Ameliorating Effect of Corn Silk and Forssk Herb *(Achillea* Fragrantissima) On renal functions of Diabetic Rats

Tasneem Sobhy Fahmy and Asmaa Ahmed M. Hussein
Nutrition and Food Science Department, Faculty of Home Economics, Helwan University, Egypt.

Abstract

The purpose of this study was to examine ameliorating Effect of corn silk and forssk herb on renal functions of diabetic rats. The study involved 42 albino rats of the Sprague-Dawley strain. Following the adaptation period, all rats were randomly divided into two main groups. The first Main group was maintained on a basal diet and keept as a negative control group (-ve). The second main group (n = 35 rats) was injected subcutaneously with a single dose of streptozotocin to induce diabetes. Following streptozotocin administration, the rats were split into 5 groups. The First, a positive control group (+ve) fed on basal diet. The other four group were feed the experimental meals contained different percentages of corn silk extract (5% and10%), and forssk extract (5% and 10%), respectively. After six weeks of the experiment, the glucose levels were determined. Additionally, the biochemical functions of the liver and kidneys were established. As well as, MDA & SOD enzyme were created. The kidney and pancreas were examined histologically. The results indicated that five groups had lower liver enzyme levels of ALT, AST and ALP than the positive control group. In comparison to the positive control group, all examined groups had significant improvements in serum levels of glucose, urea nitrogen and creatinine. The results of histological investigations, which correlated with the biochemical study, significantly improved with the addition of corn silk and forssk. The study suggests that increasing corn silk and forssk consumption may be beneficial for diabetes patients, potentially acting as an anti-diabetic agent.

Keywords
Corn Silk, Forssk, Liver Enzymes, Diabetic, Glucose 6-phosphate dehydrogenase, Antioxidant Enzymes, Insulin.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder that leads to chronic hyperglycemia, a pathogenesis condition that may include defects in insulin secretion and/or action (Clement *et al.,* 2023). Several scientific studies have indicated that diabetes affects the human quality of life by causing major risk factors for adverse complications such as stroke, amputation, kidney failure, and blindness, leading to significant morbidity and premature mortality Garcia *et al.,* (2018).

Several approaches are used for diabetes treatment: via the intake of healthy food and diet control, using insulin injections, or standard hypoglycemic chemical drugs. (Krentz, 2006). The current modes of treatment for this disease may be effective but lead to adverse complications. Consequently, for the treatment of diabetes mellitus a significant number of medicinal plants have been preferred as a natural source of drugs (Dhasarathan & Theriappan, 2011): as they are considered to be safe, less toxic, and more readily available than synthetic drugs (Arshad *et al.,* 2023).

Corn silk is composed of the style and stigma of Z. mays L., which was introduced to China during the Ming Dynasty. It is believed to be a diuretic that can promote diuresis and reduce swelling, eliminate dampness and alleviate jaundice, soothe the liver and promote bile flow. Clinical Chinese Medicine" and many other works on Chinese medicine have recorded the inclusion of corn silk as a medicine, which can be used for acute and chronic nephritis, edema, and diabetes. The research team utilized metabonomics methods to study the hypoglycemic mechanism of corn silk in the early-stage (Dong *et al.,* 2023).

Many countries of the world like the United States, China, and Turkey have been using corn silk to treat kidney stones, prostate disorders, cystitis, edema, urinary tract infections, obesity, bedwetting, and diuretic. According to recent researches, corn silk promotes the flow of bile, causes a reduction in hyperglycemia,

causes inhibition of IgE content by glycoproteins, and possesses anti-tumor effect and neuroprotective effects against oxidative stress, as well as has anti-fatigue activity by suppressing the production of blood lactic acid in animals (Ayesha *et al*., 2022).

Achillea fragrantissima (yarrow) (Forssk) is commonly known as 'Quysoom-aletri' in Arabic and is widely found in Arab countries (Alshuai *et al*., 2022). It is traditionally used as a medicinal tea for the treatment of various disorders, such as respiratory infections, digestive problems, eye infections, diabetes, and diarrhea (Yasir *et al.*, 2023). This plant is rich in phenolic acids and a large number of flavonoids that are known to possess good antimicrobial effects.

