# Effect of Alcohol Extracts of *Juniperus Phoenicea* and *Crataegus azarolus* on Diabetes Induced by Streptozotocin in Experimental Rats

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# Effect of Alcohol Extracts of *Juniperus Phoenicea* and *Crataegus azarolus* on Diabetes Induced by Streptozotocin in Experimental Rats


## Abstract

Diabetes mellitus (DM) includes a diverse range of diseases associated with hypo- or insensitive insulin secretion. Thus, the current study aimed to examine the antihyperglycemic effects of alcoholic extract of leaves of *Juniperus Phoenicea* and *Crataegus azarolus* leaves in streptozotocin-stimulated diabetic rats (STZ, intraperitoneal, 65 mg $kg^{-1}$). Thirty six rats *(Sprague-Dawley*) that weights (200±10 g) were divided randomly into six equal groups. Group (1) and group (2) were kept as negative and positive controls (- and +), respectively. Group (3) and group (4) were orally given the *Juniperus Phoenicea* extract in 200 and 400 mg $kg^{-1}$ B.wt .$day^{-1}$ doses, respectively, whereas group (5) and group (6) were orally given the *Crataegus azarolus* extract in 200 and 400 mg $kg^{-1}$ B.wt $day^{-1}$ doses, respectively, for a month. Finally, when the experiment was ended, a biological evaluation was determined. Blood glucose, serum insulin, heart enzymes, liver function, lipid profile, kidney function, and TNF- α were estimated in serum. In pancreas tissue, GSH, SOD and MDA were evaluated, as well as the chemical composition of herbs. The results exhibited that the alcoholic extract of *Juniperus Phoenicea* and *Crataegus azarolus* leaves significantly increased the biological evaluation، normalized serum levels of liver functions, kidney function, enhanced the lipid profile, lessened blood glucose, heart enzymes and MDA and increased levels of insulin, GSH and SOD than those of control diabetic rats. This work suggests that *Juniperus Phoenicea* and *Crataegus azarolus* leaves extracts administration can decline blood glucose levels and the occurrence of various problems resulting from hyperglycemia.


**Key words**: *Juniperus Phoenicea; Crataegus azarolus*; Streptozotocin; Blood glucose; Antioxidant enzymes.

## Introduction

Diabetes is a severe metabolic illness distinguished by insulin production, which leads to hyperglycemia and irregularities in protein metabolism, carbohydrates, and lipids (**Nacer *et al*., 2020)**. Diabetes is classified as a chronic irregular metabolic illness by the World Health Organization. Consequently, DM can be classed into two categories: type 1 and 2. Type 1 results from the immune system's dysfunctional performance, resulting in β cells destruction in islets and a disorder in insulin release. In contrast, type 2 is caused by insulin resistance and insufficient insulin secretion because of unhealthy lifestyle choices and thus obesity (**Huang and Chen, 2023**). Regardless of an individual's age, sex, socio-economical background, or race, diabetes incidence is steadily rising (**Okoduwa *et al*., 2017)**. Diabetes influences more than four hundred million people throughout the world**,** it is also supposed to increase this number to more than 600 million by 2040, with most of them having type 2 diabetes with huge disturbances in insulin production or its signal transmission **(Hassan *et al*., 2021)**. Also, it is associated with micro- and macro-vascular issues that adversely impact the functioning of several organs, such as retinopathy, cardiovascular disease, nephropathy, and others (**Hacioglu *et al*., 2021)**. Due to the higher oxidation rate of glucose in mitochondria, hyperglycemia has been shown to promote the producing of too many reactive O species (ROS) in people with diabetes (**Al-Brakati *et al*., 2020)**. Elevated levels of ROS and inhibition the defense system of antioxidants may cause increased lipid peroxidation, oxidative injury, insulin resistance, and cell injury (**Hacioglu *et al*., 2021)**. Also, diabetes might speed up the lipolysis process, which raises the level of free fatty acids, promoting the release of cytokines including interleukin-6 in addition to factor-α of tumor necrosis. The latter stimulates caspase transmission, that is crucial in inducing the death of cells through apoptosis (**Giribabu *et al*., 2017)**.

Diabetes has been the subject of much study, along with the creation of effective anti-diabetic medicines. Unfortunately, these medicines cannot restore the aforementioned diabetic problems, and their long-term use may result in medicine resistance and severe consequences such as acute renal damage (**Chaudhary *et al*., 2016 and Luo *et al*., 2021)**. Many phyto-extracts have been utilized in traditional

medicine as folkloric medicine to control diabetes. *Juniperus* (*Cupressaceae*: family) is one of these plants. It is a genus of around 75 species of ever green trees found worldwide (**Raina *et al*., 2019)**. *Juniperus phoenicea*(Arar is a local name), is a plant that grows up to around eight m in height and is extensively dispersed in the south of Saudi Arabia and Mediterranean region (**Raina *et al*., 2019)**. *J. phoenicea* fruits were discovered in old Egyptian tombs and were grown in the Mediterranean area and Sinai. A phytochemicals analysis of the plant's fruits and leaves revealed that they have a high carbohydrate content, and/or essential oil, glycosides, flavonoids, sterols and/or triterpenes **(Al Masoudi *et al*., 2023)**. The *J. phoenicea* species' leaves are applied in conventional medicine to treat a variety of diseases that include diabetes, bronchopulmonary disorders, and as a therapy for diuresis (**Barnawi *et al*., 2021)**. *J. phoenicea* has also been found to have antimicrobial, antioxidant, and hepatoprotective characteristics (**Laouar *et al*., 2017)**. Several studies have shown that *J. phoenicea* cultivated in various geographical zones can reduce the development of certain cancer cells (**Al Groshi *et al*., 2018)**.

Origins in Europe, Mediterranean area, Central Asia, and , and North Africa are hawthorn or *Crataegus* species. They go by the name "Hawthorn" as well. Most species of hawthorn have straight, long, and pointed thorns. According to **Bouaziz *et al*. (2016)**, *C azarolus* is the predominant plants in the Mediterranean area. Recent research reveals that major *crataegus* species offer advantageous impacts on human well-being. Extracts obtained from the plant's aboveground sections exhibit various biological actions, including anti-inflammatory, vasorelaxant, antihyperglycemic, and hypolipidemic (**Wang *et al*., 2019)**. Moreover, experts have stated that the *C. azarolus* leaves have a high concentration of phenolic substances and have considerable antibacterial and antioxidant properties (**Yahyaoui *et al*., 2019)**. Evidence indicates that the consumption of the fruits and leaves extracts of *Crataegus* is safe for humans (**Triki *et al*., 2022)**. Bioactive substances such as flavonoids and polyphenols, including hyperoside, quercetin, and isoquercitrin, have been discovered in *C. azarolus* **(Rababa'h *et al*., 2020)**.

