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Effect of Gum Arabic and Khella Seeds in Treatment of Kidney Functions Defect in Gentamicin-Induced Rats

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Abstract:
A decrease in renal function significantly impacts metabolism and nutritional status. Numerous plants have been found to possess antioxidant properties and protect against experimental renal toxicities. This study examined the effects of different doses of 2% and 4% of powdered mixes of gum Arabic (*Acacia Senegal, L.*) and Khella (*Ammi visnaga, L.*) on nephrotoxic rats. In this experiment, 48 white male albino rats weighing 140-150±10g were used. The rats were divided into eight groups. Each group contains six rats. Nephrotoxic was induced in normal healthy male albino rats by injecting 10 mg/kg body weight of gentamicin intraperitoneally once daily for ten days, while one was kept as the negative control group. The following data included glucose level, serum liver functions (ALT, AST, and ALP), markers of kidney functions (creatinine, urea, and uric acid), and lipid profile (total cholesterol, triglycerides, HDL-c, LDL-c, and VIDL-c). According to the results, rats' kidney, liver, serum glucose, and lipid profiles were all enhanced better with the combination of Gum Arabic and Khella seed powder. The best results were shown with the 4% mixture, which is advised for use as a beverage drink to improve kidney functioning. In conclusion: In treating rats with renal failure, Gum Arabic and Khella seeds can be considered potential therapeutic feeding programs.

Keywords*: Rats, Herbs, Kidney disorder, Biochemical assay*

Introduction

The kidneys are a pair of kidney-shaped organs that are found between the peritoneum and the back of the abdomen, just above the waist. The two kidneys are in the small cavity of the back, behind the liver and intestines (1). Additionally, the kidneys detoxify the body, eliminate medications, and release hormones that control blood pressure, and maintain fluid balance (2). The kidney plays a crucial role in maintaining proper blood volume and pressure as well as in managing the acid-base balance. The kidney filters around one-fourth of the

cardiac output. As the organ responsible for removing metabolic and absorption wastes, the kidneys also play a significant part in urine excretion (3). Chronic kidney disease (CKD), which can lead to renal failure, cardiovascular disease, and early death, is a global public health issue (4). In both humans and rats, chronic kidney disease and its exacerbating factors are characterized by inflammation, oxidative stress, cell death, and lineaments (5).

Acacia senegal, also known as Gum Arabic, a fermentable carbohydrate, is used in food and pharmaceutical technologies as an emulsifier and stabilizing agents (6). *Gum acacia* (GA), a soluble dietary fiber, has been shown to be advantageous for people with kidney failure, and other experimental research has validated this finding (7). According to certain studies, in both adults and children, therapy with GA has been found to reduce urea by increasing faecal urea nitrogen excretion while concurrently lowering urine total nitrogen (8). The mechanism by which GA improves renal function in chronic renal insufficiency is unclear. Theoretically, GA boosts the amount of energy that bacterial colonies that break down dietary fibers and absorb nitrogen as they grow have available to them. In addition, some of the body's nitrogen waste can be taken with these bacterial colonies as they can convert urea to ammonia, excrete it in faecal, and perform this function (9). Gum Arabic has been discovered to have the highest antioxidant activity and contains significant levels of phenols and flavonoids. High doses of gum Arabic were also found to improve renal functioning, certain serum minerals, antioxidant enzymes and prevent renal damage in the rats' kidneys with diabetic kidney failure while remaining palatable and safe (10).

Traditional Egyptian medical practices address renal disorders mostly using herbal medications. A perennial or biennial herb, *A. visnaga*, L. is also referred to as khella baladi or toothpick weed. It has long been employed in conventional medicine (11). The *Apiaceae* family, which includes the plants known as Bishop's weed, Khella, and Toothpick, includes the plant known as Pea or Khella. The fruits are used to cure kidney stones depending on their -Pyrones (mainly Khellin and Visnagin). Crushed or powdered fruits from the Khella tree have historically been used to treat kidney stone inflammation (12). Khella contains the furanochromones Khellin and Visnagin. Khella and its components are said to provide a variety of benefits, including those for bacterial, fungal, viral, anti-diabetic, anti-inflammatory, and neuroprotective properties (13). Khella has a variety of cytotoxic properties and contains coumarins, xanthotoxin, ammidin, furoquinoline alkaloids, and dihydroseselins. Khellin and visnagin are the two most prevalent. Khellin has been discovered to relax smooth muscles, cause diuresis, increase citrate excretion, and decrease oxalate excretion in urine, all of which improve nephrolithiasis and the passage of ureteric stones (14). Although khella extract and its components khellin and visnagin may be used to treat kidney stone disease caused by hyperoxaluria, it is likely that several different mechanisms of action are involved in causing these effects (15).

