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The Effect of *Teucrium Polium* Extract on Diabetic Nephropathy in Rats

Mona. E.M. Naga[1] Basma R. M. Khateib[2] Asmaa H. A.Ahmed[3]

1-Dept. of Home Economics, Faculty of Specific Education, Minufiya University, Egypt.
2- Dept. of Nutrition & Food Science, Faculty of Home Economics, Minufiya University, Egypt.
3- Dept. of Home Economics, Faculty of Specific Education, Minufiya University, Egypt

ABSTRACT

Bakground: Diabetes represents a group of common diseases that are characterized by dysregulation of blood glucose levels. Plants are traditionally used for management of diseases including diabetes. In this study, we screened the anti-diabetic effect of extract of *Teucrium Polium.* was screened for it antihyperglycemic activity. This study was aimed to screen the antidiabetic effect of Teucrium polium to obtain the most efficient herbal fraction for isolation of bioactive constituents responsible for diabetic activity diabetes was induced in Sprague Dawley rats using Alloxan. Blood glucose was measured at baseline and at every hour for 3 hours.In this exprement twenty five (25) mature male albino rats weighing 190±5g were divided into 5 equal groups (n=5 rats each); one group was kept as a negative control, while the other 4 groups were injected with alloxan and gentamicin sulfate to cause injury, one group of them was left as positive control group (C +ve) while the rest three groups were given orally three doses (150,300 and 450 mg/kg) of *Teucrium Polium* extracts. At the end of experimental period (28 days), blood samples were collected for serum separation to determine biological evalution ,serum level glucose, kidney function (creatinine, urea and uric acid) **.** The obtained results demonstrated that *Teucrium Polium* extracts caused significant improvement in seurum glucose , kidney functions in inflicted diabetic rats. Finally it could be concluded that, *Teucrium Polium* extracts could be useful for managements of hyperglycemic treatment and to improve vital functions of the body and weight loss**.**

Keyword: Diabetes- Teucrium Polium- alloxan- nephropathy – gentamicin sulfate -.

INTRODUTION

Diabetes is a metabolic and multifactorial disorder which is characterized by chronically increased levels of blood sugar and develops due to disturbed secretion and/or function of insulin **(Suji and Sivakami 2003, and Mirhoseini *et al.*,2013).** From clinical perspective, diabetes mellitus is considered to be one of the most important risk factors for certain disorders such as nephropathy, retinopathy, neuropathy, and cardiovascular disease, and according to projections, its prevalence will be increasing in human communities in the future **(Mirhoseini *et al.*, 2016).**

Different severities of insulin deficiency and resistance are seen in patients with diabetes mellitus, and when these patients are not treated by diet, physical activity, and hypoglycemic drugs, it is necessary to treat them by other approaches. Although use of insulin and hypoglycemic drugs is currently considered to be the main and effective treatment for diabetes mellitus, they may cause different complications such as increased lipid reserves, shrinkage of lipid at injection site, and hypoglycemic shock. In addition, insulin and hypoglycemic drugs affect pathogenesis of debilitating complications due to diabetes **(Gumprecht and Nabrdalik,**

2016). Since diabetes mellitus is one of the oxidative stress-associated diseases **(Roman-Pintos *et al.*, 2016)**, use of antioxidants can be a therapy approach to control diabetes and reduce associated complications **(Kooti *et al.*, 2016)**. Hyperglycemia is the most important sign of diabetes. There are different herbal and chemical medications used for the treatment of diabetes. Some herbs can increase or decrease the therapeutic effects of chemical drugs. **Khoshdel *et al.*,(2015**).

Recently efforts have been increasingly made to use alternative medicine such as herbal drugs. Actually use of medicinal plants has caused a decrease in incidence of different diseases because of their effects in protecting against oxidative damage and decreasing inflammation **(Asadi-Samani *et al.*, 2016).** In this regard, recent studies have sought to investigate traditional uses and in vitro effects of medicinal plants, and to identify and isolate their active compound to develop herbal drugs **(Sepehr *et al.*, 2014).** Therefore, the aim of this study is to identify one of medicinal plants and its traditional use to prevent and treat diabetes according to the findings of the ethnobotanical studies conducted in different regions to offer some strategies to produce new and more effective herbal drugs to researchers **Bahmani *et al.*, 2015**.

