ALT and AST Enzymes.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

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