The desert plant *Achillea fragrantissima* is traditionally used internally in traditional medicine of the Arabian region against hepatobiliary disorders, inflammatory and spasmodic gastrointestinal complaints, against skin inflammations and for wound healing and as an appetite enhancing drug. This plant is effective by antioxidative and anti-inflammatory properties. The main pharmacologically active principles were shown to be polyphenols, flavonoids, alkamides and terpenes (Jiri and Zdenka, 2019).

Achillea genus have phenolic acids such as protocatechuic, chlorogenic, vanilic, ferulic and quinic acid, in addition flavonoids such as apigenin, apigenin-rutinoside, apigeninglucoside and apigenin-neohesperioside, luteolin, vitexin and vitexin-rhamnoside, diosmetin, cirsiliol, chrysoplenetin, chrysophanol D), lignans (sesamin), terpenic lactones (achillolid A) and alkamides (pellitorin, 8,9-Z-dehydropellitorin, anacyclin) have been found as mainly bioactive compounds. In water-alcohol extracts of the above-ground portions of Achillea fragrantissima, a varied mixture of water-soluble polyphenols was found in the amount of 56.6 mg of gallic acid equivalent in 1 gram of dry weight of plant (Jiri and Zdenka, 2019).

Aim of study

The purpose of this study was to examine ameliorating Effect of corn silk and forssk herb on renal functions of diabetic rats.

Materials and Methods

Materials:

Cellulose, Casein, vitamin mixture, minerals, and the kits for the preparation of basal diet analysis were purchased from El-Gomhoria Company for Trading Drugs, Chemicals and Medical Requirements. Corn silk and Forssk were obtained from the Agricultural Research Centre, Giza, Egypt.

Forty - two albino rats of Sprague-Dawley strain weighing approximately 180 ± 5 g were purchased from Helwan Farm for Experimental Animals, Cairo, Egypt.

Methods:

Preparation of the diet

The basal diet was prepared according to Reeves *et al*., (1993). It consists of 20 % protein, 10 % sucrose,5 % corn oil, 2% choline chloride, 3.5 % minerals mixture, 1% vitamins mixture, and 5% fibers.

There were two primary groups of animals. The first main group (n = 7) was fed the baseline diet all of the trial period and used as a negative control group (-ve). The remaining animals (n=35) received a single subcutaneous injection of streptozotocin (70 mg/kg body weight). According to Dorababu et al., (2004).

Experimental animal design

After injection of rats with streptozotocin, animals were divided into 5 subgroups as follows:

Subgroup (1) Rats with diabetic rats were fed on basal diet as positive control group.
Subgroup (2) Rats with diabetic rats were fed on the basal diet and receive 1ml/day of corn silk extract at concentration 5 %.
Subgroup (3) Rats with diabetic rats were fed on the experimental diet and receive 1ml/day of corn silk extract at concentration 10 %.
Subgroup (4) Rats with diabetic rats were fed on the experimental diet and receive 1ml/day of forssk at concentration 5%.
Subgroup (5) Rats with diabetic rats were fed on the experimental diet and receive 1ml/day of forssk at concentration 10 %.

At the end of the experiment (6weeks) all rats fasted overnight, lightly anesthetized under ether. Blood was withdrawn into clean dry centrifuge plastic tubes. Blood samples were centrifuged and serum was obtained then stored at -20 º C in a clean well stopped vial until analysis.

Biochemical analysis

Serum glucose and insulin were determined according to the method described by (Astoor and King, 1954) and (Temple *et al.*, 1992), respectively. The liver enzyme alanine aminotransferase (ALT), Aspartate aminotransferase (AST), alkaline phosphatase (ALP) was determined according to Sherwin, 1984, (Young, 1990) and Roy *(1970)*, respectively. Serum urea nitrogen, and creatinine concentration were determined by the method of Fossati et al., (1980), and Henry, (1974) respectively. Serum MDA was determined according to Draper and Hadly, (1990). Serum SOD was measured according to Aebi *et al.*, (1972), respectively.

