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Evaluation the Influence of Ferula Roots on Biological Alterations in Diabetic Rats

تقييم تأثير جذور شرش الزلوع على التغيرات البيولوجية
في الفئران المصابة بالسكري

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Abstract

Present research sought to determine how Ferula roots, powdered and its extract, affected rats suffering from diabetes, induced by using alloxan. A total of thirty-six male rats ranging around 140 and 150 g had been split into two main groups of six each, the latter split into 5 groups every 6 rats also at random. Main group (I): Served as negative control group, and Group (II) diabetes: One intra-cage injection of the diabetes-inducing drug alloxan (150 mg/kg b.wt.) was given. These didactic rats were Group2, the group serving as the positive control, that just given the basal diet; group3-8, which received the basal diet plus 2, 4% Ferula roots powder, and 250 & 500mg/kg b.w. Ferula roots extract, respectively for a duration of 4 weeks. Samples were examined for biochemical markers being glucose ranges, liver enzymes, renal function, and lipid fractions; 28 days after the experiment ended. The results of the collected data confirmed that, in controlling the control positive group, the examined plants ($P \leq 0.05$) dropped serum sugar, LDL-c, and raised HDL-c. Additionally, the studied plant roots enhanced kidney and liver functions. According to the findings, the 500 mg/kg extract of Ferula roots showed a larger enhancement and may also reduce the negative side-effects and unwanted changes to rats with diabetes.

Key words: Rats, plant roots, blood glucose, chemical biomarkers.

1. INTRODUCTION

Diabetes is a frequent long-term condition that requires regular observation for the manager of blood sugar degrees as properly as different risk factors that may also additionally be present (1). Permanent excessive blood sugar ranges are an indicator of diabetes, a continual metabolic disease. It may also be brought on by means of peripheral insulin motion resistance, inadequate insulin release, or combination (2). Individuals with diabetes have a usual mortality hazard that is at least double that of their non-diabetic contemporaries (3). The hazard of long-term consequences is greater in any variety of hyperglycemia. These typically appear over numerous years (10–20), on the other hand in these who have not been recognized yet, they may want to be the preliminary symptoms. The important effects over time are related to blood vessel injury. Diabetes doubles the chance of coronary heart attack or stroke, and coronary heart failure debts for nearly 75% of diabetes mortality (4). The WHO estimated that 365 million human beings global would have troubles with diabetes by way of 2030, with men and girls between a while of forty-five and sixty-four seeing the best extend in the variety of cases. Therefore, it is crucial that these charges be lowered (5).

Medicinal plants are extensively utilized in the therapy and prevention of age-related diseases, cardiovascular conditions, diabetes mellitus, and related problems due to the fact of their biological characteristics (6). The genus *Ferula* consists of more than 70 species, such as *Ferula hermonis*, additionally acknowledged as Shirsh El Zallouh roots. *Ferula* grows in Lebanon's Hermon Mountain and has lengthy been recognized for its aphrodisiac properties. Lebanese regular medicinal drug values many *Ferula* in the remedy of pores and skin diseases, gastrointestinal problems, fever, dysentery, aphrodisiacs, and neurological prerequisites such as hysterias (7). Among the several substances current in *Ferula* are sesquiterpene esters, such as ferritin, tenuferidine, and ferritinol, which are recognized for their estrogenic characteristics (8). The pharmacological effects of *Ferula* are attributed to a range of bioactive materials that are predominantly produced through the plant's roots, leaves, and rhizomes (9). Due to its

composition and greater biological benefits past its sexual properties, Ferula is presently gaining popularity. Given that Ferula has been utilized in combination with diabetes treatment and lowering weight in the past, it makes experience that it affects the treatment of diabetes mellitus (10). However, prior to this, different species of Ferula had been quickly examined primarily based only on their hypoglycemic activity (11). In rats with chronic hyperglycemia-induced difficulties, ferula root extract and its active element isolates drastically multiplied glucose levels except inflicting use-limiting damaging responses (12). Because ferula roots decrease serum LDL, they may additionally assist diabetic dyslipidemia. Moreover, the root of this plant can end the improvement of hyperglycemia in the streptozotocin model of kind 1 diabetes, in spite of its reasonable hypoglycemic impact (13).