The purpose of this study was to determine how different doses 2, and 4% of Gum Arabic, Khella, and their powdered mixture influenced some biochemical and biological complications in nephrotoxic rats.

Material & Methods

Materials

The herbal used:

The seeds for Khella *(Ammi visnaga,* L.) and Gum Arabic (*Acacia Senegal,* L.) were bought from an herbalist in Cairo City, Cairo Governorate, Egypt.

Gentamycin

Gentamicin is an antibiotic made of aminoglycosides that Memphis Co. purchased from Pharm. Chem. Ind. in Cairo, A.R.E.

Experimental animals

Forty-eight adult normal male albino Sprague Dawley strain rats weighing 150±10g were donated by the Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt for this experiment.

The chemical kits

Chemical kits for the analysis of TC, TG, HDL-c, ALT, AST, ALP, urea, creatinine, and uric acid were obtained from Al-Gomhoria Company for Trading Drug, Chemicals, and Medical Instruments, Cairo, Egypt.

Methods

Preparations of herbs

A high-speed mixer (Molunix, Al-Araby Company, Benha, Egypt) was used to mix the dried Gum Arabic and Khella seeds into a fine powder, which was then used as powder seize.

The induction of experimental nephrotoxicity:

In accordance with **(16)** technique, nephrotoxic kidney was produced in normal, healthy male albino rats by intraperitoneal injection of gentamycin at a rate of 100 mg/kg/day for five straight days.

Experimental design

The study was conducted and approved at the Faculty of Home Economics, Animal House, Department of Nutrition and Food Science, Menoufia University, Egypt.

Forty-eight adult male white albino "Sprague Dawley" rats, 10 weeks old, weighing (150±10g), were used in this experiment. All rats were given a casein diet prepared in accordance with **(17)** for seven days as a means of adaptation. Following this period of adaption, rats were separated into 8 groups of six each as follows:

Group (1): Rats were fed a basal diet only as negative control (-ve).

Group (2): Nephrotoxic rats were fed a basal diet only as a positive control group (+ve).

Group (3): Nephrotoxic rats were fed a basal diet and Gum Arabic powder at a ratio of 2.0% kg/diet/day.

Group (4): Nephrotoxic rats were fed a basal diet and Gum Arabic powder at a ratio of 4.0% of kg/diet/day.

Group (5): Nephrotoxic rats were fed on basal diet and Khella seeds powder by 2.0% of kg/diet/day.

Group (6): Nephrotoxic rats were fed on basal diet and Khella seeds powder at a ratio of 4.0% of kg/diet/day.

Group (7): Nephrotoxic rats were fed on basal diet and mixture (1:1) of Gum Arabic and Khella seeds powder at a ratio of 2.0% of kg/diet/ day.
Group (8): Nephrotoxic rats were fed on basal diet and mixture (1:1) of Gum Arabic and Khella seeds powder at a ratio of 4.0% of kg/diet/ day.
Throughout the experiment, the body weight and feed intake were estimated weekly, and the feed efficiency ratio of rats was calculated.
The experiment lasted for 28 days; at the end of the experiment, each rat was weighed independently, sacrificed, and blood samples were taken.

Blood sampling

Rats were fasted for 12 hours at the end of the experiment (which lasted 28 days), after which they were scarified. For serum separation, blood samples were taken from the portal vein and placed in dry, clean centrifuge tubes. The blood samples were centrifuged for 10 minutes at 4000 rpm to separate the serum **(18)**. At -18 °C, serum samples were kept frozen pending chemical analysis.

Biochemical analysis

According to the method, serum urea and serum creatinine were determined using enzymatic technique **(19) and (20)**. While serum uric acid was measured using a colorimeter by the method of **(21)**.
Serum glucose was measured using the modified kinetic method **(22)** by kits supplied from spin react. Spain.
The methods given by **(23), (24),** and **(25)**, respectively, were used to measure the serum alanine aminotransferase (ALT), serum aspartate aminotransferase (AST), and serum alkaline phosphatase (ALP).
To measure serum total cholesterol, the colorimetric technique described by **(26)** was followed by applying kits and an enzymatic procedure, serum triglycerides were measured in accordance with **(27) and (28)**. The method described by **(29) & (30)** is used to determine HDL-c. According to **(31)** the VLDL-c was calculated in mg/dl using the following formula:
VLDL-c (mg/dl) = Triglycerides (mg/dl) / 5. According to **(31)** the LDL-c was estimated in mg/dl as follows:
LDL-c (mg/dl) = Total cholesterol – (HDL-c + VLDL-c).