Statistical analysis

The statistical analysis was carried out by using SPSS, PC statistical software (Version 18.0 SPSS Inc., Chieago, USA) using the Dunk 'test multiple range post-hoc test. Data were analyzed by one-way analysis variance (ANOVA). The values were considered significantly different at $P < 0.05$ (Snedecor and Cochran, 1980).

Results and Discussion

The effect role's role of corn silk extract and the extract of forssk on plasma glucose and insulin levels of the experimental rats.

Results in Table (1) showed the effect of corn silk extract and forssk on the plasma glucose of the experimental rats. Results showed that plasma glucose was increased significantly in rats suffering from diabetes with a mean value of 404.87± 35.32 mg/dl compared with the normal control group with a mean value of 89.15± 7.66 mg/dl. Results revealed that all treated rats showed a reduction in plasma glucose compared diabetic rats.

The data in the same table clarified the effect of corn silk extract and forssk on insulin levels of the experimental rats. Data indicated that insulin level was decreased significantly in rats suffering diabetes with a mean value 0.93± 0.01 μU/ml compared with the normal control group with a mean value of 9.49± 0.44 μU/ml. As shown in table (1) results revealed that all treated rats have an increase in insulin levels compared to diabetic rats. The best results were seen in rats fed on forssk at concentration 10%.

Corn silk is nutritionally rich in carbohydrates, protein, fibre and bioactive compounds namely, flavonoids, phenolic acids, flavones, volatile oils and pigments. Which favours its incorporation in therapeutic foods to prevent chronic illness (Kaur *et al.*, 2023). Our results at the line with Hamzah et al., (2023) who reported that treated diabetic rats with 100 and 200 mg/day of the phenolic-rich fraction of young corn silk had their blood glucose levels significantly lowered by 67.45 % and 66.85 %, respectively, compared with the diabetic control group, with more insulin detected in their pancreatic homogenates through ELISA assay.

Forssk is reputed for its antidiabetic properties in the folk medicine of the Middle East. Our results showed that forssk extract improved blood glucose and serum insulin levels in groups 5 and 6. These results may be attributed to the forssk compound that inhibit the activity of α-glucosidase enzyme (El-Fattah et al., 2018).

Table (1): The effect roles role of corn silk extract and forssk on plasma glucose and insulin levels of the experimental rats.

Parameters / Groups		Parameter as Mean ± SD	
		Glucose (mg/dL)	Insulin (μU/mL)
Negative control group		89.15± 7.66 [e]	9.49± 0.44 [a]
Positive control group		404.87± 35.32 [a]	0.93± 0.01 [e]
Treated groups with corn silk extract at concentration of	5%	256.66± 4.89 [b]	3.77± 0.80 [d]
	10%	189.68± 5.35[c]	5.49± 0.72[c]
Treated groups with forssk at concentration of	5%	183.69± 8.07 [c]	5.57± 0.49[c]
	10%	154.19± 3.21 [d]	7.63± 0.45 [b]

Values are expressed as mean ± S.D. Means with the different superscript letters in the same column were significantly different at $P \leq 0.05$.

The effect of corn silk extract and forssk on the Activity of ALT& AST and ALP enzyme in the experimental Rats

Results in Table (2) showed the effect of corn silk extract and forssk on serum activity of alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP). Results showed that diabetic rats (positive control group) have a significant increase in the serum levels of ALT& AST and ALP, compared to normal rates. However, all treated groups with corn silk extract a significant decrease in the serum concentration of ALT& AST and ALP, compared to positive control group. The best improved results were reported in rats treated with forssk at concentration (10%) and corn silk extract at concentration (10%).

Flavonoid is the most active compound on corn silk which evidently has high antioxidant level and uppermost DPPH scavenging activity so, the activity of corn silk infusion on liver enzyme alteration may be connected to its active compound in addition flavonoid can neutralize free radicals, *(* Pham *et al., 2008)*.

This study is in the same line with Enas *et al., (2020)* who reported that treatment with corn silk (CS) led to improvement of liver tissue which can be attributed to the antioxidant activity of corn silk due to its total phenolic and flavonoids content. Histopathological findings CS protected the hepatic tissue against acetaminophen through its antioxidant activity.

