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STUDYING THE EFFECT OF FENNEL AND BARLEY SEEDS IN MITIGATION KIDNEY DISEASE OF RATS

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ABSTRACT: This study aims to investigate the effect of fennel and barley seeds on 24 rats with inflicted kidneys weighing 150 ± 10g. Rats were fed on basal diet for 7 consecutive days on basal diet, then divided into 6 groups each of 4 rats. The first was negative control group fed on the basal diet, and the second was positive group injected with gentamicin (10 mg/kg body weight) twice a week for four weeks. As for the other groups, rats treated with 5%, 10%, fennel seeds (FS) and 5%, 10% barley seeds (BS). After twice a week for four weeks of the experiment, rats weight was measured, blood samples were taken for biochemical analysis. Fennel seeds (FS) 10% has best effect in lowering glucose, barley 10% improved enzyme activity Alanine transform (ALT) and fennel 5% improved high-density cholesterol (HDL-C). Barley seeds (BS) 10% has best effect on lowering triglycerides, barley 5% improved low-density lipoprotein and activity of creatinine and urea. Barley seeds (BS) 10% has best effect in lowering activity of total cholesterol and barley 5% acted better in decreasing activity of liver enzymes alkaline phosphatase and glutamic-oxaloacetic transaminase (ALP, AST). The histological investigation confirmed the fact that treatments with fennel and barley seeds mitigation the kidneys and livers diseases. Fennel and barley seeds has good effects on liver and kidney functions, glucose and lipid levels.

Key words: Serum Lipid Profile, Liver Functions, Renal Functions, Histopathological Changes.

INTRODUCTION

The kidneys play a crucial role in regulating blood pressure and the volume of fluid and electrolytes in the body. Although most of us are born with two kidneys, just one suffices to effectively carry out all important tasks (Edgar, 2012). In Egypt, The prevalence rate of end-Stage renal disease (ESRD) in Assiut Governorate during the year 2014 was 366 per million populations (pmp). Unknown etiology and hypertension are the major known causes of ESRD.

A unifying system of an electronic data registry should be established in each governorate to constitute the national Egyptian data registry (Ahmed R El-Arbagy *et al.*, 2016). Physiotherapy is the treatment and prevention of disease using plants, plants parts, and preparations made from them. The plants traditionally used in physiotherapy are called medicinal plants, or herbs. Physiotherapy is only one branch of herbal medicine in which this science covers photochemistry, phytoharmacy, psychopharmacology, and physiotherapy (Weiss and Fintelmann, 2000). Fennel seeds is traditionally used for medicinal and culinary purposes. The entire plant is valuable in the medicinal industry; its enlarged base is used as a vegetable; its leaves are used for culinary purposes and its seeds as a spice and for essential oil extraction. The flowers and leaves are also used to make yellow and brown dyes. Fennel pollen is the most potent form of fennel (Chadwick, 1976). Barley grain powder is the best functional food that provides nutrition and eliminates toxins from cells in human beings; however, its functional ingredients have played an important role as health benefit. In order to better cognize the preventive and therapeutic role of barley grass for chronic diseases, were carried

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out the systematic strategies for functional ingredients of barley grass (Idehen *et al.*, 2017).

The main target of this work is studying the effect of fennel and Barley seeds with different concentration (5 % and 10 %) in mitigation kidney disease of rats.

MATERIALS AND METHODS

Materials

Source of the plants

Fennel and barely seeds were purchased from local market Mnouf City, Menoufia Governorate, Egypt during season of 2018.

Animals

Twenty four adult male albino rats weighing 150 ± 10g were purchased from Helwan Experimental Animals Station. Rats were housed in wire cages under the normal laboratory condition and fed on basal diet and water ad libitum. The rats were made to acclimatize to the ambient environments for seven days before commencing the research.

Methods

Design of study

A total number of 24 male albino rats weighting 150 ± 10 g were used. All rats were fed on basal diet for 7 consecutive days on basal diet to make adjustment, then rats were divided into 6 groups each of 4 rats as following:

Group (1): Control negative group, in which the normal untreated rats fed on basal diet for four weeks.

Group (2): Control positive group in which rats treated with gentamicin (100 ml / 10 mg body weight) orally intragastric twice a week for four weeks.

Group (3): Rats treated with gentamicin then fed on 5% fennel seeds diet.

Group (4): Rats treated with gentamicin then fed on 5% barely seeds diet.

Group (5): Rats treated with gentamicin then fed on 10% fennel seeds diet.

Group (6): Rats treated with gentamicin then fed on 10% barely seeds diet.

Biological evaluation

During the experimental period for each experimental part, the diet consumed was recorded every day, and body weight recorded every week. The body weight gain (BWG %), feed efficiency ratio (FER), and also organ/ body weight% were determinate according to (Chapman *et al*., 1959).

Method of injection

Rats injected with gentamicin (100 ml / 10 mg body weight) to get rats with inflicted renal (Table 1).

Preparation of plants

Fennel and barely seeds were collected to ground by an electrical mill to get powder.

Analytical methods

Determination of serum lipid profile

Determination of triglycerides was carried out according to (Fassati and Prencipe, 1982).

Total cholesterol the principle used of total cholesterol determination according to (Allain, 1974).

HDL -cholesterol was be determined by method according to (Lopez, 1977).

The determination of very low density lipoproteins VLDLC and LDLC were carried out according to the method of (Lee and Nieman, 1996).

As follows:

VLDLC (mg/dl) = Triglycerides/5

LDLC (mg/dl)= Total cholesterol– (HDLC + VLDLC)

Determination of renal functions

Urea was determined according to the enzymatic method of (Patton and Crouch, 1977).

Serum creatinine was determined according to kinetic method of (Henry, 1974).

Determination of liver functions

Alkaline phosphatase (ALP) determined according to the method of (Roy, 1970).

Activities of aspartic aminotransferase (AST) were measured according to the method of (Reitman and Frankel, 1957).

Statistical analysis

The experimental data were subjected to analysis of variance (ANOVA) for a completely randomized design using a statistical analysis system. The results are presented as mean ± SD. Differences between treatments at $p \leq 0.05$ were considered significant (Reitman and Frankel, 1957).

RESULTS AND DISCUSSION

Body weight gain , feed intake and feed efficiency

The results showed that BWG and feed intake was reduced dramatically from 37.82 ± 2.00 % and 10.21 ± 0.84 g/day, respectively for negative control group to 26.70 ± 2.61% and 7.47 ± 0.24 g/day, respectively for positive control group.