Therefore, this study examined the hypoglycemic consequences of Ferula roots in each ordinary and alloxan-induced hyperglycemic rats to discover a possible adjuvant therapy for diabetic mullites.

2. Materials and Methods

2.1. Materials

2.1.1. Plant materials

The Ferula roots were purchased from herbalists in Cairo City, Cairo Governorate in April 2022.

2.1.2. Rats

Thirty-six male albino rats ranging approximately (140-150 g) were supplied by the Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

2.1.3. The chemical and kits

Alloxan, also known as 5, 5-dihydroxyl pyrimidine-2, 4, 6-trione, is a naturally occurring material, a cytotoxic glucose analogue, a urea-derived substance, and a carcinogen. The kits for glucose, lipid fraction, liver and renal biomarkers used in this investigation all chemicals were obtained from El-Nasr Pharmaceutical Chemicals, El-America, Cairo, Egypt.

2.2. Methods

2.2.1. The preparation of Ferula roots powder and its extract

The Ferula roots had been ground into a powder via the use of the German-made Broun high-speed blender, and the powder used to be then sealed in black glass bottles and saved in a deep freezer at -18 °C till wished for extra processing, as noted in (14).

In a glass container, 1 g of powdered Ferula roots dissolved in 20 milliliters of distilled water for forty-eight hours at room temperature, stirring occasionally. Next, the extract filtered through three layers of filter paper to make sure it is free of damaged fibers. Finally, the filtrate placed in Petri dishes and dried it at 50 °C for a few hours earlier than storing it at 4 °C till needed (15).

2.2.2. Basal diet

The basal diet that was created using the formula provided by (16) is as follows: Protein 10%, cellulose 5%, minerals, 10% corn oil and vitamin blend, 1%, and maize starch 69.5%. Also, (17) advised prepared vitamin mixes composition that was utilized, while (18) prepared the salt mix component that was used.

2.2.3. Inducing damage for pancreatic beta cells in rats

According to (19) an injection of alloxan (150 mg per kilogram of body weight) caused chronic damage to pancreatic beta cells in normal healthy rats. One week after receiving alloxan injections, fasting blood samples had been taken from rats with diabetes to check their fasting serum glucose levels, which have been 200 mg/dl (20).

2.2.4. Experimental animals and groups

The Research Ethics Committee of the Faculty of Home Economics, Menoufia University accepted research No. #20-SREC-04-2022.

Thirty-six mature male albino rats of the "Sprague Dawley" species, weighing between 140 and 150g at 10 weeks of age, were utilized in the present study. The rats were given a casein-based basal diet for seven days to help them adjust. Following this period of adaptation, the rats were split up into 6 groups, with 6 rats in each group: **Group (1):** Rats have been given a basal diet, serving as a control (-) group. **Group (2):** Hyperglycemic rats have been given a basal diet,

serving as control positive group. **Group (3):** Hyperglycemic rats have been given a basal diet and treated with 2% Ferula roots powder of the diet's weight. **Group (4):** Hyperglycemic rats have been given a basal diet and treated with 4% Ferula roots powder of the diet's weight. **Group (5):** Hyperglycemic rats have been given a basal diet and treated with 250 mg/kg Ferula roots extract. **Group (6):** Hyperglycemic rats have been given a basal diet and treated with 500 mg/kg Ferula roots extract.

2.2.5. Collection of blood

Rats were slaughtered at the finish of the experiment following a 12-hour fast. Dry, sterile centrifuge tubes have been used to gather blood samples from a portal vein. To get the serum, the samples have been centrifuged at 3000 rpm for 10 minutes. The serum was once saved at -20°C for analysis according to the method of (٢١).