Statistical analysis

The data were analyzed using a completely randomized factorial design **(32)** when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Using the Costat Program, differences between treatments at ($P \leq 0.05$) were considered significant. One Way ANOVA was used to evaluate the biological results.

Results and Discussion

Table (1) displays the effects of various concentrations of Gum Arabic, Khella, and their combined powder on the serum kidney functions (urea, uric acid, and creatinine) in nephrotoxic rats. It should be noted that the positive control group's serum uric acid was significantly ($P \leq 0.05$) higher than the negative control groups, which were 12.60 and 5.70 mg/dl, respectively. Of all the treated groups, the rats in the nephrotoxic group who received

2 percent Khella powder had the highest serum uric acid levels. The lowest result for nephrotoxic rats fed a 4% powder mixture, which were 8.40 and 6.40 mg/dl, respectively, with a significant difference (P≤0.05).

The results revealed that the positive control group's serum urea value was significantly (P≤0.05) higher than that of the negative control group. The corresponding mean values were 36.10 and 19.50 mg/dl, respectively. The greatest serum urea level of any treated group was observed in nephrotoxic rats fed 4% Khella powder, on the other hand, while the lowest value was found in the nephrotoxic group of rats fed on 4% combination powder with a significant difference (P≤0.05). The mean values were 27.25 and 20.75 mg/dl, respectively.

In contrast, there were significant differences between the serum creatinine levels of the positive control group and the negative control groups (P≤0.05), which were 1.60 and 0.58 mg/dl, respectively. The rats in the nephrotoxic group who received 4% Khella powder had the highest serum creatinine levels, even though the lowest result was observed in nephrotoxic rats fed a 4% powder mixture. The mean values were 1.30 and 0.78 mg/dl, respectively, with a significant difference (P≤0.05). These findings were in line with those of (33), who found that Gum Arabic decreased renal impairment in a model of chronic renal failure (CRF), suggesting a promising potential for it to stop the progression of renal failure. Anti-inflammatory and/or antioxidant processes may be a part of the mechanism(s) underlying this nephroprotection.

Khella umbels and fruits are very widely known for their health advantages for the cardiovascular, dental, and urinary systems. Uremia and hyperbilirubinemia are reduced (34).

Table (1): Effect of different levels of Gum Arabic, Khella, and mixture powder on kidney functions of nephrotoxic rats

Parameters Groups	Uric acid (mg/dl)	Urea (mg/dl)	Creatinine (mg/dl)
G_1 C (-)	5.70^{d}±1.14	19.50^{e}±1.12	0.58^{c}±1.13
G_2 C (+)	12.60^{a}±1.12	36.10^{a}±1.10	1.60^{a}±1.10
G3 (2% Gum Arabic)	7.93^{b}±1.10	26.50^{b}±1.13	1.16^{b}±1.12
G4 (4% Gum Arabic)	7.01^{c}±1.15	21.55^{d}±1.16	0.92^{b}±1.14
G5 (2% Khella)	8.40^{b}±1.13	27.25^{b}±1.12	1.30^{b}±1.15
G6 (4% Khella)	7.30^{c}±1.11	23.50^{c}±1.15	0.97^{b}±1.13
G 7 (2% Mixture)	6.90^{c}±1.12	24.45^{c}±1.11	0.90^{b}±1.11
G8 (4% Mixture)	6.40^{c}±1.16	20.75^{d}±1.14	0.78^{c}±1.15
LSD (P≤0.05)	1.016	1.535	0.448

Each value is represented as values are expressed as mean ± SD; means in the same column with different letters are significantly different (P≤0.05).

The influence of Gum Arabic, Khella, and their powdered mixture on serum blood glucose levels in nephrotoxic rats is shown in Table 2. The mean results for the negative control and positive control groups, 107.50 and 209.25 mg/dl, respectively, reveal significant differences (P≤0.05). Of all the treated groups, the rats in the nephrotoxic group fed a 4% mixture

powder, their glucose levels were the lowest, 2% Khella powder diet showed the highest value. The mean values were significantly different (P≤0.05) and were 117.50 and 152.50 mg/dl, respectively. These findings are consistent with those of (35), who discovered that, as compared to an oral hypoglycemic medication, a decoction made from the fruits of the Khella was able to lower blood glucose levels in rats with normoglycemia by 51%.