These findings are in agreement with Matsuzawa *et al.*, (2022) who found that the administration of forssk enhanced liver functions of rats fed on HFD, as shown by the normalization of ALT, AST, and ALP which are an indicator of liver function.

Achillea fragrantissima contains a large number of chemical constituents. Vitexin, a polyphenolic compound in the plant, is reported for enhanced liver functions.

Our results in the same line with Afnan, (2021) who demonstrated after treatment with forssk, there was a substantial drop in liver enzymes, indicating that the Achillea extract is hepatoprotective. The antioxidant components of forssk, such as terpenoids, phenolics, phenolic acids, flavonoids, and lignans, are thought to play a role in hepatoprotection role of AF. Flavonoids are antioxidants, free radical scavengers, and anti-lipoperoxidants that protect the liver. The results were confirmed by the histopathological findings in the treated groups.

Table (2): The effect of diet with corn silk extract and forssk on the activity of ALT& AST and ALP in the Diabetic rats

Parameters / Groups		Parameter as Mean ± SD		
		ALT (U/L)	AST (U/L)	ALP(U/L)
Negative control group		32.38± 1.34 e	43.73± 2.48 e	2.06± 0.10 e
Positive control group		123.60± 2.12 a	148.86± 2.15 a	8.27± 0.17 a
Treated groups with corn silk extract at concentration of	5%	83.56± 4.39 b	101.11± 4.99 b	6.73± 0.29 b
	10%	69.37± 2.42 c	80.98± 3.08 c	5.51± 0.25 c
Treated groups with forssk at concentration of	5%	64.55± 3.55 c	80.97± 1.45 c	5.16± 0.20 c
	10%	45.73± 4.65 d	57.14± 1.59 d	4.02± 0.10 d

The effect of diet with corn silk extract and forssk on Serum concentrations of creatinine and urea nitrogen in the experimental Rats

Table (3) showed the effect of corn silk extract and forssk on kidney functions (urea nitrogen and creatinine concentration in serum). Results showed that diabetic rats (positive control group) were significant increase of serum levels of urea nitrogen with a mean value of 11.41± 0.64 mg/dl compared with the negative control group (1.62± 0.07 mg/dl). While the groups of rats have corn silk extract and forssk at any level of intake showed a significant decrease in serum levels of urea nitrogen in addition group (5) considered the best value of serum urea nitrogen concentration.

The data in the same table clarified that the positive control group with diabetic had increased in the concentration of creatinine level with a mean value of 15.10± 0.36 mg /dl compared with the negative control group (2.20± 0.06 mg / dl). Groups of rats with diabetic which were have corn silk extract and forssk at any levels of intake showed a reduction in the concentration of serum levels of creatinine compared with the positive control group. The best level was shown in groups 5 and consider better than the negative control group.

Serum urea nitrogen and creatinine levels are used in the assessment of renal disease. The increase in creatinine in the positive control group recorded in this work might be due to impaired kidney function by the used toxicity. This view was supported by Ahmed *et al*., (2006) who showed that an elevation of uric acid and creatinine level in the blood is an indicator of impaired kidney functions.

This result was the same line with Sukandar et al., (2013) who demonstrated that corn silk extract improvement kidney functions by increasing the urine output, which can help remove the toxins and wastes out, hence reducing creatinine level. Also, Corn silk extract helps remove the excess fluid out, which can help relieve the swelling. High blood pressure, being the most prominent symptom, is decreased with the help of corn silk extract. CS containing chemicals that works as diuretics, and can also helpful in reducing inflammations and kidney problems (Miriam et al., 2015).

Treatment with Forssk (100 and 200 mg/kg) significantly ($P<0.05$) decreased serum blood urea nitrogen, and creatinine levels and caused increased total protein and albumin levels (Warda and Esam, 2024).