Teucrium polium (Lamiaceae family) is a wild-growing flowering herb, abundantly found in various regions such as Europe, North Africa and South-Western Asia **Nasri *et al.*, (2013)**. *T. polium* has been used for different diseases such as diabetes, rheumatologic diseases, inflammation, and gastrointestinal disorders **Rafieian-Kopaei *et al.*, (2013)**. various investigations have been conducted to confirm the effectiveness of T. polium. Recent studies have shown the antioxidant property of T. polium It was supposed that the presence of an ortho-dihydroxy substitution in the flavone B-ring is responsible for the antioxidant activity of this herb **Forouzandeh *et al.*, (2013)**.

It has been found that these compounds possess a broad spectrum of pharmacological effects including antioxidant, anticancer, antiinflammatory, hypoglycemic, hepatoprotective, hypolipidemic, antibacterial and antifungal. The results of data analyses on the chemical, pharmacological and toxicological characteristics of *T. polium* support the view that this plant has beneficial therapeutic properties **Seifollah and Razieh (2012).**

MATERIALS AND METHODS:

I- MATERIALS

I.I. Plant: The tested plant in this study was *Teucrium Polium.* it was bought from the local market in Egypt as fresh plant then dried.

I.II. Rats: twenty-five (25) mature male albino rats weighing 190±5 g. B.Wt. were obtained from Laboratory of Animal Colony, Helwan, Egypt.

I.III. Basal diet: The basal diet was prepared according to **Reeves *et al.*, (1993)**. It was consisted of 20% protein (casein), 10% sucrose, 4.7% corn oil, 0. 2% choline chloride, 1% vitamin mixture, 3.5% salt mixture and 5% fiber (cellulose). The remainder was corn starch. The composition of salt mixture was reported by **Hegested *et al.*, (1941)** and vitamin mixture according to **Campbell, (1963)**.

II- METHODS

II.1. Preparation of plant ethanolic extracts:

Teucrium polium wase collected and dried in an airy room for about 3 days of drying , away from direct sunlight to avoid possible damage to their phyto-constituents and ground into powder. 10g of the plant powder was soaked in 90 ml of ethanol alcohol (80%), shaken for 10 minutes and then allowed to stay at room temperature for 72 hours. The mixture was then filtered using a filtered paper and the filtrate evaporated to dryness on water bath at 60ºC. The ethanolic extract was kept in air tight bottle in a refrigerator at 4°C until use and served as the stock crude extract.

For preparation of hydroalcoholic extract, the air-dried plant material (3 kg) was soaked in percolation tank using ethanol: water (70:30) for 3 days and then extracted with a flow of 2 mL/min for 5 days. It was filtered and concentrated by rotary evaporator at 45°C to yield a green viscous residue (257 g). This extract was dissolved in methanol: water (70:30) and partitioned with hexane in a separation funnel to give a biphasic solution. Upper solution (hexanoic part) rich in chlorophyll and fats was discarded and methanolic part was concentrated, suspended in water, and then successively partitioned between equal volumes of chloroform and butanol to give chloroform, butanol, and aqueous fractions. Each fraction was evaporated under vacuum condition and kept in refrigerator at −20°C until use **Safaeian *et al.*, (2015).**

According to **Baradaran *et al.*, (2013)** The *T. polium* leaves were dried in a ventilated room at 45˚C for 48 h and powdered. 300 grams of aerial parts of TP were macerated with ethanol (70%) at 30°C for 24 hours and was shaken intermittently. The extraction procedure was repeated two times and then was concentrated in a rotary evaporator under low pressure to give one third of the primary volume. The solution was then dried by oven at 40°C. The dried extract was reconstructed with distilled water to prepare suitable concentrations.