GA demonstrated antidiabetic benefits in both people and animals, according to studies (36). Experimental diabetics and prediabetics who took 10 grams of GA per day for 16 weeks reported a noticeable drop in their glycated hemoglobin levels and fasting blood sugar levels.

Table (2): Effect of different levels of Gum Arabic, Khella, and their mixture powder on glucose level of nephrotoxic rats

Parameters Groups	Glucose mg/dl
G_1 C (-)	107.50^{f} ±0.30
G_2 C (+)	209.25^{a} ± 2.17
G3 (2% Gum Arabic)	143.45^{c} ±0.42
G4 (4% Gum Arabic)	135.00^{d} ±0.60
G5 (2% Khella)	152.50^{b}±0.24
G6 (4% Khella)	146.25^{c} ±0.31
G 7 (2% Mixture)	134.45^{d} ±0.24
G8 (4% Mixture)	117.50^{e} ±0.15
LSD (P≤0.05)	3.971

Each value is represented as values are expressed as mean ± SD; means in the same column with different letters are significantly different (P≤0.05).

Table (3) illustrates the effect of Gum Arabic, Khella and their combined powders on the ALT, AST, and ALP liver enzymes in nephrotoxic rats. It is evident that there were significant ALT liver enzyme differences between the negative and positive control groups, which were 30.70 and 82.50 U/L, respectively. The nephrotoxic group rats fed on 4% combination powders had the lowest ALT liver enzyme. While the diabetic group rats given 2 % Khella powder had the greatest value with a significant difference (P≤ 0.05), the mean values were 48.25 and 59.20 U/L, respectively.

The data showed significant differences (P≤0.05) between the negative and positive control groups for the liver enzyme AST, which were 21.65 and 66.00 U/L, respectively. Nephrotoxic rats fed a 4 % powder mixture had the lowest AST enzyme of any treated group. While the greatest value was reported for nephrotoxic group rats fed 2 % Khella powder with a significant difference (P≤ 0.05), which were 36.20 and 47.65 U/L, respectively, with significant differences (P≤0.05).

It is evident that ALP liver enzyme showed significant differences between negative control group and positive control groups. The mean values were 30.00 and 62.20 U/L, respectively. The lowest ALP enzyme of treated groups recorded for nephrotoxic group rats fed on 4% mixture powder. While the highest value recorded was for nephrotoxic group rats fed on 2 % Khella powder with significant difference (P≤0.05), the mean values were 36.25 and 56.30

U/L, respectively. This result confirms the findings of (37), who showed that Gum Arabic has antioxidant properties and reduces levels of bilirubin, total proteins, and liver enzymes in the blood. Additionally, it counteracted the harm that gentamicin and alloxan caused to the liver. Khella seed extract showed also a significant decrease in these markers as compared to the disease control and normal control groups' serum levels of the liver enzymes ALT, AST, and ALP (38).

Table (3): Effect of different levels of Gum Arabic, Khella and their mixture powder on liver functions of nephrotoxic rats

Parameters Groups	ALT (U/L)	AST (U/L)	ALP (U/L)
G_1 C (-)	30.70^{f}±0.15	21.75^{g}±0.18	30.00^{h}±0.10
G_2 C (+)	82.50^{a}±0.72	66.00^{a}±0.63	62.20^{a}±0.40
G3 (2% Gum Arabic)	56.25^{c}±0.50	38.60^{e}±0.40	48.30^{d}±0.26
G4 (4% Gum Arabic)	53.75^{d}±0.40	31.25^{f}±0.31	45.20^{e}±0.33
G5 (2% Khella)	59.20^{b}±0.60	47.65^{b}±0.26	56.30^{b}±0.52
G6 (4% Khella)	56.70^{c}±0.20	43.75^{c}±0.40	53.55^{c}±0.41
G 7 (2% Mixture)	54.00^{d}±0.15	41.60^{d}±0.20	40.75^{f}±0.30
G8 (4% Mixture)	48.25^{e}±0.10	36.20^{e}±0.13	36.25^{g}±0.15
LSD (P≤0.05)	2.125	1.368	1.107

Each value is represented as values are expressed as mean ± SD; means in the same row with different letters are significantly different (P≤0.05).