Table (3): The effect of Diet with corn silk extract and forssk on Serum Concentrations of Creatinine and Urea Nitrogen in the Diabetic Rats

Parameters / Groups		Parameter as Mean ± SD	
		Creatinine (mg/dl)	Urea Nitrogen (mg/dl
Negative control group		2.20± 0.06 [e]	1.62± 0.07 [e]
Positive control group		15.10± 0.36 [a]	11.41± 0.64 [a]
Treated groups with corn silk extract at concentration	5%	10.26± 0.51 [b]	7.74± 0.33 [b]
	10%	8.17± 0.75 [c]	5.51± 0.52 [c]
Treated groups with forssk at concentration	5%	7.94± 0.08 [c]	5.01 ± 0.02 [c]
	10%	5.19± 0.46 [d]	3.40± 0.39 [d]

The effect of Diet with corn silk extract (CS) and forssk on the Serum Concentrations of SOD Enzyme and MDA in the experimental Rats

Results in Table (4) illustrate the effect of CS extract and forssk on serum liver lipid peroxidation and antioxidant enzymes of experimental rats.

Results of superoxide dismutase (SOD) concentration; as a marker of oxidative stress; diabetic control group have a significant decrease in SOD concentration compared with the normal control group with a mean value of (0.78± 0.03u/ml and 3.88± 0.06 u/ml, respectively.

Concerning the first studied marker of oxidative stress; malondialdehyde (MDA) concentration; results showed that there was an increase in MDA concentration of diabetic control group with a mean value of (4.82± 0.24nmol/ml) compared with the normal control group (0.80± 0.02 nmol/ml). All treated groups showed a significant decrease in MDA concentration compared with the diabetic control group.

Many mechanisms are involved in lowering high blood glucose levels. One of them is scavenging the reactive oxygen species that destroy β-cells. Oxidative stress plays a vital role in the deterioration of all biological functions. Forssk produced significant antioxidant activity through decreasing MDA and increasing GSH in the serum sample of the treated rats. GSH is an intracellular antioxidant that can prevent oxidative stress and MDA is a highly reactive marker of oxidative stress (Abdel-Hamed *et al.*, 2021). Biochemical estimation of antioxidant activity by GSH and MDA determination as well as in vivo α-amylase decreased activity of different in vitro A. fragrantissima administered to STZ diabetic rats (Goda *et al.*, 2023). Corn silk is a rich natural source of phytosterols, proteins, antioxidant, polyunsaturated fatty acids, vitamins, carotenoids, tocopherols, and various elements, due to these components are attributed providing many health benefits (Miriam et al., 2015). CS effectively increases antioxidant enzyme levels such as SOD and CAT (Hu and Deng, 2011).

Forssk administration normalized different antioxidants in both plasma and livers of obese rats. Superoxide dismutase (SOD) and catalase (CAT) are two main antioxidant enzymes which important

for the conversion of superoxide anions to hydrogen peroxide. SOD reduces blood glucose levels by removing superoxide radicals from plasma and the liver (Zhang *et al.*, 2015). Sanad *et al.*, (2022) found when treating the obese rats with two doses of Forssk resulted in higher SOD and CAT activities in both plasma and livers, which proves the capability of Forssk to eradicate ROS and protect the SOD/CAT system that removed superoxide radicals.

Increased hepatic MDA causes the production of free radicals, which result in decreased membrane functions eventually leading to macrovascular and microvascular dysfunction. Hyperlipidemic rats had elevated MDA levels and decreased SOD levels, which were effectively reversed by administration of forssk. This could be owing to the phytochemicals found in forssk, such as flavonoids, saponins, and tannins, which have been shown to have antioxidant properties. Antioxidants reduce lipid peroxidation and other free radical-mediated actions by acting as radical scavengers. As a result, they aid in the prevention of a wide range of diseases especially diabetes and kidney disease caused by radical reactions Afnan, (2021)

Table (4): Effect of diet with corn silk extract and forssk on the serum concentrations of SOD and MDA the enzymes in the experimental rats