Therefore this study aimed to examine how the alcohol extracts of *j. phoenicea* and *C. azarolus* leaves affect the anti-hyperglycemic in

addition to anti-hyperlipidemic capabilities of rats with streptozotocin-induced diabetes.

## Materials and Methods

### Plant Material:

Dehydrated Dry leaves of *Juniperus Phoenicea* and *Crataegus azarolus* were locally obtained from Egypt (from Haraz Shop in Cairo for medicinal plants and herbs).

### Rats:

Thirty rats (male albino) (*Sprague Dawely* strain) weighing 200±10 g were acquired from the animals house in National Research Center, Giza, Egypt.

### Streptozotocin and Biochemicals Kit:

El-Gomhoryia Company for Chemicals in Cairo, Egypt, supplied the streptozotocin (STZ). Gamma Trading Corporation in Egypt provided kits for evaluating the serum lipid profile, radioimmunoassay kits for insulin hormones , and glucose enzymatic kits to calculating blood glucose (BG), and. Gama Trading Company, Dokki, Egypt, provided the other biochemical kits.

### Measurment of the chemical composition of herbs:

Chemical composition (i.e. protein, carbohydrate, fibre, fat, and ash) was assessed according to (**AOAC , 2000).**

### Preparation of alcohol herbal extracts:

To create the extract, 400 g of powdered of dried leaves from *J. phoenicea* and *C. azarolus* were soaked in two L of 90% ethanol and refrigerated while being shaken daily for five days. Afterward, the solution was percolated five to seven times until completely depleted. The resulting ethanolic extracts were then concentrated by a vacuum rotatory evaporator at a temperature of 50°C **(Shalaby and Hamowieh, 2010).**

### Diabetes Induction:

Rats were induced with diabetes through a single intraperitoneal injection of STZ produced freshly, with a dosage of 65 mg $kg^{-1}$ body

weight. The injection was diluted in 0.02 milliliter of 0.05 Molar citrate buffer with a pH of 4.5, as mentioned in **Nafiu *et al*. (2011)**. After a period of 72 hours, blood samples were taken from each rat's orbital plexus vein using tiny capillary tubes to verify the occuring of diabetes by testing the level of blood glucose. A diagnosis of diabetes was made once non-fasting blood glucose concentrations reached 200 mg $dL^{-1}$, according to **Al-Malki and El Rabey (2015).**

**Experimentation and dividing of rats:**

Thirty-six male adult rats (Sprague-Dawley) weighing 200±10 g were accommodated in an airy environment. The rats were kept to adapt for a week before starting the experiment, and they were fed a basal diet as outlined by **Reeves *et al*. (1993).** The rats were then separated into six groups (each comprising of six rats). Group 1 acted as a normal control and received a baseline diet. Diabetes was stimulated in the other five groups by an intravenous STZ injection. Using a specialized approach, blood glucose concentrations were monitored starting on the third day after STZ injection, and continued until diabetes was confirmed (defined as blood glucose concentrations > 200 mg $dl^{-1}$) **(Al-Malki and El Rabey, 2015).** The untreated rats with diabetes comprised group (2) (as a (+) positive control), while group 3 and group 4 comprised of diabetic rats, that were fed a standard diet, and given oral doses of *J. phoenicea* extract at 200 mg $kg^{-1}$ b.wt $day^{-1}$ and 400 mg $kg^{-1}$ b.wt $day^{-1}$, respectively, for a duration of four weeks **(Al-Ahdab, 2017)**. On the other hand, **group 5 and group 6** were given the extract of *C. azarolus* in the mouse for four weeks in dosages of 200 and 400 mg $kg^{-1}$ b.wt $day^{-1}$ respectively **(Pirmoghani *et al*.,** 2019). Weekly, the animals' body weight and feed intake were recorded. Following the experimental time, the animals were weighed and then subjected to an overnight fast and sacrificed under the effects of mild ether anaesthesia.

**Biological evaluation**

After four weeks, the experiment was finished and body weight growth, feed efficiency ratio, feed intake, and relative organ weights were measured (**Chapman *et al*., 1959).**

**Serum biochemical analysis:**

After rat sacrifice, a blood sample was taken from each rat's hepatic portal vein in a dried washed centrifuge tube. Serum was cautiously extracted from blood samples by centrifugation at 3500 rpm (for 15 minutes) at room temperature, moved to a clean dry ebendorf tube, and stored at - 20 °C for further analyses. Glucose enzymatic kits were used for measuring blood glucose (BG) (**Siest *et al*., 1981)**. A particular antibody radioimmunoassay kit was used to determine serum insulin levels (**Yallow and Bauman, 1983)**.

Alanine aminotransferase and aspartate aminotransferase (ALT and AST) were determined **(Bergmeyer *et al*., 1986)**; serum (ALP) was colorimetriclly determined by (**Roy, 1970)**; albumin (**Drupt, 1974)** ; and total protein **(Sonnenwirth and Jaret, 1980).** Globulin was estimated through the next equation :

Globulin = total protein – albumin (**Busher, 1990)**

Serum uric acid was assessed by the enzymatic colorimetric technique **(Fossati *et al*., 1980)**. Serum creatinine levels were determined by the calorimetric method **(Husdan and Rapoport, 1968)**. Serum urea nitrogen levels were measured in the serum (**Patton and Crouch, 1977)**.

Total cholesterol, triglycerides, and HDL-C were determined in the serum **(Allain *et al*., 1974; Trinder and Ann, 1969; Lopes- Virella *et al*., 1977)**. measured in the serum. Serum VLDL-C and LDL-c were estimated **(Friedwald *et al*., 1972).** The atherogenic index was estimated by using the formula: log (TG/HDL-C) (**Nwagha, 2010).**

Serum tumor necrosis factor-α (TNF-α) was evaluated as an inflammatory indicator **(Luo *et al*., 2014).** The serum enzymes creatine kinase (CK) lactate dehydrogenase (LDH) were estimated by (**Uotila *et al*., (1981).**

Malondialdehyde (MDA) **(Yoshioka *et al*., 1979),** declined glutathione (GSH) **(Beutler *et al*., 1963)** and superoxide dismutase (SOD) **(Giannopolitis and Ries, 1977)** were estimated in the homogenized pancreas.