Moreover, the feed efficiency ratio (FER) showed insignificant decrease from 0.131 ± 0.24 for negative control group to 0.126 ± 0.04 for positive control group.

Whereas, the BWG and feed intake were increased from 26.70 ± 2.61 % and 7.47 ± 0.24 g/day, respectively for positive control group and from 37.82 ± 2.00 % and 7.47 ± 0.24 g/day, respectively for negative control group to 40.13 ± 2.27 %, 42.62 ± 2.27%, 41.31 ± 3.68%, 40.30 ± 3.68% and 10.98 ± 0.52 g/day, 11.32 ± 0.25 g/day, 11.41 ± 0.21 g/day, 10.70 ± 0.21 g/day for G3, G4, G5, G6, respectively as shown in Table (2).

The results presented in Table (2) indicated that feed efficiency ratio increased from 0.126 ± 0.04 for positive control group and from 0.131 ± 0.24 for negative control group to 0.138 ± 0.04 for G6, decreased from 0.126 ± 0.04 for positive control group and from 0.131 ± 0.24 for negative control group to 0.097 ± 0.13 for G3. Feed efficiency ratio showed insignificant differences in G4 and G5 (0.131 ± 0.08 and 0.132 ± 0.05 respectively) compared to both positive control and negative control groups.

Table (1): Nutrients found in dried fennel (USDA, USA 2014).

Composition	Quantity (Per 100 g)
Proximities	
Moisture	90.21 g
Protein	1.24 g
Total lipid (fat)	0.2 g
Carbohydrate	7.3 g
Total dietary fiber	3.1 g
Sugars	3.93 g
Minerals	
Calcium, Ca	49 mg
Phosphorus, P	50 mg
Potassium, K	414 mg
Sodium, Na	52 mg
Vitamins	
Vitamin C	12 mg
Thiamin B-1	0.01 mg
Riboflavin B-2	0.032 mg
Lipids	
Fatty acids, total saturated	0.09 g
Fatty acids, total monounsaturated	0.068 g
Fatty acids, total polyunsaturated	0.169 g

Table (2): Effect of fennel and barley on body weight gain (BWG), Feed intake (FI) and Feed efficiency ratio (FER) of renal inflammation rats

Parameters / Groups	Body Weight Gain (BWG %)		Feed Intake (G / Day)		Feed Efficiency Ratio (FER)	
	Mean ± SD	% Change of Control (+ Group)	Mean ± SD	%Change of Control (+Group)	Mean ± SD	% Change of Control (+ Group)
G1:Control (-ve)	37.82 ±2.00^{a}	- 41.64	10.21 ±0.84^{c}	- 36.68	0.131 ±0.24^{c}	- 3.96
G2: Control (+ve)	26.70 ± 2.61^{d}	-	7.47 ±0.24^{d}	-	0.126 ±0.4 ^{c}	-
G3: FS 5 %	40.13 ±2.27^{b}	- 50.29	10.98 ±052^{ab}	- 46.98	0.097 ±0.13 ^{d}	- 23.01
G4: BS 5 %	42.62 ±2.27 ^{b}	- 59.62	11.32 ±0.25^{a}	- 51.53	0.131 ±0.08 ^{c}	- 3.96
G5: FS 10%	41.31 ±3.68 ^{b}	- 54.71	11.41 ±0.21^{a}	- 52.74	0.132 ±0.05 ^{b}	- 4.76
G6: BS 10%	40.30 ±3.68 ^{b}	- 50.93	10.70 ±0.21^{b}	- 43.23	0.138 ±0.04 ^{b}	- 9.52
LSD	1.091	-	1.17	-	0.008	-

-Values are expressed as mean of ± SD.
-Significance at ($P \leq 0.05$) using one way ANOVA test.
-Values which have different letters differ significantly and vice versa.

According to the results obtained from this study, BWG was in significantly ($P \leq 0.05$) different among the four groups but barley 5% had the best effect in feed intake increasing activity. Regarding FER, Barley 10% had the best effect in FER increasing activity.

The obtained results are similar to Mazaheri *et al.,* (2013). Who used the fennel essential oil (FEO) as a phytoestrogen source against cisplatin induced nephrotoxicity. The study included Fifty four ovariectomized Wistar rats were divided into seven groups. Groups 1-3 received different doses of FEO (250, 500, and 1000 mg/kg/day, respectively) for 10 days. Group 4 received saline for 10 days plus single dose of CDDP (7 mg/kg, intraperitoneally (ip)) at day 3. Groups 5-7 received FEO similar to groups 1-3, respectively; plus, a single dose of CDDP (7 mg/kg, ip) on day 3. On day 10, the animals were sacrificed for histopathological studies. The results showed that there was no significant change in body weight among the different studied groups.

Additionally, regarding the feed efficiency ratio the results are similar to Abd El-Mageed, (2011) who investigated the effect of diet supplementation with celery, chicory, and barley powder on liver enzymes and blood lipids in rats fed with cholesterol-enriched diet. This study used four groups of rats fed with 3% cholesterol were supplemented diet to induce hypercholesterolemia and one group was fed on cholesterol-free basal diet. Biochemical analyses of serum liver enzymes and blood lipids as well as histopathological examination of liver were performed. The results showed that diets supplemented with 10% barley caused a significant increases in FER. While, contrasted to our results there was a significant increase in BWG%.

Glucose content

Additionally, glucose level was estimated in all studied groups as shown in Table (3).

Glucose level increased ($P \leq 0.05$) from 75.00 ± 0.70 mg/dl for negative control group to 254.66 ± 1.10 mg/dl for positive control group. Glucose level decreased ($P \leq 0.05$) from 254.66 ± 1.10 for positive control group to 96.33 ± 0.50, 105.33 ± 0.80, 81.03 ± 0.90 and 102.32 ± 0.90 mg/dl for G3, G4, G5 and G6, respectively. From the same table glucose level increased ($P \leq 0.05$) from 75.00 ± 0.70 mg/dl for negative control group to 96.33 ± 0.50, 105.33 ± 0.80 and 102.32 ± 0.90 mg/dl for G3, G4 and G6 respectively but showed insignificant ($P \leq 0.05$) increase from 75.00 ± 0.70 mg/dl for negative control group to 81.03 ± 0.90 mg/dl for G5 as presented in Table (3). According to the obtained results from this study, it is concluded that Fennel 10% have the best effect in glucose lowering activity. These findings are comparable to Hong *et al.*, (2022) who estimated the olfactory stimulation by fennel (*Foeniculum vulgare*, Mill) essential oil improves lipid metabolism and metabolic disorders in high fat-induced obese rats.