2.2.6. Biochemical tests

Glucose was estimated using procedure (22). Triglycerides were quantified and carried out using the techniques mentioned in (23). Total cholesterol was estimated with the (24) technique. The levels of HDL-C levels were calculated with the technique of (25). The following equation was used to determine both VLDL-c and LDL-c as follows: VLDL-c = (Triglycerides/5).

$$\text{LDL-C} = (\text{T. C.} - \text{HDL-C}) - \text{VLDL-C} \quad (2٦).$$

Alkaline phosphatase (ALP) concentration was estimated by using the method of (2٧), alanine amino transferase (ALT) levels estimated by using the method of (2٨), and aspartate amino transferase (AST) levels estimated by using the method of (٢٩). While serum creatinine, urea, and uric acid were calculated by using the methods of (3٠, 3١ and, 3٢), respectively. Insulin level (mIU/L) was also determined according to method of (33).

2.2.7. Statistic evaluation

The data were analyzed using a completely randomized factorial design (34) when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

3. Results and Discussion

The information in table (1) explains that the Ferula roots powder and its extract influenced the sugar and insulin ranges of hyperglycemic rats. The received data confirmed a substantial difference in the sugar degrees between two control groups, with the negative control group recording the lowest value. The corresponding averages have been 296.25 and 97.35 mg/dl.

For the groups that had been given 2% Ferula powder confirmed the highest value of glucose levels, whilst the G6 500mg/kg Ferula extract group showed the least value with substantial difference. The corresponding averages for powder and extract were 156.00 and 107.10 mg/dl for G3 and G6, respectively.

As for insulin, there is a substantial difference in the insulin degrees between two control groups, with the negative control group recording the highest value. The corresponding averages were 35.08 and 17.54 mIU/L for G1 and G2, respectively.

Regarding the diabetic groups, data showed that the groups that had been given 2% Ferula powder confirmed the lowest value of insulin levels, whilst the G6 500mg/kg Ferula extract group showed the highest value with substantial difference. The corresponding averages have been 31.15 and 22.19 mIU/L. These results corroborated that of (35), discovered that Ferula extracts apparently showed a more potent pattern of amelioration of diabetes mellitus. This could be explained by the most active chemicals' simultaneous pattern of enhancement with other extractable substances. These outcomes concur with those of (36), who confirmed that reduced blood glucose and increased serum insulin in alloxan-induced diabetic rats. Ferula roots also showed fat lowering, anti-obesity, effects in type 2 diabetic rats.

Table (1) Influence of Ferula roots powder and its extract on glucose and insulin range of hyperglycemic rats

Parameters Groups	Glucose mg/dl	Insulin mIU/L
G ₁ C (-)	97.35 ^f ±3.07	35.08 ^a ±1.34
G ₂ C (+)	296.25 ^a ±4.26	17.54 ^f ±1.02
G ₃ (2% Ferula roots powder)	156.00 ^b ±3.34	22.19 ^e ±1.15
G ₄ (4% Ferula roots powder)	142.45 ^c ±3.42	25.28 ^d ±1.37
G ₅ (250 mg/kg Ferula roots extract)	118.75 ^d ±3.35	28.32 ^c ±1.34
G ₆ (500 mg/kg Ferula roots extract)	107.10 ^e ±3.23	31.15 ^b ±1.46
LSD (P≤ 0.05)	4.152	1.035

Each value represents the mean ± SD of six replicates. Means in the same column with different letter are significantly different (P<0.05).

The data provided in table (2) illustrates how Ferula roots powder and its extract affected the ALP, AST, and ALT ranges in the livers of diabetic rats. The data accrued confirmed that the group with a control positive had the biggest value of ALT ranges, whilst group with negative control had the least value, with major variations. The corresponding suggested amounts were 129.75 and 52.34, U/L. With major variations, the 500 mg/kg Ferula extract recorded the lowest value of ALT ranges for the treatment groups, whereas the 2% Ferula powder group recorded the maximum value, which were 103.00 and 77.87 U/L on average respectively.