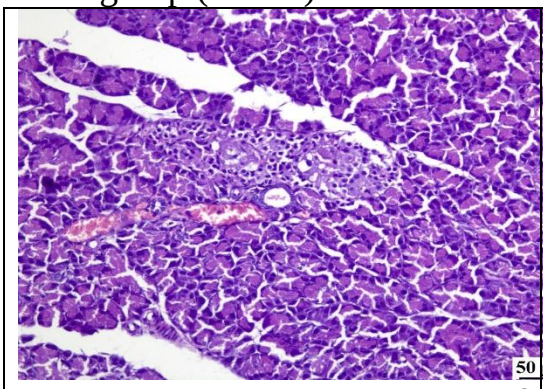
Parameters / Groups		Parameter as Mean ± SD	
		SOD (µ/ mg)	**MDA (µmol /g)**
Negative control group		**3.88± 0.06 [a]**	**0.80± 0.02 [e]**
Positive control group		**0.78± 0.03[e]**	**4.82± 0.24[a]**
Treated groups with corn silk extract at concentration	**5%**	**1.67± 0.07[d]**	**3.57± 0.35 [b]**
	10%	**1.99± 0.04[c]**	**2.16± 0.09 [c]**
Treated groups with forssk at concentration	**5%**	**2.14± 0.17 [c]**	**2.12± 0.07 [c]**
	10%	**2.64± 0.20 [b]**	**1.75± 0.23 [d]**

Histopathological examination of Pancreas:

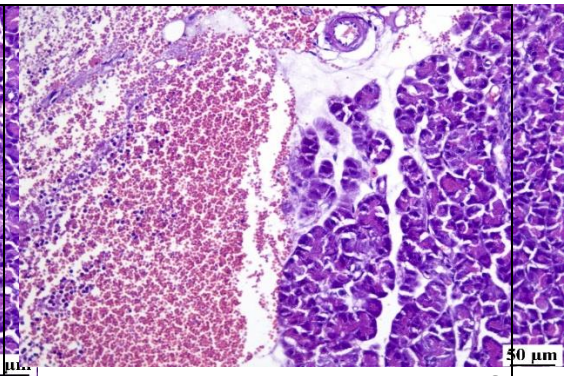
Microscopic examination of pancreas from the control group (Pho. 1) revealed normal structure of both exocrine units and endocrine components of pancreas. Islets of Langerhans appeared of normal size and containing β-cells.

Photomicrograph of pancreas group (Pho. 2) showed atrophied ill-distinct islets of Langerhans. The endocrine cells exhibited degeneration with marked vacuolation, necrosis and inflammation in some instances. The peripancreatic tissue showed severe hemorrhages.

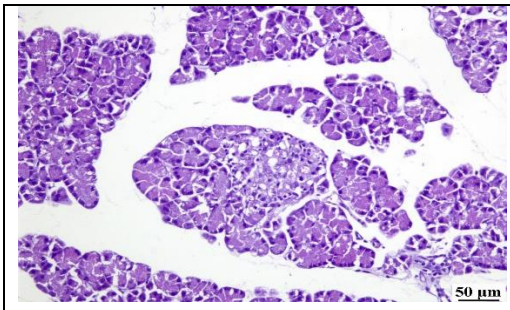
Moderate alteration was detected in the islets of Langerhans in G3 group (Pho. 3) that characterized by moderate atrophy of pancreatic islets with degeneration of endocrine cells. Marked improvement was observed in G4 group (Pho. 4) . Several islets of Langerhans revealed apparently normal histological structure. Mild degeneration was observed in G5 group (Pho. 5). with normal sized pancreatic islets. Apparently normal pancreatic islets were observed in G6 group (Pho. 6).



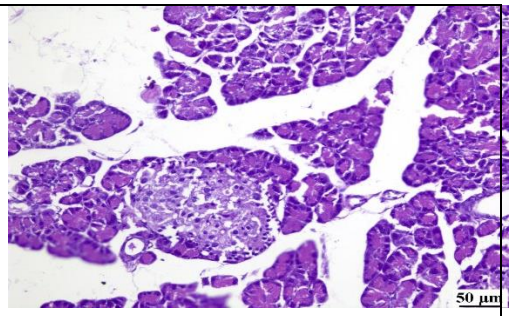
Pho. (1): Photomicrograph of pancreas control group(-ve) showing normal histology of normal islets of Langerhans exocrine acini (H&E).