The odor components were analyzed using gas chromatography/mass spectrometry (GC/MS) and solid-phase microextraction (SPME), and odor-active compounds (OACs) were identified using GC-olfactometry (GC-O). The results demonstrated that the blood glucose level showed a significant increase in the diseased group 126.7 ± 6.5 mg/dl compared to the normal control group 108.7 ± 5.5 mg/dl. Moreover, the blood glucose level was dramatically decreased from 126.7 ± 6.5 mg/dl in the diseased group to 107.2 ± 6.6 mg/dl in the fennel seeds groups after 7 weeks of treatment.

The obtained results are similar to Malunga *et al.*, (2021) who studied his mechanism through which BG from barley affects post-prandial glycemic response. Waffles containing 0, 1, 2, and 3 g barley BG and the same amount of available carbohydrate (15 g) were fed to the TIM-1 dynamic gastrointestinal digestion system to study the effect of BG on starch hydrolysis. The findings illustrated that the administration of barley could significantly reduce the post-prandial blood glucose concentration due to the BG's ability to inhibit intestinal glucose uptake via SGLT1 and GLUT2 transporters.

Liver functions

Liver function was investigated to determine the effect of gentamicin and the therapeutic effect of barley and fennel seeds on the different studied groups as explained in Table (4).

Table (3): Effect of fennel and barley on glucose of renal disorder rats

Groups	Glucose (mg / dl)	
	Mean ± SD	% Change of Control (+ Group)
G1: Control (-ve)	$75.00^{f} \pm 0.70$	70.54
G2: Control (+ve)	$254.66^{a} \pm 1.10$	-
G3: FS 5 %	$96.33^{d} \pm 0.50$	62.17
G4: BS 5 %	$105.33^{b} \pm 0.80$	58.63
G5: FS 10 %	$81.03^{e} \pm 0.90$	68.18
G6: BS 10 %	$102.32^{c} \pm 0.90$	59.82
LSD	1.37	-

-Values are expressed as mean of ± SD.
-Significance at (P ≤ 0.05) using one way ANOVA test.
-Values which have different letters differ significantly and vice versa.

Table (4): Effect of fennel and barley seeds on ALP, AST and ALP of activities.

Parameters / Groups (diets)	ALP U / L		GOT (AST) U / L		GPT (ALT) U / L	
	Mean ± SD	% Change of Control (+ Group)	Mean ± SD	% Change of Control (+ Group)	Mean ± SD	% Change of Control (+ Group)
G1:Control (-ve)	25.33 ± 1.70^{f}	68.73	27.67 ± 1.10^{e}	80.82	8.50 ± 0.80^{d}	62.55
G2:Control (+ve)	81.01 ± 0.90^{a}	-	144.33 ± 1.35^{a}	-	22.70 ± 0.40^{a}	-
G3: FS 5 %	72.00 ± 2.10^{b}	11.12	96.34 ± 2.05^{b}	33.25	11.20 ± 1.20^{c}	50.66
G4: BS 5 %	46.33 ± 1.10^{e}	42.80	64.66 ± 0.60^{d}	55.19	12.93 ± 0.90^{b}	43.03
G5: FS 10 %	63.67 ± 0.80^{c}	21.40	98.67 ± 0.90^{b}	31.63	9.00 ± 0.60^{d}	60.35
G6: BS 10 %	57.67 ± 0.80^{d}	28.81	74.33 ± 0.90^{c}	48.49	7.50 ± 0.60^{d}	99.96
LSD	2.31	-	2.28	-	1.38	-

-Values are expressed as mean ± SD.
-Significance at (P≤0.05) using one way ANOVA test.
-Values which have different letters differ significantly and vice versa.

ALP, AST and ALT activities increased (P ≤ 0.05) from 25.33 ± 1.70 U/L, 27.67 ± 1.10 U/L and 8.50 ± 0.80 U/L, respectively for negative control group to 81.01 ± 0.90 U/L, 144.33 ± 1.35 U/L and 22.70 ± 0.40 U/L, respectively for positive control group ALP, AST and GPT activities reduced (P ≤ 0.05) from 81.01 ± 0.90 U/L, 144.33 ± 1.35 U/L and 22.70 ± 0.40 U/L, respectively for positive control group to 72.00 ± 2.10 U/L, 46.33 ± 1.10 U/L, 63.67 ± 0.80 U/L, 57.67 ± 0.80 U/L and 96.34 ± 2.05 U/L, 64.66 ± 0.60 U/L, 98.67 ± 0.90 U/L, 74.33 ± 0.90 U/L and 11.20 ± 1.20 U/L, 12.93 ± 0.90 U/L, 9.00 ± 0.60 U/L, 7.50 ± 0.60 U/L, respectively for G3, G4, G5 and G6. ALP and GOT levels increased from 25.33 ± 1.70 U/L and 27.67 ± 1.10 U/L, respectively for negative control group to 72.00 ± 2.10 U/L, 46.33 ± 1.10 U/L, 63.67 ± 0.80 U/L, 57.67 ± 0.80 U/L and 96.34 ± 2.05 U/L, 64.66 ± 0.60 U/L, 98.67 ± 0.90 U/L, 74.33 ± 0.90 U/L for G3, G4, G5 and G6, respectively ALT activities showed in significant (P ≤ 0.05) differences from 8.50 ± 0.80 U/L for negative control group to G5 and G6 (9.00 ± 0.60 U/L and 7.50 ± 0.60 U/L, respectively) but increased from 8.50 ± 0.80 U/L for negative control group to 11.20 ± 1.20 U/L and 12.93 ± 0.90 U/L for G3 and G4, respectively. This Table shows that barley seeds 5% have good effect in ALP and AST lowering activity but fennel seeds 10% and barely seeds 10% have good effect in ALT lowering activity in addition, Abdeen *et al.*, (2021) reported similar results in the study that was conducted to assess the ameliorative influence of date palm extract (DE) supplementation against gentamicin (GM)-induced hepato-renal injury. The protective action of high and low doses of DE was assessed alongside the GM remediation (80 mg/kg) in rats. The results explained that GM evoked significant alterations in liver function biomarkers proved by a worthy rise in the activities of liver enzymes AST and ALT in GM group (150 and 59 U/L, respectively) compared to the control group (79 and 38 U/L, respectively). Furthermore, the results come in the line with El Rabey *et al.*, (2013) who studied the efficiency of oat bran and barley bran in lowering the induced hyperlipidemia and hypercholesterolemia in blood of male Albino rats. Twenty rats were divided into four groups each consisted of five rats and fed the specified test diets for eight weeks. The first group (G1) is the negative group which was fed basal diet, the second group (G2) was fed 1.0% cholesterol, the third group (G3) fed 1.0% cholesterol and 10% oats bran, and the fourth group (G4) was fed 1.0% cholesterol and 10% barley bran. The results explained that the mean values of ALP, GOT, and GPT in the positive control (294.20 ± 37.66, 263.02 ± 26.60 U/L and 38.46 ± 2.51, respectively) were higher than that of the negative control (182.60 ± 25.23, 206.20 ± 19.1 U/L and 32.84 ± 2.1, respectively). The differences were significant ($P \leq 0.05$) in case of GPT, nonsignificant (P≤0.05) in case of GOT, and highly significant ($P \leq 0.05$) in case of ALP. In barley seeds treated group, the mean values of ALP, GOT, and GPT (184.20 ± 20.60, 206.80 ± 16.79U/L and 37.34 ± 5.18, respectively) were lower than that of the positive control (294.20 ± 37.66, 263.02 ± 26.60 U/L and 38.46 ± 2.51, respectively) these findings are comparable to Al-Amoudi, (2017) who carried out his study to investigate the possible effect of fennel oil against the toxicity of Sodium-Valproic (SVP) in albino rats. In order to assess the protection of fennel oil on SVP induced hepato- and nephro-toxicity, male albino rats were treated with 1 ml/kg b.w fennel oil 3 days/week for 6 weeks. The biochemical analyses of hepatic enzymes were evaluated by estimating blood biomarkers of liver and renal damage along with histological examination. The results showed that the administration of fennel to rats succeeded significantly in reducing ALP, GPT and GOT (95 , 70 and 65 U/L, respectively) as compared to the diseased group (100, 145 and 115 U/L).