**Statistical analysis:**

Statistical analysis was done with the analysis of variance (one-way) (ANOVA) and Duncan assess in the SPSS software (Chicago, IL, USA). The results were presented as average ± SD. The difference among averages was considered significant at $P< 0.05$ **(Snedecor and Cochran, 1989)**.

## Results

### 1. Chemical analysis of *Juniperus phoenicea* and *Crataegus azarolus*

The data in Table 1 displayed that *J. phoenicea* and *C. azarolus* chemical analysis have the highest values of carbohydrate (66.66% ± .04), crude protein (10.61% ± .02) and ash (8.69% ± .020), while *J. phoenicea* has the highest values of fiber (17.10% ± .22) and crude fat (5.28% ±.020).

**Table (1): Chemical analysis of leaves of *Juniperus phoenicea* and *Crataegus azarolus* g 100g$^{-1}$**

| Components % | *Juniperus phoenicea* | *Crataegus azarolus* |
|---|---|---|
| **Carbohydrate** | 64.80 ± .05$^{b}$ | 66.66 ± .04$^{a}$ |
| **Fiber** | 17.10 ± .22$^{a}$ | 13.27 ± .02$^{b}$ |
| **Crude fat** | 5.28 ±.020$^{a}$ | 0.76 ± .02$^{b}$ |
| **Crude protein** | 5.78 ± .02$^{b}$ | 10.61 ± .02$^{a}$ |
| **Ash** | 7.04 ± .04$^{b}$ | 8.69 ± .020$^{a}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

### 2. Biological evaluation

The results in Table 2 display that the average values of FI, BWG %, FER and relative pancreas weight in the + control group were lower significantly than the - control group. Conversely, all measurements in the remedy groups were increased significantly at ($P < 0.05$). Therefore, the best relative pancreas mass and FI results were recorded at 400 mg kg$^{-1}$ BW *J. phoenicea*. Simultaneously, the preferable BWG % and FER findings were noticed in *J. phoenicea* and *C. azarolus* (400 mg kg$^{-1}$ BW).

**Table (2): The effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on feed intake (FI), body weight gain (BWG %), feed efficiency ratio (FER) and relative pancreas mass in diabetic rats (M±SD)**

| Parameters<br>Groups | FI (g)<br>28days | BWG (%) | FER(g) | Pancreas (%) Row |
|---|---|---|---|---|
| **Control –ve** | 500.13 ±5.20$^{a}$ | 40.38±3.11$^{a}$ | 0 .122±0. 004$^{a}$ | 0.60±0.03$^{a}$ |
| **Control +ve** | 378.40±2.23$^{f}$ | 13.80±2.05$^{d}$ | 0 .053±0.005$^{e}$ | 0.36±0.04$^{d}$ |
| ***J. phoenicea* 200 mg** | 423.33 ±2.81$^{d}$ | 24.53±1.88$^{c}$ | 0.085±0.002$^{c}$ | 0.49±0.01$^{bc}$ |
| ***J. phoenicea* 400 mg** | 464.67±3.84$^{b}$ | 35.17±3.06$^{b}$ | 0 .112±0.008$^{b}$ | 0.52±0.02$^{b}$ |
| ***C. azarolus* 200 mg** | 414.60± 40$^{e}$ | 20.82±4.01$^{c}$ | 0.075 ±0.006$^{d}$ | 0.46±0.02$^{c}$ |
| ***C. azarolus* 400 mg** | 442.93±2.97$^{c}$ | 31.45±1.78$^{b}$ | 0.104 ±0.005$^{b}$ | 0.50±0.02$^{bc}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant**.

## 3. Blood glucose and serum insulin

According to data in Tables (3), the (+ve) control group's average values of blood glucose were significantly higher than the (-ve) control. All handled groups recorded a significant decline in all parameters than the control (+ve). The best results were recorded in rats receiving *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW), while serum insulin in the positive control was significantly decreased than the normal rats. The highest serum insulin concentration was recorded in treated groups with *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW).

**Table (3): The effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on blood glucose and serum insulin in diabetic rats (M±SD)**

| Parameters<br>Groups | Blood glucose (mg $dl^{-1}$) | Serum insulin (pg $ml^{-1}$) |
|---|---|---|
| **Control –ve** | 80.0±2.0$^{e}$ | 287.50±4.78$^{a}$ |
| **Control +ve** | 403.67±3.51$^{a}$ | 81.00±3. 0$^{e}$ |
| ***J. phoenicea* 200 mg** | 271.33±3.05$^{c}$ | 152.33±4.517$^{c}$ |
| ***J. phoenicea* 400 mg** | 124.67±4.04$^{d}$ | 256.83±6.53$^{b}$ |
| ***C. azarolus* 200 mg** | 281.67±3.05$^{b}$ | 142.17±5.01$^{d}$ |
| ***C. azarolus* 400 mg** | 128.67±3.21$^{d}$ | 249.00±6.00$^{b}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

## 4. Liver functions

The data in Table 4 demonstrate that the average value of AST, ALT and ALP levels in the +ve group was significantly higher compared with the–ve group. However, all other examined groups decreased significantly than the +ve group. The minimum AST, ALT and ALP levels were noticed in the treated group with *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW).

**Table (4): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on liver enzyme (AST, ALT and ALP) in diabetic rats (M±SD)**

| Parameters<br>Groups | AST (U $L^{-1}$) | ALT (U $L^{-1}$) | ALP (U $L^{-1}$) |
|---|---|---|---|
| **Control –ve** | 91.0± 4.0$^{e}$ | 29.0±3.0$^{d}$ | **251.33±4.51$^{d}$** |
| **Control +ve** | 200.33±4.51$^{a}$ | 69.0±2.0$^{a}$ | **463.0 ±7.0$^{a}$** |
| ***J. phoenicea* 200 mg** | 180.0±3.0$^{c}$ | 52.0±3.0$^{b}$ | **388.33±4.51$^{b}$** |
| ***J. phoenicea* 400 mg** | 112.67±2.31$^{d}$ | 35.0±3.0$^{c}$ | **277.67±2.51$^{c}$** |
| ***C. azarolus* 200 mg** | 191.0±4.0$^{b}$ | 56.0±4.0$^{b}$ | **390.0±5.0$^{b}$** |
| ***C. azarolus* 400 mg** | 116.0±4.0$^{d}$ | 38.0±2.0$^{c}$ | **284.0±3.61$^{c}$** |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

## 5. Serum albumin, globulin and total protein

The obtained numbers in Table 5 show that the average values of total protein, albumin, and globulin in the +ve control declined significantly than the –ve one. Conversely , the other investigated groups showed a significant increase than the +ve control. The highest total protein and albumin were noted in the handled group with *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW). However, the maximum globulin was recorded in group *J. phoenicea* (200 mg $kg^{-1}$ BW).