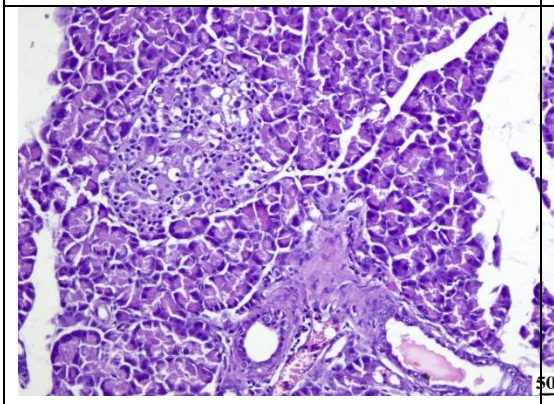
Pho. (2): Photomicrograph of pancreas PC group showing inflammatory cells infiltration in the peripancreatic tissue (arrow) with marked hemorrhages (H&E).



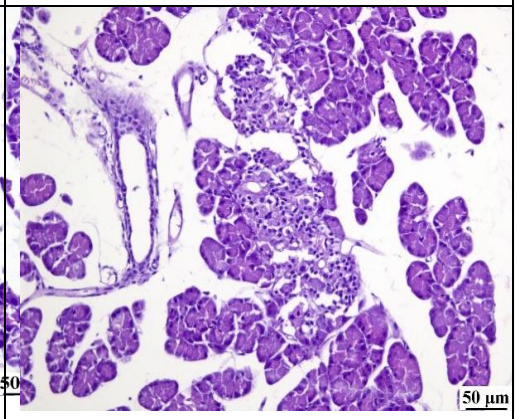
Pho. (3): Photomicrograph of pancreas G3 group showing atrophy of pancreatic islet with degeneration and necrosis of endocrine cells (arrow) (H&E).



Pho. (4): Photomicrograph of pancreas G4 group showing apparently normal pancreatic islet (arrow) (H&E).



Pho. (5): Photomicrograph of pancreas G5 group showing mild vacuolation of endocrine cells (H&E).

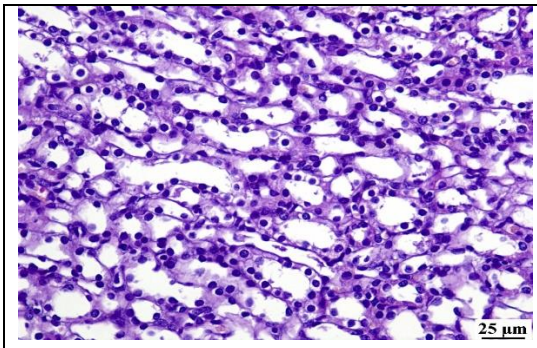


Pho. (6): Photomicrograph of pancreas G6 group showing apparently normal endocrine islet (H&E).

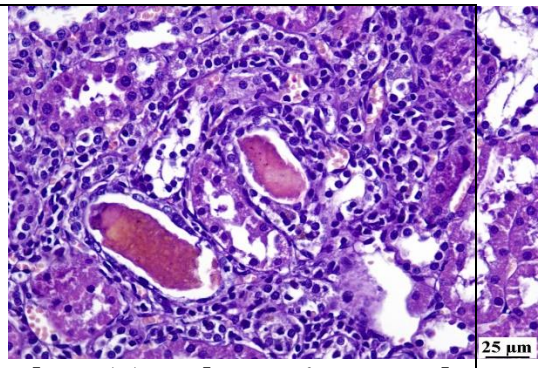
Histopathological examination of Kidney:

Histopathological examination of kidney sections from G1 group (Pho. 6) revealed normal renal cortex and medulla. Examination of G2 group (Pho. 7) revealed multifocal interstitial nephritis associated with severe congestion of interstitial blood