Serum lipid profiles

The obtained data estimated lipid profile in different studied groups and the results were as following in Table (5) and Table (6).

TG and TC levels increased from 103.66 ± 1.31 and 113.10 ± 2.28 mg/dl, respectively for negative control group to 180.67 ± 2.20 and 251.04 ± 3.69 mg/dl, respectively for positive control group. TG level reduced from 180.67 ± 2.20 mg/dl for positive control group to 130.34 ± 1.53, 105.00 ± 4.06, 130.00 ± 2.12 and 97.32 ± 1.50 mg/dl for G3, G4, G5 and G6, respectively. Moreover, TG level increased insignificantly from 103.66 ± 1.31 mg/dl for negative control group to 105.00 ± 4.06 mg/dl for G4 but increased for G3 and G5 (130.34 ± 1.53 and 130.00 ± 2.12 mg/dl). TG level reduced from 103.66 ± 1.31 mg/dl for negative control group to 97.32 ± 1.50 mg/dl for G6 Therefore, it is concluded that Barley 10% have good effect in TG lowering activity. The obtained results are comparable to El Rabey *et al.*, (2013) who demonstrated that the mean values of serum triglycerides (s.TG) in the positive control 114.26 ± 1.67 mg/dL was significantly ($P \leq 0.001$) higher than that of the negative control 93.34 ± 5.7 mg/dL (In the barley treated group, the mean values of the s.TG 62.06 ± 6.44 mg/dL was reduced significantly as compared to the positive control group 114.26 ± 1.67 mg/dL. The findings are compatible to Hong *et al.*, (2022) they demonstrated that the TG level showed a significant increase in the positive control group 102.52 ± 3.14mg/dl as compared to the normal control group 94.20 ± 3.03 mg/dl. In addition, the TG level was decreased in the fennel seeds treated group 88.75 ± 2.02 mg/dl as compared to the positive control group 102.52 ± 3.14 mg/dl after 7 weeks of treatment. The obtained results are matched with El Rabey *et al.*, (2013) who demonstrated that the mean values of s.TC in the positive control 119.46 ± 1.10 mg/dL was significantly higher than that of the negative control 92.70 ± 0.95. In addition, the barley treated group had a significant ($P \leq 0.05$) reduced mean values of the s.TC (73.64 ± 3.93 mg/dL) compared to that of the positive control 119.46 ± 1.10 mg/dL. The current study showed a compatible result to Hong *et al.*, (2022) who demonstrated that the cholesterol (TC) level showed a significant ($P \leq 0.05$) increase in the positive control group (131.45 ± 2.07 mg/dl) compared to the normal control group (128.91 ± 3.63 mg/dl). In addition, the TC level was decreased in the fennel seeds treated group (124.07 ± 4.05 mg/dl) compared to the positive control group (131.45 ± 2.07mg/dl) after 7 weeks of treatment.

Table (5): Effect of fennel and barley seeds on the serum lipid profiles of renal Disorder rats

Groups	TG (mg / dl)		TC (mg / dl)	
	Mean ± SD	% Change of Control (+ Group)	Mean ± SD	% Change of Control (+ Group)
G1: Control (-ve)	103.66 ±1.31[c]	42.62	113.10 ±2.28[f]	54.94
G2: Control (+ve)	180.67 ±2.20[a]	-	251.04 ±3.69[a]	-
G3: FS 5 %	130.34 ±1.53[b]	27.85	185.00 ±3.41[b]	26.30
G4: BS 5 %	105.00 ±4.06[c]	41.88	146.03 ±2.61[g]	41.82
G5: FS 10 %	130.00 ±2.12[b]	28.04	168.00 ±3.34[c]	33.07
G6: BS 10 %	97.32 ±1.50[d]	46.13	133.10 ±3.35 [e]	46.98
LSD	3.66	-	1.26	-

TG = Triglyceride /TC = Total Cholesterol.
-Values are expressed as mean ± SD.
-Significance at ($P \leq 0.05$) using one way ANOVA test.
-Values which have different letters differ significantly and vice versa.