II.III. Experimental design:

All the experiment process was done in the Faculty of Home Economics, Minufiya University, Shebin El-kom. Twenty-five Sprague-Dawley male albino rats, each weighing 190±5 g., were housed in special cages under controlled conditions. Every day, animals were observed for the external appearance, shape, colour and distribution of hair and physical activity. All rats were fed on basal diet for 7 consecutive days before the beginning of the experiment for adaptation. Diets were presented to rats in special non-scattering feeding cups to avoid loss of feed and contamination. Tap water was provided to rats by mean of glass tubes projecting through wire cages from inverted bottles supported to one side of the cage. Rats were divided into two main groups. The first main group (n= 5 rats) fed on basal diet and left as a negative control group. The second main group injected intro peritoneal with alloxan 150 mg/kg body weight according to **Dasai and Bhide (1985)** and induce nephrotoxicity following the method of **Farooqui, *et al.*, (2017)** for 28 days**,** then they were divided into four equal groups (4x5 rats each), one of them was left as positive control group (C +ve) while the rest three groups were orally given three doses of (150,300 and 450 mg/kg) of *Teucrium polium* ethanolic extract individually for each of them.

II.IV. Biological and biochemical evaluation

During the experimental period, the diet consumed was recorded every day, and body weight recorded every week. The body weight gain (BWG) and feed efficiency ratio (FER) were determined according to **(Chapman *et al.* 1959)** using the following equations.

$$\textbf{B.W.G. \%} = \frac{(\text{Final weight} - \text{Initial weight}) \times 100}{\text{Initial weight}}$$

$$\textbf{FER} = \frac{\text{Body weight gain (g/day)}}{\text{Feed intake (g/day)}}$$

Relative organ weight calculated by the following formula:

$$\textbf{Relative organ weight (ROW)} = \frac{\text{Organ weight}}{\text{Total body weight}} \times \mathbf{100}$$

At the end of experimental period (28 days), blood samples were collected for serum separation to determine the following parameters: Serum glucose: which was measured using the modified kinetic method according to **Kaplan (1984)** by using kit supplied by Spinreact, Spain.

Determination of kidneys function

Creatinine, urea and uric acid were determined according to **(Henry, 1974), (Pattn and Crouch, 1977) and (Schultz and Kaplan, 1984)** respectively.

II.VI. Statistical analysis

The obtained data were statistically analyzed using computerized SPSS (Statistic Program Sigma Stat, statistical soft-ware, Effects of different treatments were analyzed by one-way ANOVA (Analysis of variance) test using Duncan's multiple range test and $p \leq 0.05$ was used to indicate significant differences between groups (**Snedecor and Cochran, 1967**).

RESULTS AND DISCUSSION

1. Biological evaluation

1.1 Effect of *Teucrium polium* on inititial weight, final weight, and body weight gain (g) of diabetic and Renal rats

Table (1) illustrate the initial weight, final weight and BWG of diabetic rats. As for initial weight, it could be noticed that the mean values of groups 1, 2, 3, 4 and 5 showed non-significant difference when compared with positive control group, which were 197.66+2.44, 198.66+3.51, 199.00+2.00, 198.66+2.08 and 196.3+2.64 (g), respectively.

Also, it could be noticed that the mean value of negative control group showed non-significant difference when compared with positive control group.

Concerning final weight, the results indicated that the mean value of final weight of (c+ve) group was lower than (c-ve) group, which were 224.00+3.60 and 287.66+3.21 (g), respectively, with percentage of increase +18.44% when compared with positive control group. The mean values of groups 4, 5, 6 and 7 showed a significant difference when compared with positive control group, which were 234.3+4, 242.3+2.51, 251+2.64 and 256.6+2.8 (g), respectively. Percentage of increase were +6.2%, +9.93%, +13.78% and +16.32% for groups 4, 5, 6 and 7 as compared with positive control group. Regarding BWG (g), data mentioned that the mean value of weight gain in normal rats group was 90.00+4.35 g while it was 25.33+5.85 g in control positive group. it's clear that weight gain for positive control group was lower than negative control group.