Data from Table (4) demonstrated how varied concentrations of Gum Arabic, Khella, and their powdered mixture affected the nephrotoxic rats' serum total cholesterol and triglycerides. The obtained results showed that there is a significant difference (P≤0.05) in the total cholesterol levels between the negative control group and the positive control group, which were 81.75 and 122.00 mg/dl, respectively. On the other hand, the nephrotoxic group of rats fed with 4% combination powder had the lowest total cholesterol among the treated groups. While the maximum value reported for the nephrotoxic group rats fed on 2% Khella powder had a significant difference (P≤0.05), which were 105.00 and 86.50 mg/dl, respectively.

Data showed that there were significant differences (P≤0.05) between the positive control group and the negative control group for triglycerides. The mean values were 109.00 and 69.50 mg/dl. The lowest triglyceride levels were found in the 4% combination powder-fed nephrotoxic group of rats. While the nephrotoxic group rats fed on 2% Khella powder showed the highest value with a significant difference (P≤0.05). The best result was obtained using a 4% mixture of Khella and Gum Arabic. The mean value was 78.00 mg/dl, respectively. These findings are consistent with (39) who discovered that after utilizing Khella for nine days, the patient exhibited an increase in HDL cholesterol levels as well as a decline in triglycerides.

The findings of (40) suggest that the soluble fiber content of GA, which caused LDL-c levels to fall and HDL-c production to increase, may be the reason for the increased HDL-c levels.

Induced hypercholesterolemic Wistar albino rats fed 10%, 20%, and 30% Gum Arabic, resulted in a substantial increase in serum HDL-c and a significant decrease in plasma LDL-c (P≤0.05).

Table (4): Effect of different levels of Gum Arabic, Khella, and their mixture powder on total cholesterol and triglycerides of nephrotoxic rats

Parameters Groups	Total cholesterol mg/dl	Triglycerides mg/dl
G_1 C (-)	81.75^{e}±1.10	69.50^{f}±1.18
G_2 C (+)	122.00^{a}±2.18	109.00^{a}±1.92
G3 (2% Gum Arabic)	95.25^{c}±1.14	86.00^{c}±1.16
G4 (4% Gum Arabic)	89.75^{d}±1.13	80.00^{e}±1.13
G5 (2% Khella)	105.00^{b}±1.17	95.25^{b}±1.12
G6 (4% Khella)	96.00^{c}±1.15	87.75^{c}±1.14
G 7 (2% Mixture)	88.00^{d}±1.14	84.00^{d}±1.13
G8 (4% Mixture)	86. 50^{d}±1.12	78.00^{e}±1.11
LSD (P≤0.05)	3.460	3.218

Each value is represented as values are expressed as mean ± SD; means in the same row with different letters are significantly different (P≤0.05).

Table (5) illustrates how varying concentrations of Gum Arabic, Khella, and their powdered mixture affected the lipid profiles of nephrotoxic rats for high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c), and very low-density lipoprotein cholesterol (VLDL-c). It is apparent that the levels of HDL-c are significantly different (P≤0.05) considered by the negative and positive control groups. There were 48.75 and 30.25 mg/dl on average, respectively. The greatest HDL-c levels were found in the rats from the nephrotoxic group that were fed a 4% powder mixture. While the lowest value was observed in nephrotoxic rats fed 2% Khella powder, which were 42.15 and 35.25 mg/dl, respectively, with significant differences (P≤0.05).

The data show that the LDL-c levels for the negative control group and the positive control group are significantly different (P≤0.05), which were 19.10 and 69.65 mg/dl, respectively. The nephrotoxic group rats fed a 4% mixture powder had the lowest LDL-c of all the treated groups. While the greatest value obtained for nephrotoxic group rats fed 2 % Khella powder with a significant difference (P≤ 0.05), which were 28.75 and 50.70 mg/dl, respectively.

However, there were significant differences (P≤0.05), considered by the negative and positive control groups for VLDL-c, which were 13.90 and 21.80 mg/dl, respectively. For the treatment groups, the nephrotoxic group of rats fed on 4% mixture powder had the lowest VLDL-c levels. Whereas the greatest value was noted in the nephrotoxic group of rats fed on 2% Khella powder with a significant difference (P≤ 0.05). The mean values were 15.60 and 19.05 mg/dl, respectively. These findings are consistent with (41) who reported that oral administration of 50 mg of khellin, which has anti-dyslipidemia and anti-oxidative activities, four times per day for four weeks resulted in noticeably higher HDL cholesterol concentration levels.