Table (6): Effect of fennel and barley seeds on HDLC, LDLC and VLDLC in rats infected with Gentamicin powder

Groups	HDLC (mg / dl)		LDLC (mg / dl)		VLDLC (mg / dl)	
	Mean ± SD	%Change of Control (+ Group)	Mean ± SD	% Change of Control (+ Group)	Mean ± SD	% Change of control (+ group)
G1: Control (-ve)	46.67[a] ± 0.025	23.07	45.67[i] ± 0.022	- 50	20.73[h] ±0.75	- 51.61
G2: Control (+ve)	37.92[e] ± 2.788	-	176.99[a] ±0.145	-	36.13[a] ±0.024	-
G3: FS 5 %	55.46[b] ± 0.401	46.25	103.42[c] ± 0.024	- 33.03	26.07[g] ±0.04	- 29.84
G4: BS 5 %	53.33[b] ±0.010	40.63	71.7[i] ± 0.025	- 45.56	21.00[b] ±0.050	- 17.44
G5: FS 10 %	48.33[a] ± 0.055	27.45	93.67[c] ± 0.253	- 36.31	26.00[b] ±0.025	- 19.38
G6: BS (10 %)	47.50[b] ±0.70	25.26	66.44[c] ± 0.014	- 40.06	19.44[g] ±0.77	- 30.45
LSD	1.074	-	0.163	-	0.928	-

-Values are expressed as mean ± SD.
-Significance at ($P \leq 0.05$) using one way ANOVA test.
-Values which have different letters differ significantly and vice versa.

HDLC level reduced from 46.67 ± 0.025 mg/dl for negative control group to 37.92 ± 2.788 mg/dl for positive control group but increased from 37.92 ± 2.788 mg/dl for positive control group to 55.46 ± 0.401, 53.33 ± 0.01 and 48.33 ± 0.055 mg/dl for G3, G4 and G5, respectively as illustrated in Table (6). HDLC level showed insignificant increase from 46.67 ± 0.025 mg/dl for negative control group to 48.33 ± 0.055 mg/dl for G5 but increased from 46.67 ± 0.025 mg/dl for negative control group to 55.46 ± 0.401 mg/dl and 53.33 ± 0.01 mg/dl for G3 and G4, respectively.

According to the obtained results from this study, it is concluded that fennel seeds 10% have good effect in HDLC lowering activity. The results are in agreement with El Rabey *et al.*, (2013) who found that the mean values of the serum HDLC- cholesterol (HDLC) was decreased significantly from 13.40 ± 0.86 mg/dl in the negative control group to 8.34 ± 0.56 mg/dl in the positive control group. In the barley treated group, the mean values of the HDLC 18.98 ± 0.94 mg/dL showed a statistically significant elevation when compared to the positive control group 8.34 ± 0.56 mg/dl the current study showed a contrasted results with Hong *et al.*, (2022) who demonstrated that the HDLC level showed a significant increase in the positive control group 42.51 ± 0.44 mg/dl as compared to the normal control group 35.50 ± 0.79 mg/dl. On the other hand the obtained results come in the line with Hong *et al.*, (2022) results as the HDLC level was increased in the fennel seeds treated group 49.90 ± 1.13 mg/dl as compared to the positive control group 42.51 ± 0.44 mg/dl after 7 weeks of treatment. LDLC level increased from 14.65 ± 0.022 mg/dl for negative control group to 29.3 ± 0.145 mg/dl for positive control group but reduced from 29.3 ± 0.145 mg/dl for positive control group to 19.62 ± 0.024, 15.94 ± 0.025, 18.66 ± 0.253 and 17.56 ± 0.014 mg/dl for G3, G4, G5 and G6, respectively. LDLC level showed in significant increase from 14.65 ± 0.022 for negative control group to 15.94 ± 0.025 mg/dl for G4 but increased from 14.65 ± 0.022 mg/dl for negative control group to 19.62 ± 0.024 mg/dl, 18.66 ± 0.253 and 17.56 ± 0.014 mg/dl for G3, G5 and G6, respectively. This table shows that barley seeds 5% have good effect in LDLC lowering activity. VLDLC level increased from 20.75 ± 0.75mg/dl for negative control group to 36.13 ± 0.024 mg/dl for positive control group but decreased from 36.13 ± 0.75mg/dl for positive control group to 26.07 ± 0.04, 21.00 ± 0.050, 26.00 ± 0.025 and 19.44 ± 0.77 mg/dl for G3, G4, G5 and G6, respectively. VLDLC level increased from 20.73 ± 0.75mg/dl for negative control group to 26.07 ± 0.04, 21.00 ± 0.050, 26.00 ± 0.025 and 19.44 ± 0.77 mg/dl for G3, G4, G5 and G6, respectively. So, it is concluded that barley seeds 10% have good effect in VLDLC lowering activity. The obtained results are in a harmony with El Rabey *et al.*, (2013) who showed that the mean values of S. LDLC, and serum very low density lipoprotein cholesterol (S. VLDLC) in the positive control (88.12 ± 3.35 and 20.17 ± 1.67 mg/dl, respectively) were higher than that of the negative control (58.93 ± 1.54 and 17.45 ± 1.37 mg/dl, respectively).

The difference was highly significant ($P \leq 0.001$), in S.LDLC compared with that of the negative control. In the barley treated group, the mean values of the S.LDLC, and S.VLDLC 42.26 ± 4.28 and 12.40 ± 1.28 mg/dL , respectively were lower than that of the positive control it was 88.12 ± 3.35 and 20.17 ± 1.67 mg/dl, respectively, the differences were highly significant ($P \leq 0.001$) as compared with the positive control. The current study exposed a harmonious result with Hong *et al.*, (2022) who demonstrated that the LDLC level showed a significant increase in the positive control group 75.62 ± 1.59 mg/dl compared to the normal control group 46.72 ± 1.78 mg/dl. In addition, the LDLC level was decreased in the fennel treated group 55.95 ± 5.41 mg/dl compared to the positive control group 75.62 ± 1.59 mg/dl after 7 weeks of treatment.