In the instance of serum AST, it was once established that the group with control positive had the higher value of AST enzyme ranges, whereas the group with control negative had the least value, with considerable variations. The common averages are respectively 264.75 and 122.50 U/L. The 2% Ferula powder group had the biggest value of

AST ranges for the treated groups, whereas the 500 mg/kg Ferula extract group had the least value, with considerable variations, that were 171.00 and 149.70 U/L on average, respectively.

Additionally, the data showed that the group with control positive had the most elevated ALP enzyme, whereas the negative control group had the least amount, with statistically significant variations, the corresponding mean values were 270.00 and 134.55 U/L. The 2% Ferula powder recorded the greatest amount of ALP concentrations for the treatment groups, whereas the 500 mg/kg Ferula extract group recorded a smaller value with statistically significant variations, the corresponding average that 187.80 and 146.56 U/L. These findings corroborated the observations of (37) who claimed that **the** Ferula roots can prevent carbon tetra chloride (CCl₄) induced oxidative damage in rat liver. It decreased lipid oxidation and restored the hepatic antioxidant defense system as shown by the elevated activity of oxidative enzymes like super oxide dismutase (SOD) and glutathione (GPx). Ferula extract could provide protection against CCl₄ induced hepatic injury, which supports the traditional use of this plant to treat liver damage.

Additionally, (38) observed that when ferula was orally taken instead of the CCl₄ group, the synthesis of 8-OHdG in liver DNA was dramatically reduced, suggesting that Ferula could prevent CCl₄ induced DNA damage. Administration of Ferula increased the roles and purposes of natural antioxidants, SOD and GPx, which indicates that the effects of Ferula might be due to its antioxidant properties.

Moreover, the obtained results of (39) indicated that the lowest ALT, AST, and ALP liver enzymes of treated groups (hepatic groups) recorded for 5.0% plant roots with significant differences. 5% of plant roots recorded the best levels for hepatoprotective effects.

Table (2) Influence of Ferula roots powder and its extract on liver enzymes of diabetic rats

ALT=Alanine aminotransferase. AST= Aspartate aminotransferase. ALP=Alkaline phosphatase. Each value represents the mean \pm SD of six replicates. Means in the same column with different letter are significantly different ($P<0.05$).

The influences of Ferula roots powder and its extract on ranges of total cholesterol (TC) and triglyceride (TG) in hyperglycemic rats were demonstrated through the data in table (3). The obtained outcomes confirmed that, with considerable differences, the group with control positive had the biggest value of cholesterol ranges whilst the group with control negative had the least. Relative suggested average has been 188.15 and 84.00 mg/dl. For the groups receiving treatment, 2% Ferula powder recorded the greatest value of serum cholesterol levels, whilst 500 mg/kg Ferula extract group observed the least with statistically considerable variations. The relative suggested values had been 150.25

Parameters Groups	ALT U/L	AST U/L	ALP U/L
G ₁ C (-)	52.34 ^f \pm 1.10	122.20 ^e \pm 2.120	134.55 ^e \pm 1.80
G ₂ C (+)	129.75 ^a \pm 2.60	264.75 ^a \pm 3.30	270.00 ^a \pm 3.80
G ₃ (2% Ferula roots powder)	103.00 ^b \pm 2.30	171.00 ^b \pm 2.40	187.80 ^b \pm 2.10
G ₄ (4% Ferula roots powder)	92.34 ^c \pm 1.20	162.25 ^c \pm 2.70	163.75 ^c \pm 2.40
G ₅ (250 mg/kg Ferula roots)	85.90 ^d \pm 1.50	151.57 ^d \pm 2.60	161.50 ^c \pm 2.50
G ₆ (500 mg/kg Ferula roots)	77.87 ^e \pm 1.40	149.70 ^d \pm 2.50	146.65 ^d \pm 2.30
LSD ($P \leq 0.05$)	2.314	2.415	2.503

and 95.35 mg/dl.