**Table (5): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on total protein, albumin and globulin in diabetic rats (M±SD)**

| Parameters<br>Groups | T. Protein (g $dl^{-1}$) | Albumin (g $dl^{-1}$) | Globulin (g $dl^{-1}$) |
|---|---|---|---|
| **Control –ve** | $8.40\pm0.01^{a}$ | $4.64\pm0.04^{a}$ | $3.76\pm0.04^{a}$ |
| **Control +ve** | $5.93\pm0.03^{d}$ | $3.06\pm0.03^{d}$ | $2.87\pm0.03^{d}$ |
| ***J. phoenicea* 200 mg** | $7.17\pm0.03^{c}$ | $3.60\pm0.06^{c}$ | $3.57\pm0.03^{b}$ |
| ***J. phoenicea* 400 mg** | $7.91\pm0.04^{b}$ | $4.38\pm0.02^{b}$ | $3.53\pm0.03^{bc}$ |
| ***C. azarolus* 200 mg** | $7.12\pm0.02^{c}$ | $3.59\pm0.03^{c}$ | $3.53\pm0.03^{bc}$ |
| ***C. azarolus* 400 mg** | $7.88\pm0.03^{b}$ | $4.42\pm0.08^{b}$ | $3.46\pm0.07^{c}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

## 6. Heart enzyme

Table 6 displays the serum LDH and CPK levels that were increased in the unhealthy rats than in the standard control. It was lower significantly in all treatments than the + ve control. The most effective outcomes in LDH were noted with *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW). In comparison, a preferable finding in CPK was found in *J. phoenicea* (400 mg $kg^{-1}$ BW).

**Table (6): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on heart enzyme (LDH and CPK) in diabetic rats (M±SD)**

| Parameters / Groups | LDH ($U\ L^{-1}$) | CPK ($U\ L^{-1}$) |
|---|---|---|
| **Control –ve** | 450.0 ±10.0$^{e}$ | 350.0 ± 5.0$^{f}$ |
| **Control +ve** | 717.0 ±17.0$^{a}$ | 670.0 ± 12.0$^{a}$ |
| ***J. phoenicea* 200 mg** | 600.0 ±10.0$^{c}$ | 520.0 ± 9.0c |
| ***J. phoenicea* 400 mg** | 500 .0±12.0$^{d}$ | 400.0 ±10.0$^{e}$ |
| ***C. azarolus* 200 mg** | 630.0 ±13.0$^{b}$ | 550.0 ±15.0$^{b}$ |
| ***C. azarolus* 400 mg** | 516.67 ± 6.66$^{d}$ | 500.0 ±11.0$^{d}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

## 7. Kidney functions

The obtained results in Table 7 show that + ve control group's average serum creatinine, urea, and uric acid levels were higher significantly than their counterparts in the – ve negative control. Compared to the + ve control, all parameters in the remedy categories reduced significantly ($P < 0.05$). The best creatinine and urea findings were found in *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW). At the same time, the preferable serum uric acid finding was found in *J. phoenicea* (400 mg $kg^{-1}$ BW).

**Table (7): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on creatinine, urea and uric acid in diabetic rats (M±SD)**

| Parameters / Groups | Creatinine (mg $dl^{-1}$) | Urea (mg $dl^{-1}$) | Uric acid (mg $dl^{-1}$) |
|---|---|---|---|
| **Control –ve** | 0.43±0.03$^{d}$ | 14.33± 2.97$^{d}$ | 1.95± 0.15$^{d}$ |
| **Control +ve** | 1.55±0.05$^{a}$ | 81.67± 3.48$^{a}$ | 3.74 ± 0.04$^{a}$ |
| ***J. phoenicea* 200 mg** | 0.99±0.04$^{b}$ | 50.43± 4.76$^{b}$ | 3.04± 0.21$^{b}$ |
| ***J. phoenicea* 400 mg** | 0.60±0.02$^{c}$ | 28.20± 3.95$^{c}$ | 2.29± 0.26$^{cd}$ |
| ***C. azarolus* 200 mg** | 0.98±0.04$^{b}$ | 55.63±4.20$^{b}$ | 3.08± 0.20$^{b}$ |
| ***C. azarolus* 400 mg** | 0.61±0.03$^{c}$ | 29.53±3.87$^{c}$ | 2.34± 0. 26$^{c}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

## 8. Lipid profile

The data in Tables 8 and 9 reveal that the +ve control average values of the lipid profile (TC, LDL, AI, TG, and VLDL) increased significantly when than the - ve control group. All treatments recorded a significant decline in all parameters than the +ve control. The best data was noticed in the rats that received *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW) in AI, TG and VLDL. While the best results in TC and LDL were found in rats receiving *J. phoenicea* (400 mg $kg^{-1}$ BW). On the other hand, HDL in the +ve control was significantly decreased than the normal rats. The highest HDL content was recorded in thegroup that treated with *J. phoenicea* (400 mg $kg^{-1}$ BW).

**Table (8): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on (TC, HDL, LDL and AI) in diabetic rats (M±SD)**

| Parameters<br>Groups | TC<br>(mg $dl^{-1}$) | HDL<br>(mg $dl^{-1}$) | LDL<br>(mg $dl^{-1}$) | AI<br>(mg $dl^{-1}$) |
|---|---|---|---|---|
| **Control –ve** | 130.0±4. $0^{f}$ | 40.0±4.$00^{a}$ | 75.53±4.$00^{e}$ | 1.82± 0.$16^{c}$ |
| **Control +ve** | 200.0±5.$0^{a}$ | 20.0±3.$00^{d}$ | 153.40±3.$64^{a}$ | 6.76±1.$11^{a}$ |
| ***J. phoenicea* 200 mg** | 179.67±4.$51^{c}$ | 25.33±2.$51^{c}$ | 132.73±1.$81^{b}$ | 4.29± 0.$39^{b}$ |
| ***J. phoenicea* 400 mg** | 149.67±4.$51^{e}$ | 37.00±3.$00^{ab}$ | 95.47±1.$97^{d}$ | 2.34±0.$25^{c}$ |
| ***C. azarolus* 200 mg** | 189.0±4.$0^{b}$ | 26.0±2.$65^{c}$ | 141.40±7.$15^{b}$ | 4.17±0.$30^{b}$ |
| ***C. azarolus* 400 mg** | 167.0±3.$0^{d}$ | 32.0±2.$00^{b}$ | 117.53±0.$50^{c}$ | 2.73±0.$09^{c}$ |