Table (7): Effect of fennel and barley seeds on creatinine and urea of renal disorder rats

Groups	Creatinine (mg / dl)		Urea (mg / dl)	
	Mean ± SD	% change of control (+group)	Mean ± SD	% change of control (+group)
G1: Control (-ve)	0.64[e] ±0.05	- 48.38	22[e] ±2.64	-47.19
G2: Control (+ve)	1.24[a] ±0.025	-	41.66[a] ±3.05	-
G3: FS 5 %	0.74[d] ±0.025	- 40.32	27.73[d] ±0.025	- 33.43
G4: BS 5 %	0.65[e] ±0.014	- 47.58	26.74[d] ±0.014	- 35.81
G5: FS 10 %	0.72[d] ±0.01	- 41.93	27.53[d] ±0.403	- 33.91
G6: BS 10 %	0.88[g] ±0.01	- 29.03	32.4[d] ±0.2	- 22.22
LSD	0.42	-	2.446	-

-Values are expressed as mean ± SD.

-Significance at (P≤0.05) using one way ANOVA test.

-Values which have different letters differ significantly and vice versa.

Renal functions

The laboratory investigation of renal function for all studied groups was illustrated in Table (7).

The obtained results demonstrated that creatinine level increased from 0.64 ± 0.05 mg/dl for negative control group to 1.24 ± 0.025 mg/dl for positive control group but reduced from 1.24 ± 0.025 mg/dl for positive control group to 0.74 ± 0.025, 0.65 ± 0.014 , 0.72 ± 0.01 and 0.88 ± 0.01 mg/dl for G3, G4, G5 and G6, respectively. Creatinine level showed insignificant increase from 0.64 ± 0.05 for negative control group to 0.65 ± 0.014 mg/dl for G4 but increased from 0.64 ± 0.05 mg/dl for negative control group to 0.74 ± 0.025, 0.72 ± 0.01 and 0.88 ± 0.01 mg/dl for G3, G5 and G6, respectively.

Therefore, barley seeds 5% have good effect in creatinine lowering activity. The obtained results are similar to Comba *et al.*, (2017) who conducted his study to search the effect of barley grass (BG) on the total antioxidant (TAS) – (oxidant status (TOS)) and DNA damage (8OHdG) in rat with renal failure. The rats were randomly divided into 4 groups: Control gp; injected i.p. with saline for 7 days, Gentamicin gp; GM (80 mg/kg/day) was injected i.p. for 7 days, barley gp; was given oral BG (250 mg/kg/day) for 4 weeks, GM+BG gp; it was a GM gp with BG (250 mg/kg/day) orally for 4 weeks. Blood sample and kidney tissue were taken for biochemical and histological analysis. The results showed that creatinine level was significantly decreased in barley treated groups (0.57±0.06 mg/dL) compared to gentamycin group (0.76±0.07 mg/dL).

Moreover, Al-Amoudi, (2017) reported similar results where the group treated with fennel showed a significant decline in the creatinine level (0.85 mg/dL) in comparison to the diseased group (1.95mg/dL). Additionally, the current study found that urea level increased from 22 ± 2.64 mg/dl for negative control group to 41.66 ± 3.05 mg/dl for positive control group but reduced from 41.66 ± 3.05 mg/dl for positive control group to 27.73 ± 0.025 , 26.74 ± 0.014, 27.53 ± 0.403 and 32.4 ± 0.2 mg/dl for G3, G4, G5 and G6, respectively.

Urea level increased from 22 ± 2.64 mg/dl for negative control group to 27.73 ± 0.025, 26.74 ± 0.014, 27.53 ± 0.403 and 32.4 ± 0.2 mg/dl for G3, G4, G5 and G6, respectively. So, according to the obtained results from this study, it is concluded that 5% barley seeds have good effect in Urea lowering activity. These findings are in accordance with Comba *et al.*, (2017) who exhibited that urea level was significantly decreased in barley treated groups (45.57±2.99 mg/dL) as compared to gentamycin group (65.24±4.98 mg/dL). Furthermore, the obtained results are matched to [20] who reported that the group treated with fennel showed a significant decline in urea level (37 mg/dL) in comparison to the diseased group (52mg/dL).

Histopathological examination of kidneys

Microscopically, kidneys of rats from group 1 revealed the normal histological structure of renal parenchyma (photo.1). Meanwhile, kidneys of rats from group 2 revealed vacillation of epithelial lining renal tubules, distension of Bowman's space with filtrate (photo.2) and interstitial nephritis (photo.3). However, kidneys of rats from group 3 revealed no histopathological changes (photo.4) except congestion of renal blood vessel and congestion of glomerular tuft (photo. 5) in some examined sections. Meanwhile, kidneys of rats from group 4 showed congestion of renal blood vessel and congestion of glomerular tuft (photo. 6) as well as vacuolation of epithelial lining renal tubules (photo. 7). However, kidneys from group 5 showed slight congestion of glomerular tufts (photo. 8), congestion of renal blood vessel and thickening of the glomerular basement membrane (photo.9).

Examination of kidneys from group 6 revealed slight congestion of glomerular tufts (photo.10) in some examined sections, whereas, in other sections showed vacuolation of epithelial lining renal tubules with congestion and vacuolation of glomerular tufts (photo.11).

Histopathological examination of liver

Microscopically, liver of rats from group 1 revealed the normal histological structure of hepatic lobule (photo.1). In contrary, liver of rats from group 2 revealed focal hepatic necrosis associated with inflammatory cells infiltration (photo.2) and portal infiltration with inflammatory cells (photo.3). However, liver of rats from group 3 revealed slight congestion of central veins (photo.4) and small focal hepatic necrosis associated with inflammatory cells infiltration (photo.5). Meanwhile, liver of rats from group 4 showed no histopathological changes (photo.6) except congestion of central veins and hepatic sinusoids (photo.7) in some examined cases. Liver of rats from group 5 revealed focal hepatic necrosis associated with inflammatory cells infiltration (photo.8) and slight congestion of central veins and hepatic sinusoids (photo.9). However, liver of rats from group 6 revealed no histopathological changes except Kuepfer cells activation (photoes.10&11).

The obtained results are in a harmony with Abdeen *et al.,* (2021) who demonstrated that GM-intoxicated rats exhibited cytoplasmic vacuolation of centrilobular hepatocytes. Central vein and portal blood vessels congestion, as well as sinusoidal obliteration, were also spotted. Besides, focal areas of hemorrhage, necrosis, and fibrosis with tremendous portal inflammatory seepage and obvious zonation of hepatic lobules were noticed.

Moreover, the obtained results come in the line with El Rabey *et al.,* (2013) who studied the microscopic structure of hepatic tissues and found that the control group had the hepatic strands of cells and blood sinusoids. The hepatic tissue suffering from hypercholesterolemia has fatty liver tissue with disrupted cells, vacuolated cytoplasm, and necrosis with disrupted hepatic strands. The hepatic tissues of rats fed barley showed no necrotic hepatic tissues with normal hepatic strands.