In addition, the body's chemistry behaves strangely after consuming GA. Indicators of this include body weight and other biochemical processes like enzyme activity, lipid profile, and sugar level. But obese individuals who are trying to reduce weight can find GA to be useful for this purpose (42).

Table (5): Effect of different levels of Gum Arabic, Khella, and their mixture powder on lipid profile of nephrotoxic rats

Parameters Groups	HDL-c mg/dl	LDL-c mg/dl	VLDL-c mg/dl
G_1 C (-)	48.75^{a}±1.60	19.10^{f}±1.10	13.90^{e}±1.11
G_2 C (+)	30.25^{d}±2.18	69.95^{a}±1.94	21.80^{a}±1.65
G3 (2% Gum Arabic)	37.00^{c}±1.14	41.05^{c}±1.46	17.20^{c}±1.41
G4 (4% Gum Arabic)	38.90^{c}±1.13	34.85^{d}±1.12	16.00^{d}±1.35
G5 (2% Khella)	35.25^{cd}±1.17	50.70^{b}±1.50	19.05^{b}±1.60
G6 (4% Khella)	36.90^{c}±1.15	41.55^{c}±1.33	17.55^{c}±1.42
G 7 (2% Mixture)	40.85^{b}±1.14	30.35^{e}±1.13	16.80^{c}±1.23
G8 (4% Mixture)	42.15^{b}±1.15	28.75^{e}±1.15	15.60^{d}±1.20
LSD (P≤0.05)	2.503	2.485	1.125

Each value is represented as values are expressed as mean ± SD; means in the same column with different letters are significantly different (P≤0.05).

Conclusions

Therefore, we might utilize a blend of Gum Arabic or Khella seeds powder in our regular beverage drinks. Gum Arabic or Khella seeds or their mixture significantly (P≤0.05) improved renal functions level, enhanced HDL-c, and decreased levels of liver functions and glucose level.

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تأثير الصمغ العربي وبذور الخلة في علاج خلل وظائف الكلى في الفئران المستحث بالجنتاميسين

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الملخص العربي:

الأيض والحالة التغذوية تتأثر بشـــكل كبير بانخفاض وظائف الكلى. تم التعرف على العديد من النباتات التي تمتلك خصـائص مضـادة للأكسـدة والحماية من التسـمم الكلوي. تناولت هذه الدراسـة تأثير مسـحوق الصـمغ العربي، وبذور الخلة ومخلوطهما معا، بنسب مختلفة ٢٪، ٤٪ على الفئران المصابة بخلل في الكلي. في هذه التجربة تم استخدام ٤٨ من ذكور الفئران البيضـــاء، وزنها ١٤٠-١٥٠ ± ١٠ جرام في هذه الدراســـة. تم تقســـيم الفئران إلى ٨ مجموعات. كل مجموعة تحتوي على ٦ فئران. تم إحداث خلل في الكلى في ذكور الفئران البيضـاء السـليمة عن طريق حقن ١٠ ملجم / كجم من وزن الجســم من الجنتاميســين مرة واحدة يوميًا لمدة ١٠ أيام عن طريق الوريد، بينما تم الاحتفاظ بإحداهما كمجموعة ضـــابطة ســـالبة. تم تقدير التحاليل التالية، مســـتوى الجلوكوز، وظائف الكبد في ســـيرم الدم (ALT، AST، ALP)، ووظائف الكلى (الكرياتينين، واليوريا، وحمض البوليك)، وصـــورة دهون الدم (الكوليســـترول الكلي، والدهون الثلاثية، HDL-c، LDL-c، VIDL-c. وفقًا للنتائج، تم تحسين وظائف الكلى والكبد ومستوى الجلوكوز في الدم والدهون في الفئران عن طريق مخلوط الصمغ العربي ومسحوق بذور الخيلة. تم الحصول على أفضل النتائج مع المخلوط بتركيز ٤٪، والذي ينصح باستخدامه كمشروب لتحسين وظائف الكلى. في الختام: في علاج الفئران المصابة بالفشل الكلوي، يمكن اعتبار الصمغ العربي وبذور الخلة من برامج التغذية العلاجية الفعالة.

الكلمات المفتاحية: الفئران، الأعشاب، الفشل الكلوي، التحاليل الكيميائية الحيوية.