It is noticed that the best group administrated with ethanolic extract at dose of 450 mg/kg bw.t. for initial weight, final weight and BWG which was 196.00+ 2.64, 271.33+3.21and 75.33 +0.75, respectively.

These results similar to **Gjoshe *et al.*, (2011)** demonstrated that examined plant extracts of Teucrium *polium* L. ssp. *capitatum* (L.) Arcangeli (Lamiaceae) contain flavonoids with insulinotropic and antihyperglycemic effects.

Mansour *et al.*, (2018) concluded that treatment with TPHAE caused dose-dependent decrease in serum levels of inflammatory markers and lipid profile in hypercholesterolemic rats. Therefore, it can be applied as a natural product for the management of cardiovascular diseases.

2.Effect of *Teucrium polium* extract on feed intake (FI), feed efficiency ratio (FER) and body weight gain (BWG %) of inflicted diabetic and Renal rats

Data of table (2) evident that diabetes mellitus reduced the BWG of rats. BWG% of control -ve was 45.55 + 2.71 % while that of control +ve was 12.78± 3.17%. Indicating higher BWG% of control negative, being 396.01%that of control -ve . This showed that BWG % of control -ve was about 4 folds higher than the control +ve group. Plants extracts reversed the change occurring in the control +ve rats leading to increased BWG% maximum increase of BWG% recorded for teucrium polium extract group (450 mg/kg bw.t.) .As for (FER) the result revealed that control positive group showed significant decrease ($P \leq 0.05$) in feed efficiency ratio (FER) of hyperglycemic rats than control negative group, the highest increased in (FER) was observed in *teucrium polium* extract group (450 mg/kg bw.t.). regarding food intake data presented that rats of (c+ve) group were 14.16 ± 1.25 while for (c-ve) group were 19.00 ± 1.80, *teucrium polium* extract group (450 mg/kg bw.t. then 300 mg/kg bw.t.) were the best group in (FI) which were 18.33±0.76 and 17.56 ± 0.58 (g), respectively.

These results agree with those of **Stefkov *et al.*, 2011** concluded that the extract of *teucrium polium* lowered blood glucose levels by ~35%. The treatment reduced hepatic glycogen and tended to normalize the activity of gluconeogenic enzymes. The results demonstrate that examined plant extracts contain flavonoids with insulinotropic and antihyperglycemic effects.

Malki *et al.*, (2018) mentioned that serum cholesterol and triglyceride values decreased significantly ($p<0.01$) in the test groups, but serum glucose values were unaffected by *Teucrium polium L.* treatment compared to non-treated control animals. According to the experimental findings, the decreased lipids clearly showed the antihyperlipidemic effect of *Teucrium polium L.* Capitatum apart from its antidiabetic effect.

3- relative organs weight for Liver, Kidneys, Spleen.

Data illustrated in table (3) show the effect of treatments of *teucrium polium* extract on relative organ (liver, kidney and spleen) weights of hyperglycemic rats. It is clear that in rats injected with alloxan and gentamicin (control +ve) group, ROW for liver, kidney and spleen increase in the mean values which were 3.71± 0.13, 0.93 ± 0.02 and 0.32± 0.02 g/100g B.w.t as compared to normal rats which were 1.74 ± 0.51, 0.29 ± 0.03 and 0.18± 0.01 g/100g, respectively. Meanwhile the mean value of treated group with *teucrium polium* extract donated that there were significant decrease in all treated groups as compared to control +ve group. It could be noticed that rats administrated with *teucrium polium* extract at dose 450 mg/ kg B.w.t

showed the lowest decrease in relative liver, kidney and spleen weights as compared to control +ve Where the results are approaching normal rats.