Furthermore, similar findings were recorded by Al-Amoudi, (2017) who reported that there was a remarkable improvement and regeneration in the periportal zone was noticedafter administration of fennel in dite. In addition, some hepatocytes appeared acidophilic with granular cytoplasm and central vesicular nuclei were similar to the normal, but few leukocyte inflammatory.

Finally treatment with fennel and barley diets actually mitigated kidney and liver diseases.

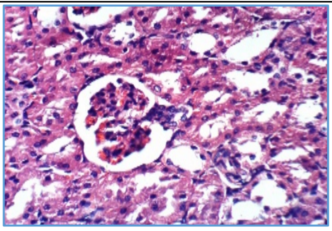

Photo (1): Kidney of rat from group1 showing the normal histological structure of renal parenchyma (H & E X 400).

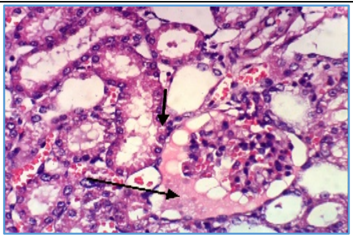

Photo (2): Kidney of rat from group 2 showing vacuolation of epithelial lining renal tubules and distension of Bowman's space with filtrate (H & E X 400).

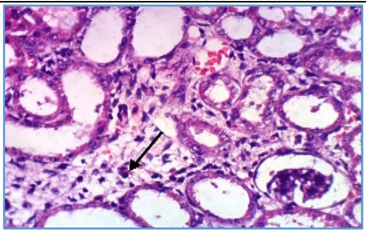

Photo (3): Kidney of rat from group 2 showing interstitial nephritis (H & E X 400).

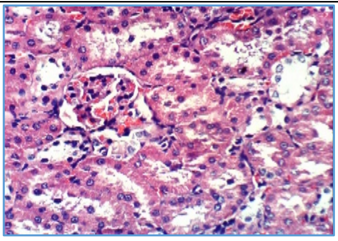

Photo (4): Kidney of rat showing no histopathological changes (H & E X 400).

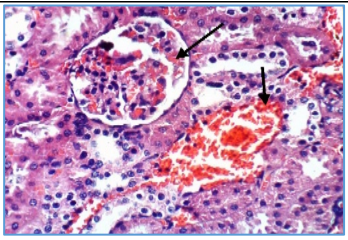

Photo (5): Kidney of rat from group 3 showing congestion of renal blood vessel and congestion of glomerular tuft (H & E X 400).

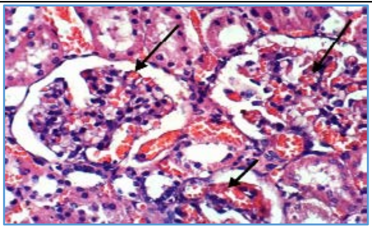

Photo (6): Kidney of rat from group 4 showing congestion of renal blood vessel and congestion of glomerular tuft (H & E X 400).

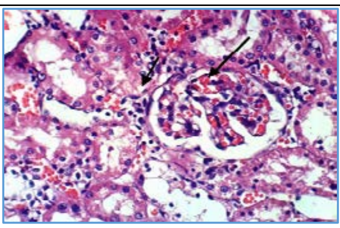

Photo (7): Kidney of rat from group 4 showing vacuolation of epithelial lining renal tubules and congestion of glomerular tufts (H & E X 400).

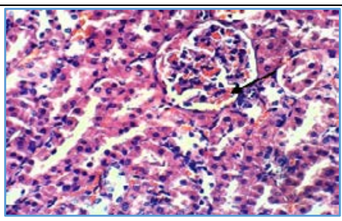

Photo (8): Kidney of rat from group 5 showing slight congestion of glomerular tufts (H & E X 400).

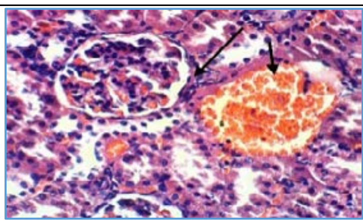

Photo (9): Kidney of rat from group 5 showing congestion of renal blood vessel and thickening of the glomerular basement membrane (H & E X 400).

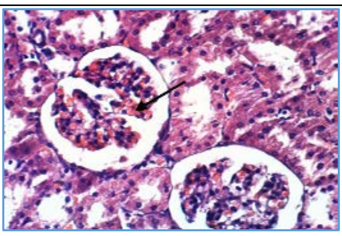

Photo (10): Kidney of rat from group 6 showing slight congestion of glomerular tufts (H & E X 400).

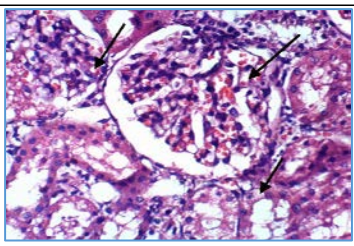

Photo (11): Kidney of rat from group 6 showing vacuolation of epithelial lining renal tubules with congestion and vacuolation of glomerular tufts (H & E X 400).

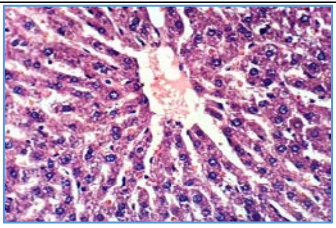

Photo (1): Liver of rat from group 1 showing the normal histological structure of hepatic lobule **(H & E X 400).**

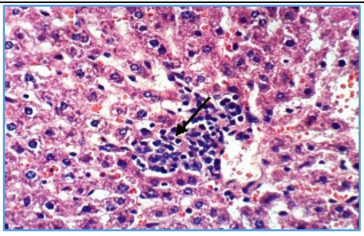

Photo (2): Liver of rat from group 2 showing focal hepatic necrosis associated with inflammatory cells infiltration **(H & E X 400).**

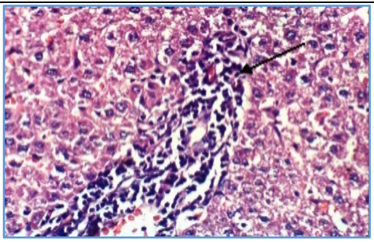

Photo (3): Liver of rat from group 2 showing portal infiltration with inflammatory cells **(H & E X 400).**