**At significance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

**Table (9): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on (TG and VLDL ) in diabetic rats (M±SD)**

| Parameters<br>Groups | TG (mg $dl^{-1}$) | VLDL (mg $dl^{-1}$) |
|---|---|---|
| **Control –ve** | 72.33±3.$51^{d}$ | 14.47±0.$70^{d}$ |
| **Control +ve** | 133.0±4.$00^{a}$ | 26.60±0.$80^{a}$ |
| ***J. phoenicea* 200 mg** | 108.0±2.$00^{b}$ | 21.60±0.$40^{b}$ |
| ***J. phoenicea* 400 mg** | 86.0±3.$00^{c}$ | 17.20±0.$60^{c}$ |
| ***C. azarolus* 200 mg** | 108.0 ±3.$00^{b}$ | 21.60±0.$60^{b}$ |
| ***C. azarolus* 400 mg** | 87.33±2.$52^{c}$ | 17.47±0.$50^{c}$ |

**Atsignificance level of ($P < 0.05$), the letters in the same column with different letters are statistically significant.**

## 9. Serum tumor necrosis factor -α (TNF- α)

Table 10 shows that the average values of serum TNF- α were higher in the unhealthy group than in the standard control rats. It was lower significantly in all treatment groups than the +ve control. The most effective outcomes were noted with *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW).

**Table (10): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on serum tumor necrosis factor -α (TNF- α) in diabetic rats (M±SD)**

| Parameters / Groups | TNF-α (pg $ml^{-1}$) |
|---|---|
| **Control –ve** | 21.47±1. 72[e] |
| **Control +ve** | 60.85±2.32[a] |
| ***J. phoenicea* 200 mg** | 40.25±1.05[c] |
| ***J. phoenicea* 400 mg** | 26.57±1.60[d] |
| ***C. azarolus* 200 mg** | 44.03±1.74[b] |
| ***C. azarolus* 400 mg** | 27.42±2.73[d] |

**At level of (*P* < 0.05), the same letters in the column with different letters are significant statistically.**

## 10. Antioxidant enzymes (GSH, SOD), malondialdehyde (MDA) in pancreas tissue.

Table 11 illustrates that the activities of pancreatic reduced glutathione (GSH) and superoxide dismutase (SOD) were lowered significantly in the +ve positive control group than the –ve one. At the same time, they rose in other groups compared with the +ve controlrats. The best findings in GSH and SOD were noticed in groups of *J. phoenicea* and *C. azarolus* (400 mg $kg^{-1}$ BW). The average value of MDA was significantly higher in the +ve control than in the - ve one; however, their values were significantly lower in other groups than in the + ve control. The best finding was got in *J. phoenicea* (400 mg $kg^{-1}$ BW).

**Table (11): Effect of *Juniperus phoenicea* and *Crataegus azarolus* alcohol extracts on Antioxidant enzymes (GSH, SOD), malondialdehyde (MDA) in diabetic rats (M±SD)**

**At significance level of ($P < 0.05$), the letters in the same column with different**

| ` Parameters<br>Groups | GSH<br>(mmol $g^{-1}$) | SOD<br>(U $g^{-1}$) | MDA<br>(nmol $g^{-1}$) |
|---|---|---|---|
| **Control –ve** | 2.06± 0.16$^{a}$ | 133.38± 3.19$^{a}$ | 6.12±1.21$^{d}$ |
| **Control +ve** | 0.51± 0.03$^{c}$ | 60.75 ± 1.98$^{d}$ | 27.59±2.71$^{a}$ |
| ***J. phoenicea* 200 mg** | 1.14± 0.17$^{b}$ | 92.58± 2.86$^{c}$ | 15.06±1.15$^{b}$ |
| ***J. phoenicea* 400 mg** | 1.89± 0.23$^{a}$ | 127.30± 3.20$^{b}$ | 8.19±2.05$^{cd}$ |
| ***C. azarolus* 200 mg** | 1.06±0.17$^{b}$ | 87.55± 3.25$^{c}$ | 15.77±1.39$^{b}$ |
| ***C. azarolus* 400 mg** | 1.85±0.23$^{a}$ | 126.33± 3. 91$^{b}$ | 10.0±2.0$^{c}$ |

**letters are statistically significant.**

## Discussion

Diabetes is intimately linked to oxidative stress, which can harm both islet β cells and insulin signalling pathways, possibly leading to catastrophic effects such as cardiovascular disease and nephropathy **(Zhang *et al.*, 2019)**. According to recent research, several medicinal herbs are recognized as valuable bases for conventional medications , and many contemporary medications are derived from these plants **(Dar *et al.*, 2019)**.Though , the use of herbs in remedy is mostly relied on their physiologically active chemicals, which offer a diversity of therapeutic capabilities such as antioxidant, anti-diabetic, anti-inflammatory, and anti-hypercholesterolemic properties. **(Neeta *et al.*, 2015)**. As a consequence, many researches have been found to evaluate plant secrets. Thus, the current research was designed to assess the possible anti-diabetic benefits of alcohol extract of *J. phoenicea* and *C. azarolus*. **Özcan *et al.* (2005)**

found that the chemical composition of hawthorn (*Crataegus* spp.) was 34.02 kcal $g^{-1}$ energy, 2.48% protein, 0.87% oil, 4.67% cellulose, and 2.28% ash. **Chen *et al*. (2019)** revealed that protein level was 0.83% for *C. azarolus* pulps (CAP) and 5.68% for seeds (CAS). The CAP had 82.35% of carbohydrate and and 52.86% neutral sugar level, respectively, that were more than those of the CAS; 64.93% of carbohydrate and 45.25% of neutral sugar. **Zhang *et al*., (2022)** stated that the chemical composition of hawthorn (*C. azarolus*) was recorded as 7 mg $g^{-1}$ of protein, 2 mg $g^{-1}$ of fat, and 68.98% of water.