Seifollah and Razieh (2012) mentioned that *Teucrium polium* .l has been found that these compounds possess a broad spectrum of pharmacological effects including antioxidant, anticancer, anti-inflammatory, hypoglycemic, hepatopro-tective, hypolipidemic, antibacterial and antifungal. The results of data analyses on the chemical, pharmacological and toxicological characteristics of *T. polium* support the view that this plant has beneficial therapeutic properties.

Also, **Forouzandeh *et al.*, (2013)** that investigated protective effect of Teucrium polium L. (Labiatae) extract on acetaminophen-induced hepatotoxicity on mice, results of this study showed the protective effect in all doses but the most significant protection was observed in doses of 250 and 500 mg/Kg ($p < 0.05$). Also, these findings were supported and confirmed by histological examination.

3. Biochemical analysis

Tables from (4,5) show the effect of oral ingestion of *Teucrium polium* extract on serum glucose and kidneys function (creatinine, urea and uric acid) of obese rats.

3.1. Serum glucose:

Data listed in table (4) demonstrated the effect of oral ingestion of *Teucrium polium* extract on serum glucose level on infected with diabetes and Nephropathy rats. The result of serum glucose level showed significant increase ($P<0.05$) in control positive group (c+ve) as compared to the control negative group (c-ve) which were 238.16±2.02 and 84.5±3.12 mg\dl, respectively. As shown in the same table, all treated groups indicated significant decrease when compared to control (+ve group). The best treatment found for rats administrated with 450 mg/kg B.wt. which was 118±2.64 mg\dl as compared to control (+ve) group.

Mojtaba *et al.*, (2015) presented that metformin and the hydroalcoholic extract of Teucrium polium treated by 100, 200, and 400 mg/kg of the extract prevent diabetes-induced memory deficits in rats. Protection against brain tissues oxidative damage might have a role in the beneficial effects of the extract and metformin.

These results agree with those of **Majid *et al.*, (2017)** concluded ethnobotany of different regions of Iran, to prevent and treat diabetes. According to this review article, certain plant species such as Urtica dioica L., popularly called nettle, in eight regions, *T. polium L.*, popularly called poleigamander, in five regions, and Trigonella foenum-graecum L., Citrullus colocynthis (L.), Schrad., and Juglans regia L. in four regions, were reported to be frequently used to prevent and treat diabetes.

Khodadadi *et al.*, (2018) reported that *T. polium* extract could improve endothelial dysfunction by ameliorating the vasoreactivity and regulating eNOS and VCAM-1 gene expressions as well in STZ-induced diabetic rats' aorta.

2.5. Effect on kidney function (Creatinine, Urea and Uric acid)

Table (5) shows the effect of oral ingestion with *Teucrium polium* extract on kidney function (Uric acid, Urea, and Creatinine) in diabetic rats.

The serum levels of the mentioned previously parameters were 1.39±0.217, 29.16±2.56 and 0.37±0.03 U/L in negative control group rats (C–ve), while in positive control group (C+ve) the mean values were 3.89±0.507, 44.83±1.75 and 1.09±0.105 U\L respectively. These findings

denote that there were significant increases in serum levels of Uric acid, Urea, and Creatinine of rats (C+ve) as compared to (C–ve) normal rats $p<0.05$. *Teucrium polium* ethanolic extract at a dose of 450/mg/kg B. Wt., group showed the highest significant improvement in Uric acid, Urea, and Creatinine when compared to most of other tested groups. This group was also the best for biological evaluation and other parameters (Table 1, 2 ,3and 4).

Baradaran et al., (2013) reported that *T. Polium* consumption (phase I), kidney damages were not increased in comparison with control group ($P > 0.05$). However, following 28 days of drug cessation, kidney damages including degeneration, destruction and vacuolization, appeared in comparison with control group and with increasing the doses of TP. Conclusion: Due to nephrotoxicity, *T. polium* should not be used or should be consumed with great caution.

Conclusion:

According to the results obtained *Teucrium polium* ethanolic extract at a dose of 450/mg/kg B. Wt. could be used for treatment and to improve vital functions of the body diabetis and Nephropathy.