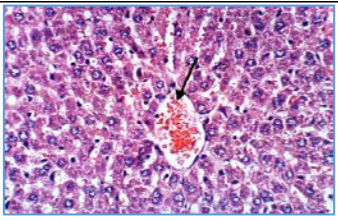

Photo (4): Liver of rat from group 3 showing slight congestion of central veins **(H & E X 400).**

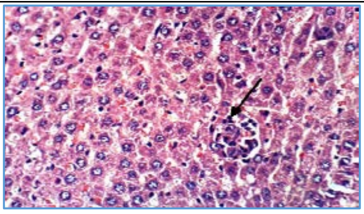

Photo (5): Liver of rat from group 3 showing small focal hepatic necrosis associated with inflammatory cells infiltration **(H & E X 400).**

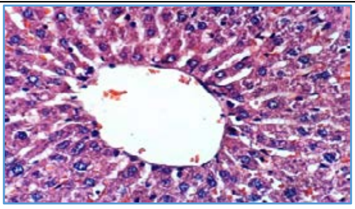

Photo (6): Liver of rat from group 4 showing no histopathological changes **(H & E 400).**

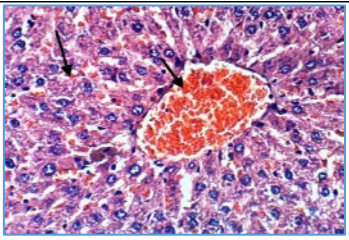

Photo (7): Liver of rat from group 4 showing congestion of central veins and hepatic sinusoids **(H & E X 400).**

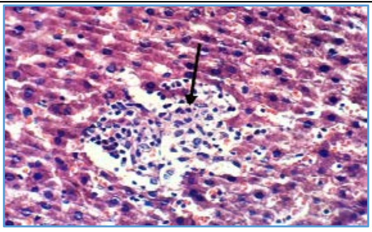

Photo (8): Liver of rat from group 5 showing focal hepatic necrosis associated with inflammatory cells infiltration **(H & E X 400).**

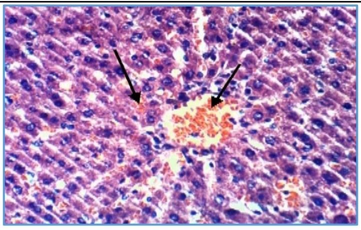

Photo (9): Liver of rat from group 5 showing slight congestion of central veins and hepatic sinusoids **(H & E X 400).**

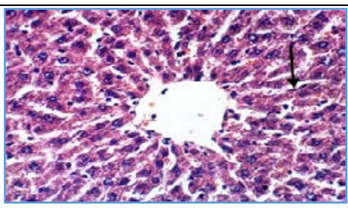

Photo (10): Liver of rat from group 6 showing Kupffer cells activation **(H & E X 400).**

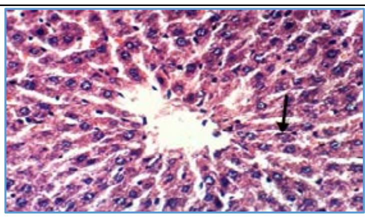

Photo (11): Liver of rat from group 6 showing Kupffer cells activation **(H & E X 400).**

Conclusion

The current research shows that the use of fennel seeds has a good effect on glucose, lipid levels, liver and kidney functions, also fennel seeds have a protective effect on liver and kidney disorders. Moreover, barley seeds has been shown to lower cholesterol and has a protective effect on various tissues that can improve glucose level and reduce fatty liver. The study also showed that giving barley improves nephrotoxicity. In general both barley and fennel acted good on the inflicted rats.

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دراسة تأثير بذور الشمر والشعير في تخفيف مرض الكلي للفئران

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قسم التغذية وعلوم الأطعمة ، كلية الاقتصاد المنزلي ، جامعة المنوفية ، شبين الكوم ، مصر

الملخص العربي

تهدف هذه الدراسة إلى استخدام بذور الشمر والشعير على الفئران المصابة بالكلى. ٢٤ فأر وزنهم ١٥٠ ± ١٠ جم. تم تغذيتهم لمدة ٧ أيام متتالية بنظام غذائي أساسي ، ثم قسمت الفئران إلى ٦ مجموعات كل منها ٤ فئران ، المجموعة الأولى مجموعة ضابطة سالبة تم تغذيتها على النظام الغذائي الاساسي والمجموعة الثانية مجموعة ضابطة موجبة حقنت بالجنتاميسين (١٠ملجم / ١٠٠جم من وزن الجسم) عن طريق الفم مرتين في الأسبوع لمدة أربعة أسابيع اما المجموعات الأخري تم علاجها بنسبة ٥٪ شمرو ٥٪ شعير كما تم استخدام ١٠٪ شمرو ١٠٪ شعير بعد انتهاء التجربة تم قياس وزنهم وأخذ عينات الدم لتقدير بعض (وظائف الكلى - وظائف الكبد - مستويات الدهون - الجلوكوز). وأوضحت النتائج أن التغذية على الشمر ١٠٪ له أفضل تأثير في خفض نسبة الجلوكوز ووجد ان التغذية على ١٠٪ شعير أثرت علي نشاط الإنزيم (ALT) جيدا والتغذية على ٥٪ شمر أثرت جيدا علي البروتين الدهني عالي الكثافة. والتغذية على الشعير ٥٪ له أفضل تأثير في خفض الدهون الثلاثية والبروتين الدهني منخفض الكثافة ومستويات الكرياتينين واليوريا. والتغذية على الشعير ١٠٪ له أفضل تأثير في خفض نشاط الكوليسترول الكلي وكما ان التغذية على ١٠٪ شعير كانت الافضل في التأثير علي نشاط إنزيمات الكبد (ALP،AST). يمكن القول بأن للشمر تأثير جيد على وظائف الكبد والكلى ومستوى الجلوكوز والدهون كما ان للشعير تأثير جيد علي مستوى الجلوكوز والكبد الدهني و يخفض نسبة الكوليسترول ويحسن من السمية الكلوية وعموما كان كل من الشمر والشعير ذات تأثير جيد في تخفيض مؤشرات تدهور الكلى وقد تأيد ذلك بالفحص الهستولوجي .

الكلمات الداله : الجلوكوز ، وظائف الكبد ، وظائف الكلي .