In this work, rats that STZ-induced diabetic exhibited a decline in BWG%, and FER when than the–ve group. The current results were accorded with **(Suryanarayana *et al*., 2005)** and **(Gupta *et al*., 2012)** where they stated that STZ-induced diabetic rats displayed weight loss than rats not treated with STZ. **Kota *et al*. (2012)** stated that an relationship between hyperglycemia and loss of body weight in diabetic rats, diabetes-induced weight loss, as well as the body's inability to retain or utilize glucose, promote hunger and weight loss. Body weight loss in STZ diabetic rats is ascribed to an increment in blood glucose with insulin inhibition, a reduction in tissue proteins, and an increment in muscle wasting **(Zafar and Naqvi, 2010).** These obtained data were in accordance with **Yang and Hyung-Sub, (2018)** where they show that the significant loss in body weight in sSTZ-induced diabetic rats is attributable to relative or absolute insulin insufficiency or reduced protein creation in the tissues **(Sadri *et al*., 2017)**.

The findings of the ongoing work also accord with **Tebboub and Kechrid (2021) and Triki *et al*. (2022)** where they noticed that the group of individuals with diabetes displayed a noteworthy decline in body weight contrary to the healthy group. This outcome can be attributed to a disruption in their metabolic state, suggesting that the inability to utilize carbohydrates as a source of energy and the elevated breakdown of fat and protein mass may be the causes of weight loss. In this regard, **Gadewar et al. (2023)** discovered that significant weight loss is one of the most prominent aspects of STZ-induced diabetes, because of greater protein waste and the non-availability of glucose for energy use. The present results were supported by **Saswata *et al*. (2013)** proposed that the rise in body weight was gradually seen in STZ diabetic animals that treated with

the extract of *J. Phoenicea* leaves might be attributed to the preserved contents of glucose and insulin due to the antioxidant actions of the extract of *J. Phoenicea* leaves. **Keskes *et al*. (2014)** discovered that *J. Phoenicea* leaves extract enhanced the feed intake and body weight in diabetic rats given *J. Phoenicea* leaves extract compared to diabetic untreated rats because of its potential to prevent angiogenesis in adipose tissues and diminish preadipocytevariation .

**Dall et al. (2016)** underlined that the streptozotocin (STZ) group lost body weight whereas the hawthorn leaf (*C. azarolus*) flavonoids group increased body weight since hawthorn leaf flavonoids had a preventive impact on diabetic cardiomyopathy rats to some extent. **Triki et al. (2022)** observed that *C. azarolus* improved body weight in diabetic rats. The considerable increment in animal body weight might be attributed to increased food intake and protein synthesis. As well, *C. Azarolus* has also been shown to be capable of reversing gluconeogenesis and controlling protein loss. **Kumar *et al*. (2012)** found a similar conclusion, indicating that streptozotocin injection resulted in a significant increase in plasma glucose and a drop in insulin level because STZ caused the death of β-cells in the islets of Langerhans, leading to in cell degranulation and a decrease in insulin production as suggested by **Zhang and Tan, (2002).** Our study goes along the same lines as **Sekkin *et al*. (2015**) who noticed that an injection for one time of STZ causes the advance of DM, which is featured by high blood glucose and reduced serum insulin levels. This happened due to STZ-induced islet cell damage, β cell death within 24 hours, and the activation of an inflammatory process that resulted in macrophage and lymphocyte infiltration. STZ-induced oxidative damage in rats is directly linked to chronic inflammatory disease, which may lead to tissue damage **Xu et al. (2014a).**

These conclusions are accorded with **El-Sawi et al. (2015)**, who evaluated the influences of *J. phoenicea* fruits and leaves on diabetic animals. The obtained data demonstrated that *J. phoenicea* extracts reduced blood glucose levels. Animal DM inductions caused injury to pancreatic tissues. This damage can cause histopathological changes in pancreatic islets, in addition to a rise in blood glucose as well a drop in insulin levels **(Wahba *et al*., 2016, Elkotby *et al*., 2018).** Extraction *of J. Phoenicea* leaf decreases fasting blood glucose concentration in a dose-

dependent method, most likely via boosting insulin production from remaining beta cells **(Karuppusamy and Thangaraj, 2012).** In accordance with the present findings, which were supported by **Al-Ahdab (2017)**, the J. *phoenicea* extract lowered blood glucose and rised insulin concentrations, normalized serum contents of liver enzymes and biochemical markers of kidney functions, and improved the lipid profile in STZ rats treated when comparing with untreated animals.

These data also are in accordance with **Goyal et al. (2016)**, who discovered that the leaf flavonoids of hawthorn significantly lowered blood glucose levels when compared to diabetic cardiomyopathy rats due to hawthorn leaf flavonoids' preventive impact. **Abu-Gharbieh and Shehab (2017)** reported that treating diabetic rats with the extraction of *C. azarolus* leaves resulted in a reduced baseline blood glucose concentration. According to **Abu-Gharbieh and Shehab (2017)**, oral administration of *C. azarolus* demonstrated strong antihyperglycemic influence and noticeable performance in glucose tolerance (OGTT), confirming the efficiency of C. azarolus extract as a hypoglycemic agent by postponing the ingestion of carbohydrates and reducing blood glucose concentration. The current study's results correspond with those of **Zafar et al. (2009)**; **Najla et al., (2012)**; and **Soliman, (2013)**, who indicated that STZ diabetes produces increases in amino transferases as well as a rise in blood ALP activity. The increased oxidative stress caused by STZ diabetes may be the reason for the hepatotoxicity that occurs when ALT and AST leak from liver cells **(Okechukwu *et al*. 2013)**. In this regard, **Ramesh *et al*. (2010)**and **Dewanjee *et al*. (2020)** stated that in hyperglycemia-related liver disorders, oxidative stress is critical. STZ-induced necrosis raises blood ALT and AST levels due to cytosol leak from the liver, and excessive contents of these enzymes imply possible liver injury and hepatotoxicity. These findings were in accordance with the results of **Makena et al. (2018)**, who found that ALT and AST levels were higher in the diabetic rats than the control rats. In Diabetes Mellitus, ALT and AST are linked to the transformation of amino acids into keto acids.

These results also were verified by **Yang *et al*. (2011)** who found that *J. phoenicea* berries have elevated plasma total protein and albumin levels indicating hepatoprotectiveactivity. Protein production stimulation

has been proposed as a hepatoprotective process that speeds the self-renewal and formation of liver cells. **Mistry *et al*., (2013)** stated that administration of *J. phoenicea* berries has significantly protected hepatocytes injury boosted by CCl4 through decreasing AST and ALT levels, which is a sign of the hepatic cell renewal process. However, a decrease in ALP levels with contemporaneous depletion shows that biliary function is stable. The significant reducing in blood liver enzymes level (ALT, AST, and ALP) in diabetic animals demonstrated the hepatoprotective activity of the extract of *J. Phoenicea* Leaves described in this work; this result was consistent with its polyphenols **(Salma *et al*., 2017)**. **Dessoky et al., (2020)** also found that gamma-irradiated rats that pre-treated the extraction of *J. phoenicea* leaves had a significant rise in total protein, albumin, and globulin concentrations and a significant decrease in liver enzymes and lipid profile indicators compared to healthy rats because *J. phoenicea* leaves could be a possible source of therapeutic antioxidants. This result was also supported by **Nasir et al. (2013)** who noted that *C. azarolus* methanolic extract administration stabilizes the endoplasmic reticulum, leading to a rise in total protein levels and protein production in the liver. Moreover, **Othman and Mustafa (2017)** observed that hawthorn dramatically lowers ALP levels while increasing SGOT and SGPT levels when compared to a high-triglyceride diet.