Table (1): Effect of Teucrium polium extract on initial weight, final weight and BWG(g) of diabetic and Renal rats

Groups Parameters	Control -ve (G1)	Control +ve (G2)	ethanolic *Teucrium polium* extract			LSD
			150 mg/kg B.Wt. (G3)	300 mg/kg B.Wt. (G4)	450 mg/kg B.Wt. (G5)	
Initial weight (g) Mean ± SD	197.66±2.44 a	198.66±3.51 a	197 ±2.00 a	198.66±2.08 a	196 ±2.64 a	5.440
Final weight (g) Mean ± SD	287.66±2.51 a	224±3.60 e	235±3.00 d	247.33±2.51 c	271.33±3.21 b	6.197
BWG (g) Mean ± SD	90± 4.35 a	25.33±5.85 e	38±4.35 d	48.66±1.52 c	75.33±0.75 b	7.97

Means with different letters (a, b,c,d) in the same column different significantly at $p \leq 0.05$ using one way ANOVA test, while those with similar letters denote non-significant difference.

Table (2): Effect of Teucrium polium extract on FI, FER and BWG(%) of diabetic and Renal rats.

Groups Parameters	Control -ve (G1)	Control +ve (G2)	ethanolic *Teucrium polium* extract			LSD
			150 mg/kg B.Wt. (G3)	300 mg/kg B.Wt. (G4)	450 mg/kg B.Wt. (G5)	
FI (g) Mean ± SD	19.00±1.80 a	14.16±1.25 b	16.66±1.75 ab	17.56±0.58 a	18.33±0.76 a	2.60
FER (g) Mean ± SD	4.76 ± 0.56 a	1.77± 0.28 d	2.28± 0.12 cd	2.77 ± 0 .16 c	4.11± 0.20 b	0.638
BWG (%) Mean ± SD	45.55±2.71 a	12.78±3.17 d	19.99±3.19 c	24.49±0.83 c	38.43±0.23 b	4.89

Means with different letters (a, b, c, d) in the same column differ significantly at $p \leq 0.05$ using one-way ANOVA test, while those with similar letters denote non-significant difference.

Table (3): Effect of Teucrium polium extract on relative weight of liver, kidney and spleen of diabetic rats:

Groups Parameters	Control -ve (G1)	Control +ve (G2)	ethanolic *Teucrium polium* extract			LSD
			150 mg/kg B.Wt. (G3)	300 mg/kg B.Wt. (G4)	450 mg/kg B.Wt. (G5)	
Liver (g) Mean±SD	1.74±0.051 e	3.71±0.130 a	3.22±0.131 b	2.81±0.156 c	2.19±0.081 d	0.235
Kidney (g) Mean ± SD	0.29±0.03 e	0.93±0.02 a	0.78±0.035 b	0.65±0.037 c	0.38±0.075 d	0.073
Spleen (g) Mean ± SD	0.18±0.017 d	0.32±0.020 a	0.27±0.023 b	0.25±0.023 bc	0.216±0.035 cd	0.047

Means with different letters (a, b, c, d) in the same column differ significantly at $p \leq 0.05$ using one-way ANOVA test, while those with similar letters denote non-significant difference.

Table (4): Effect of Teucrium polium extract on serum glucose level of diabetic experimental rats

Groups Parameters	Control -ve (G1)	Control +ve (G2)	ethanolic *Teucrium polium* extract			LSD
			150 mg/kg B.Wt. (G3)	300 mg/kg B.Wt. (G4)	450 mg/kg B.Wt. (G5)	
Glucose (mg/dl) Mean ± SD	84.5±3.12 e	238.16±2.02 a	195.5±2.5 b	155±4.27 c	118±2.64 d	5.973

Means with different letters (a, b, c, d) in the same column differ significantly at $p \leq 0.05$ using one-way ANOVA test, while those with similar letters denote non-significant difference.

Table (5): Serum Creatinine, Urea and Uric acid of obese treated rats.