In relation to triglycerides, it was once evident that the group with control positive appeared the biggest range, but group with control negative had the smallest value, with statistically considerable variations. The relative averages had been 165.75 and 73.33 mg/dl. The 2% Ferula powder recorded the greatest value of blood triglyceride ranges for treated groups, whereas the 500 mg/kg Ferula extract group recorded a smaller value with statistically considerable variations. The relative averages had been 129.65 and 88.59 mg/dl. These results corroborated that of (40), maintained that anti-hypolipidemic activities of *Ferula* oleo-gum-resin extract are probably related to its antioxidant activity. Phenolic, flavonoid compounds like ferulic acid, umbellifer one, and quercetin may play an important role in its mechanism of action.

Furthermore, in contrast to the group of control (+), diabetic rats treated unique plants had lower ranges of lipid fractions that is TC, and TG (41).

Table (3) Influence of Ferula roots powder and its extract on serum triglycerides, and total cholesterol of hyperglycemic rats

Parameters Groups	Total cholesterol mg/dl	Triglycerides mg/dl
G ₁ C (-)	84.00 ^f ±1.31	73.33 ^f ±1.25
G ₂ C (+)	188.15 ^a ±1.82	165.75 ^a ±1.71
G ₃ (2% Ferula roots powder)	150.25 ^b ±1.52	129.65 ^b ±1.41
G ₄ (4% Ferula roots powder)	132.65 ^c ±1.40	105.74 ^c ±1.37
G ₅ (250 mg/kg Ferula roots extract)	127.40 ^d ±1.64	94.75 ^d ±1.50
G ₆ (500 mg/kg Ferula roots extract)	95.35 ^e ±1.60	88.59 ^e ±1.31
LSD (P≤ 0.05)	2.458	2.170

TC = Total cholesterol. TG= Triglycerides Each value represents the mean ± SD of six replicates. Means in the same column with different letter are significantly different ($P < 0.05$).

The data provided in table (4) demonstrate how Ferula roots powder and its extract influence the ranges of the lipids fraction that is HDL-c, LDL-c, and VLDL-c in the rats suffering from diabetes. It is evident that the group with control negative had the maximum ranges of HDL-c whilst the group with control positive had smallest levels, at variations that had been statistically considerable, the average reading was 48.23 and 23.09 mg/dl, respectively. As contrasted with that, the 500 mg/kg Ferula extract group had the maximum ranges of HDL-c amongst the treatment groups, whilst the 2% Ferula powder group had smallest ranges with statistically considerable variations. The corresponding mean values had been 41.80 and 27.44 mg/dl.

Additionally, the findings confirmed that the group with control positive had the maximum LDL-c values, whereas the group with control negative had the lowest value, with statistically considerable variations. The relative average had been 131.91 and 21.60 mg/dl. For the groups receiving treatment, 2% Ferula roots powder had the maximum value of serum LDL-c levels, whilst 500 mg/kg Ferula root extract had the least value at statistically considerable variations. The corresponding averages have been 96.88 and 35.83 mg/dl.

With respect to VLDL-c, the group with control positive had the maximum value while group with control negative had the least value; these differences were significant. There were two different mean values: 33.15 and 14.67 mg/dl. For the groups receiving treatment, 2% Ferula roots powder had the maximum value of VLDL-c levels, but 500 mg/kg Ferula root extract had the least value with statistically significant variations, the average reading was 25.93 and 17.72 mg/dl, respectively. These findings corroborated what was once observed by way of (42) recent reports, they found that *F. assa-foetida* has remarkable antioxidant, and anti-hyperlipidemia effects. The biological effect of this plant is due to the presence of phenols and flavonoids in its extract, and therefore, it will be promising to investigate this assumption.