This finding was confirmed by **Mohammed *et al*. (2016)** and **Suanarunsawat *et al*. (2016)** who stated that the CK and LDH levels were significantly higher in diabetic animals because the integrity of cardiac tissues' cellular membranes may be disturbed. **Mandlem and Annapurn, (2017)** found that increased levels of serum CK and LDH in STZ diabetic animals may be due to their increased produce from cardiac necrotic tissues. As well, fibrosis and necrosis of cardiac muscle fibers, changes in oxidative stress, and cardiac biomarker indicators were noticed in diabetic animals and patients.

The results also accorded with those of **Cui et al. (2006)** and **Ali and Shapour (2013)** who showed that rats treated with hawthorn *(C. azarolus*) induced decreased cardiac enzymes (creatinine kinase and lactate dehydrogenase) suggesting that hawthorn may be moderating the harmful impact of Doxorubicin as a result of hawthorn's antioxidant scavenging potential.

According to **Xu et al. (2014 b)** and **Guo et al. (2021)**, STZ-induced diabetic nephritis group rats had higher levels of BUN and uric acid than the untreated and treated groups. Kidney disease progresses through modifying kidney hemodynamics, resulting in glomerulosclerosis, kidney failure, and proteinuria. With diabetic nephropathy, a nitrogen imbalance combined with decreased protein synthesis causes the production of non-protein nitrogenous substances such as creatinine and BUN. The untreated diabetic group showed significantly higher blood levels of BUN, UA, and Cr when than normal control group .These data is in accordance with **Ana *et al*. (2009)** who signified that enhanced kidney activities are indications of kidney disorder in diabetic patients, but after therapies with extract of *J. Phoenicea* leaves, a significant decrease was noticed in comparison to the + ve group, which may be due to the antioxidant activities. These obtained results were also accorded with **Mall *et al*. (2016)** where they stated that the antioxidant and hypoglycemic of *J. Phoenicea* leaves extract reduced oxidative stress, leading to reduce the serum content of BUN, UA, and Cr.

This conclusion is reinforced by **Qin *et al*. (2019)** who observed that Hawthorn (Crataegus azarolus) significantly lowered blood urea nitrogen in DKD rats since hawthorne may prevent kidney damage and improve kidney function. This might be done by modulating p38MAPK activation and reducing oxidative stress damage.

The results are also reinforced by **Kusunoki *et al*. (2000)** who described that hyperlipidemia is a result of elevated lipolysis, which results in an increase in free fatty acids due to s and glycerol, which the liver uses to create acetyl Co A. Because of the rise in intestine acyl coenzyme A, acetyl Co A is a precursor for cholesterol formation in STZ-induced diabetic rats. **Zhang et al. (2016)** showed that diabetic rats had considerably higher triglycerides, cholesterol, VLDL-C, and LDL-C, and lower HDL-C. **Pirmoghani et al. (2019)** noted that the contents of TG and cholesterol in the diabetic group rose when comparing with the - ve control. Furthermore, these data are in the line with those of **Chen *et al*. (2020)** who found that generally diabetes is related to irregular lipid metabolism, that is a great risk reason for diabetic cardiovascular disease. Elevated concentrations of cholesterol and triglycerides were undoubtedly caused by changes in lipid metabolism under diabetes

circumstances, which eventually led to suppression of the activity of lipoprotein lipase due to insulin insufficiency and insulin resistance. These results were well-matched with **Abbas and Ali, (2021)** found that there were a significant increase in triglyceride (TG), cholesterol, (LDL), combined with significant decline in high density lipoprotein (HDL) in diabetic groups than the control groups. In this regard, **Gadewar *et al*., (2023)** noticed an increment in the level of serum total cholesterol and triglycerides with a reduction in the HDL level that was noticed in STZ-induced diabetic groups.

The results in agreement with those observed by **Ono et al. (2006)** revealed that treatment by *J. Phoenicea* leaves extract may inhibit pancreatic lipase activity and inhibit or delay lipid absorption. **Saswata *et al*. (2013)** informed that treating of diabetic animals with the extraction of *J. Phoenicea* leaves showed extremely improved consequences; there was a significance in enhancement TC, TG, LDL-C, and HDL-C concentrations than the untreated diabetic rats. **Henda *et al*. (2014)** found that the inhibitive powers of *J. phoenicea* extract contrary to lipase activity may be entirely coincidental with their total phenolic components.

The present findings were verified by **Jia *et al*. (2011)** who reported a significant decrease in the TG, TC, LDL-C, and VLDL-C levels of the group treated with the extraction of ethanolic leaves of *C. azarolus*. As well, the serum level of HDL-C was greater than its counterpart in the control rats decreasing the "Atherogenic Index" and the ratios of LDL-C: HDL-C by enhancing fatty acid absorption and oxidation while blocking fatty acid synthesis. **Pirmoghani *et al*. (2019)** showed that *C. azarolus* extract lowered LDL and cholesterol and rised HDL in diabetic groups.

Numerous studies have demonstrated that an increase in TNF- is connected with diabetes and insulin resistance occurrence in type 2 diabetic individuals, either directly or indirectly **(Navarro and Mora, 2006)** and **(Alexandraki *et al*., 2006)**.

The findings are accorded with th **Mardiaha et al., (2015)**, where they demonstrated that diabetic animals had the maximum level of TNF-α. This was related to the inflammatory response of TNF-α, which resulted in β-cell death. A high concentration of inflammatory cells may

cause β-cell apoptosis, which may result in a decrease in the cell numbers of insulin-producing or a fall in insulin levels. **Elsawy and Emara (2016)** found that elevated MDA and TNF-α levels in diabetes mellitus were caused by increased oxidative stress or a reduction in antioxidant defence mechanisms. According to **Zhao et al. (2016)**, *J. sabina* considerably reduced the concentrations of TNF-α, hence *J. sabina* handled rats exhibited a significant decrease in arthritic scoring than the control group. The current results were supported by **Mostafa et al. (2018)** who noticed that *Crataegus aronia* reduced glucose concentration, serum lipids, and significantly reduced tumour necrosis factor alpha. (TNFα).