Groups Parameters	Control -ve (G1)	Control +ve (G2)	ethanolic *Teucrium polium* extract			LSD
			150 mg/kg B.Wt. (G3)	300 mg/kg B.Wt. (G4)	450 mg/kg B.Wt. (G5)	
Uric acid (mg/dl) Mean + SD	1.39± 0.217 d	3.89± 0.507 a	3.22± 0.220 b	2.50± 0.173 c	1.82± 0.180 d	0.542
Urea (mg/dl) Mean + SD	29.16± 2.56 e	44.83 ± 1.75a	40.5± 1.32 b	35.93± 1.90 c	32.33± 2.51 d	3.034
Creatinine (mg/dl) Mean + SD	0.37 ± 0.03 e	1.09 ± 0.105a	0.9± 0.045 b	0.77± 0.025 c	0.50± 0.10 d	0.114

Means with different letters (a, b,c,d) in the same column differ significantly at $p \leq 0.05$ Using one way ANOVA test, while those with similar letters denote non-significant difference.

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تأثير مستخلص نبات الجعدة على اعتلال الكلية السكري لدى الفئران.

المستخلص

منى إبراهيم محمد نجا* بسمة رمضان خطيب أسماء حسن عبد العظيم أحمد*****

*كلية التربية النوعية-قسم الاقتصادالمنزلي- تغذية وعلوم أطعمة- جامعة المنوفية

**قسم التغذية وعلوم الأطعمة -كلية الاقتصاد المنزلي -جامعة المنوفية-مصر

***قسم الاقتصاد المنزلي (تغذية وعلوم الأطعمة) -كلية التربية النوعية-جامعة المنوفية – مصر

المستخلص العربى

يمثل مرض السكري أحد الأمراض الشائعة التي تتميز بعدم تنظيم مستويات الجلوكوز في الدم. و يتم استخدام النباتات عادة في علاج كثير من الأمراض بما في ذلك مرض السكري. في هذه الدراسة ، تم فحص التأثير المضاد للسكري لمستخلص الجعدة (*Teucrium Polium*). وقد تم فحصه نظرا لنشاطه المضاد للالتهاب و سكر الدم ،كما تهدف هذه الدراسة إلى فحص التأثير المضاد لمرض السكر من مستخلص نبات الجعدة للحصول على الجزء العشبي الأكثر فعالية لعزل المكونات النشطة بيولوجياً المسؤولة عن نشاط السكري. تم استقصاء مرض السكري في فئران الألبينو باستخدام الألوكسان والجنتاميسين، تم قياس مستوى السكر في الدم في الأساس وفي كل ساعة لمدة 3 ساعات. المواد والطرق: خمسة وعشرون (25) ذكور الجرذان البيضاء التي تزن 190 ± 5جم تم تقسيمها إلى 5 مجموعات متساوية (ن = 5 فئران لكل منهما) ؛ تم الاحتفاظ بمجموعة ضابطه سالبه ، في حين تم حقن المجموعات الأربع الأخرى بألالوكسان و الجنتاميسين لإحداث الاصابة ، تركت مجموعة واحدة منهم كمجموعة ضابطة (C + ve) بينما بقية المجموعات الثلاث أعطيت ثلاث جرعات فموية (300،150 و 450 مغ / كغ) من المستخلص . في نهاية الفترة التجريبية ، تم جمع عينات الدم لفصل المصل لتحديد مستوى الجرعة ، مستوى الجلوكوز في المصل ، وظائف الكلى (الكرياتينين واليوريا وحمض اليوريك) النتائج: أظهرت النتائج أن مستخلص الجعدة تسبب في تحسن ملحوظ. في مستوي الجلوكوز ووظائف الكلى في الجرذان المصابة بالسكري. الخلاصة: وفقا للنتائج التي تم الحصول عليها ، يمكن أن يكون مفيد لعلاج فرط سكر الدم وتحسين الوظائف الحيوية للكلي وفقدان الوزن.