Table (4): Effect of Ferula roots powder and its extract on lipid profile of diabetic rats

Parameters Groups	HDL-c mg/dl	LDL-c mg/dl	VLDL-c mg/dl
G ₁ C (-)	48.23 ^a ±0.00	21.10 ^f ±0.12	14.67 ^f ±0.20
G ₂ C (+)	23.09 ^e ±0.20	131.91 ^a ±1.63	33.10 ^a ±0.51
G ₃ (2% Ferula roots powder)	27.44 ^d ±0.33	96.88 ^b ±1.32	20.93 ^b ±0.40
G ₄ (4% Ferula roots powder)	30.00 ^c ±0.42	76.00 ^c ±1.27	21.15 ^c ±0.30
G ₅ (250 mg/kg Ferula roots extract)	37.89 ^c ±0.01	70.06 ^d ±1.50	18.95 ^d ±0.40
G ₆ (500 mg/kg Ferula roots extract)	41.80 ^b ±0.04	35.83 ^e ±1.41	17.72 ^e ±0.33
LSD (P≤0.05)	2.260	2.615	1.115

LDL-C=Low-density lipoprotein. VLDL-C. Very low-density lipoprotein. HDL-C= High-density lipoprotein. Each value represents the mean ± SD of six replicates. Means in the same column with different letter are significantly different (P<0.05).

The information displayed in table (5) illustrates the influence of bitter wood powder and nettle roots on the ranges of renal biomarkers in hyperglycemic rats. It is evident that the group with control positive had the most elevated urea ranges, whereas the group with control negative had the least amount, at variations that have been statistically considerable. The relative mean values were 48.10 and 21.70 mg/dl. The 2% group of Ferula roots powder had the most elevated urea ranges amongst hyperglycemic groups, whilst the 500mg/kg Ferula root extract group had the least amount with variations that have statistically considerable. The relative mean values have been 42.54 and 30.58 mg/dl.

The information additionally observed that, with statistically significant variations, the effective group with control positive had the

greatest amount of uric acid ranges, and the group with control negative had the least amount, that were ٦.٧٣ and ٣.٣٦ mg/dl on average, respectively. On the different hand, 2% Ferula roots powder had the maximum percentage of blood uric acid ranges in the treated groups, whilst 500mg/kg Ferula roots extract had the smallest amount with statistically significant variations, which were 5.80 and 4.33 mg/dl on average, respectively.

In the instance of creatinine, the group with control positive had the greatest amount observed, whereas group with control negative had the smallest reading with significant ($P \leq 0.05$) variations. The relative mean values have been 1.11 and 0.50 mg/dl. In contrast, the 500mg/kg Ferula roots extract group recorded the smallest value of serum creatinine ranges for hyperglycemic groups, whereas 2% Ferula roots powder group recorded the most elevated value with significant variations. 0.89 and 0.59 mg/dl on average, respectively. Positive control, 500mg/kg Ferula roots extract, and 2% Ferula roots powder did not vary significantly. Our findings have been constant with those of (43) who discovered that all kidney-damaging rats given on various diets, renal functions including creatinine and urea showed substantial declines. Rats given powdered roots and leaves of Ferula improved the rats' renal markers.

The possible functional mechanisms of these plants include anti-inflammatory, anti-oxidative, as well as improvement of glomerular filtration, prevention of tissue damage, and enhancing reconstructive power of cells. Medicinal herbs like Ferula roots can be used for the prevention or treatment of renal failure and for the enhancement of renal function (44).

In addition, every group of rats that were kidney-damaging given diets containing leaves and seeds exhibited a considerable drop in the average readings of kidney function biomarkers concentrations as compared to group with control positive (45).