The present study's results are also in the line with those of**Mahboob et al., (2005)**, **Senthilkumar et al., (2006)**, and **Gadewar et al., (2023)**, where they discovered that hyperglycemia related to diabetes produces free radicals via glucose breakdown, non-enzymatic glycation of protein, or resulting oxidative degradation, and that these free radicals induce cellular membrane destruction and lipid peroxidation in diabetes. Alterations in lipid peroxidation in diabetic rats revealed a reduction in numerous antioxidant enzymes activities, including superoxide dismutase, which have a significant function in removing the toxic compounds created during the incomplete oxidation process. Our findings suggest that hyperglycemia raises pancreatic MDA while decreasing SOD and GSH activity. These influences might be attributed to hyperglycemia's increased oxidative stress via the overproduction of ROS (**Hussein and Abu-Zinadah, 2010**). **Molehin et al. (2018)** stated that the increment in levels of ROS in diabetic animals resulted in a decline in SOD and GSH levels and an increase in MDA levels, confirming that STZ generated oxidative stress. The results were agreed with those of **Elbe *et al*., (2015)** and **Lo *et al*., (2017)** showed that a lowered catalase level and rised level of MDA in diabetic rats. The lowering in these antioxidants activity can cause an increment in hydrogen peroxide and superoxide anion in biological systems, consequently create hydroxyl radicals that result in lipid peroxidation. **Al-Attar and Alsalmi (2019)** found a decline in SOD and GSH, and significant enhancement in MDA value in diabetic rats.

*Juniperus Phoenicea* leaves extract increases pancreatic tissue MDA, GSH, and SOD levels in hyperglycemic rats. *J. Phoenicea* leaves

extract decreases oxidative stress by lowering peroxide production and enhancing antioxidant enzyme activity, according to **Barrero et al. (2004)**. **Al-Ahdab (2017)** demonstrated that J. *phoenicea* extract decreased MDA and elevated SOD and GSH concentrations in STZ diabetic rats in comparison with untreated diabetic rats. According to the current findings, which were validated by **Ayala et al., (2014)**, treatment with hawthorn leaf flavonoids boosted SOD activity and dramatically reduced the level of diabetic cardiomyopathy. Hawthorn (*C. azarolus*) leaf flavonoids may preserve diabetic cardiomyopathy rats by reducing ROS production and alleviating oxidative stress damage by antioxidant interventions. **Triki et al., (2022)** showed that treating with *C. Azarolus* resulted in a considerable decrease in the generation of malondialdehyde, an increase in GSH content, and an enhancement in SOD activity in zinc deficiency diabetic rats.

## Conclusion

Among the most crucial non-infectious diseases to affect the world in the current millennium is diabetes mellitus. It is among the most severe, long-lasting disorders of protein, lipid, and carbohydrate metabolism. Despite significant medical advancements, there is still no fully effective medication to treat diabetes mellitus. More and more research is showing that a variety of nutritious natural foods, medicinal herbs, and dietary additions have the possibility to be effective complementary therapies for the treating of type 2 diabetes and its consequences. In the current investigation, diabetic male rats were used to test the hypoglycemic effects of alcohol extracts from *Juniperus Phoenicea* and *Crataegus azarolus* leaves. Considering the outcomes of the current experiments, it can be concluded that this study demonstrates that alcoholic extracts of *J. Phoenicea* and *C. azarolus* leaves reduced the physiological alterations caused by STZ in the experimental groups. To determine the ideal dosages of such extracts as hypoglycemic drugs and to clarify their modes of action, more physiological, pharmacological, and biochemical researches are required

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# تأثير المستخلصات الكحولية لنبات العرعر الفينيقي و الزعرور الشائع على مرض السكر المحدث بالستربتوزوتوسين في فئران التجارب

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## المستخلص العربي

مرض السكري عبارة عن مجموعة غير متجانسة من الاضطرابات التي تتميز بنقص إفراز الأنسولين أو وجود حساسية للأنسولين. لذلك، صممت الدراسة الحالية لمعرفة التأثير المضاد للمستخلصات الكحولية لأوراق العرعر الفينيقي والزعرور الشائع علي ارتفاع سكر الدم في الفئران المصابة بمرض السكري التي يسببها الستربتوزوتوسين. تم استخدام 30 فأر من سلالة الألبينو تتراوح أوزانهم بين (200 ± 10 جم). وتم تقسيم الفئران إلى 6 مجموعات متساوية مجموعة (1) تركت أحد المجموعات كمجموعة ضابطه سالبه، المجموعة (2) تم تغذيتها علي الغذاء القياسي كمجموعة ضابطه موجبة، (3 و 4) تمت معالجتهم بمستخلص العرعر الفينيقي (200 و 400 مجم لكل كجم من وزن الجسم) على التوالي ، (5 و 6) تمت معالجتهم بمستخلص الزعرور الشائع (200 و 400 مجم لكل كجم من وزن الجسم) على التوالي لمدة أربعة أسابيع . في نهاية فترة التجربة تم حساب التقييم البيولوجي. وتم تقدير الجلوكوز والأنسولين، وظائف الكبد، إنزيمات القلب، وظائف الكلي، دهون الدم وعامل النخر في السيرم .وتم تقدير بعض العوامل المؤكسدة ومضادات الأكسدة في أنسجة البنكرياس .كما تم تحليل التركيب الكميائي للأعشاب. أظهرت النتائج أن المستخلصات الكحولية لأوراق العرعر الفينيقي و الزعرور الشائع أدت إلي زيادة في التقييم البيولوجي وتحسين في وظائف الكبد، ووظائف الكلى، وتحسن مستوى الدهون، وانخفاض نسبة الجلوكوز في الدم، وإنزيم القلب، و MDA ولكن زيادة في مستويات الأنسولين و GSH و SOD مقارنة بالفئران المصابة بمرض السكري وغير المعالجة. لذلك أوصت الدراسة بأن تناول مستخلص أوراق العرعر الفينيقي والزعرور الشائع يمكن أن تقلل من مستوي سكر الدم والمضاعفات الناتجة عن ارتفاع سكر الدم.

**الكلمات المفتاحية:** العرعر الفينيقي، الزعرور الشائع، الستربتوزوتوسين، سكر الدم،الأنزيمات المضادة للأكسدة.