Table (5): Influence of Ferula roots powder and its extract on renal functions of hyperglycemic rats

Parameters Groups	Urea mg/dl	Uric acid mg/dl	Creatinine mg/dl
G ₁ C (-)	21.70 ^f ±0.15	3.36 ^{bc} ±0.26	0.50 ^{ab} ±0.13
G ₂ C (+)	48.10 ^a ±0.65	6.73 ^a ±0.50	1.11 ^a ±0.40
G ₃ (2% Ferula roots powder powder)	42.54 ^b ±0.40	5.80 ^a ±0.43	0.89 ^a ±0.41
G ₄ (4% Ferula roots powder powder)	37.09 ^c ±0.42	5.40 ^{ed} ±0.52	0.79 ^a ±0.35
G ₅ (250 mg/kg Ferula roots extract)	35.09 ^d ±0.33	5.03 ^b ±0.31	0.70 ^a ±0.38
G ₆ (500 mg/kg Ferula roots extract)	30.58 ^e ±0.29	4.33 ^{bc} ±0.25	0.59 ^a ±0.22
LSD (P≤0.05)	1.134	1.035	0.340

Each value represents the mean ± SD of six replicates. Means in the same column with different letter are significantly different (P<0.05).

4. Conclusion

It is possible to incorporate Ferula roots into our regular drinks since they have been shown to considerably improve serum glucose levels, boost HDL-c, lower liver, and renal biomarkers levels, and when taken as a powder or extraction.

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تقييم تأثير جذور شرش الزلوع على التغيرات البيولوجية في الفئران المصابة بالسكري

الملخص العربي

سعى البحث الحالي إلى تحديد التغيرات عند إصابة الفئران بمرض السكري الناتج عن الحقن بالألوكسان ثم استخدام مسحوق جذور شرش الزلوع ومستخلصها. تم تقسيم مجموعته ستة وثلاثين فأراً ذكراً تتراوح أوزانها بين ١٤٠ - ١٥٠ جراماً إلى مجموعتين رئيسيتين تتكون كل منهما من ستة فئران بشكل عشوائي. كانت المجموعة الأولى بمثابة المجموعة الضابطة السالبة، وتلقت المجموعة الثانية (٣٠ فأراً) جرعة واحدة من مادة الألوكسان المسبب لمرض السكري (١٥٠ ملجم/كجم من وزن الجسم). تم بعد ذلك تقسيم الفئران المصابة بالسكري في المجموعة الرئيسية الثانية إلى خمس مجموعات بشكل عشوائي: المجموعة الثانية (٦ فئران) هي المجموعة الضابطة الموجبة، التي تلقت النظام الغذائي الأساسي فقط؛ من المجموعة الثالثة إلى المجموعة السادسة التي تلقت الفئران المصابة العليقة الأساسية مضافاً إليها ٤,٢% مسحوق جذور شرش الزلوع، ٢٥٠، ٥٠٠ ملجم/كجم مستخلص جذور شرش الزلوع على التوالي لمدة ٤ أسابيع. تم فحص العينات عن طريق المؤشرات الكيميائية الحيوية مثل مستوى الجلوكوز، وإنزيمات الكبد، ووظائف الكلى، صورة دهون الدم؛ بعد ٢٨ يوماً من بداية التجربة. أشارت نتائج البيانات التي تم الحصول عليها إلى أن جذور شرش الزلوع أدت إلى انخفاض معنوي في مستويات كلاً من نسبة الجلوكوز في الدم والبروتين الدهني منخفض الكثافة والبروتين الدهني منخفض الكثافة جداً في الدم وزيادة البروتين الدهني مرتفع الكثافة مقارنة بالمجموعة الضابطة الموجبة. ووفقاً للنتائج، فإن مستخلص جذور شرش الزلوع بتركيز ٥٠٠ ملجم/كجم أظهر تحسناً أكبر وقلل أيضاً من الآثار السلبية في الفئران المصابة بمرض السكري.

الكلمات المفتاحية: الفئران، جذور النبات، سكر الدم، المؤشرات الحيوية.