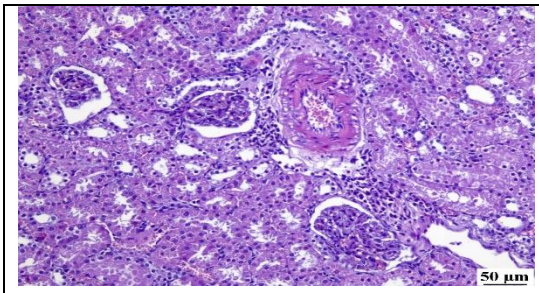
vessels. Renal casts were observed in several sections. Examination of G3 group (Pho. 8) revealed swelling of epithelial lining renal tubules in the renal cortex with narrowing of the tubular lumen. The renal medulla showed moderate congestion of the interstitial blood vessels. Apparently normal renal parenchyma was determined in G4 group (Pho. 9). Poor protective effect occurred in G5 group (Pho. 10) that revealed multifocal interstitial nephritis that characterized by higher aggregation of mononuclear inflammatory cells. Renal casts were less frequently detected. Higher protective effect was determined in G6 group (Pho. 11) that revealed mild interstitial nephritis in fewer examined sections, with apparently normal renal tissue in several examined sections.



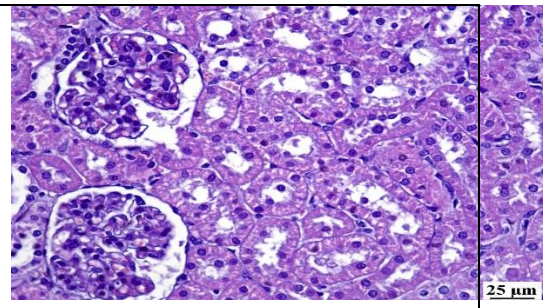
Pho. (6): Photomicrograph of kidney, G1 group showing normal renal medulla (H&E).



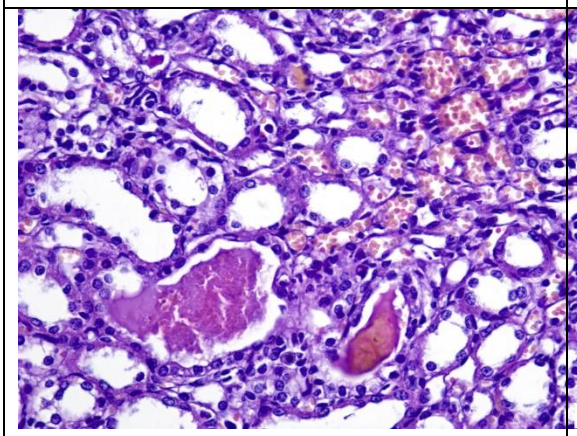
Pho. (7): Photomicrograph of kidney, G2 group showing interstitial nephritis with presence of renal casts in the tubular lumen (H&E).



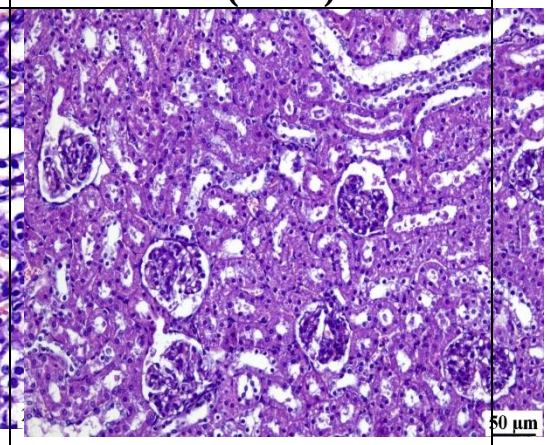
Pho. (8): Photomicrograph of kidney, G3 group showing fewer perivascular inflammatory cells infiltration (H&E).



Pho. (9): Photomicrograph of kidney, G4 group showing apparently normal renal cortex (H&E).



Pho. (10): Photomicrograph of kidney, G5 group showing renal casts in the tubular lumen of renal medulla (H&E).



Pho. (11): Photomicrograph of kidney, G6 group showing apparently normal renal tissue (H&E).

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التأثير التحسينى لحرير الذرة و عشبة القيصوم على الخلل الكلوى الناجم عن مرض السكرى للفئران

تسنيم صبحى فهمى & أسماء أحمد محمد حسين
قسم التغذية وعلوم الاطعمة، كلية الاقتصاد المنزلى، جامعة حلوان

الملخص العربي

تعتبر النباتات الطبية ومكوناتها علاجًا آمنًا لمجموعة متنوعة من الأمراض ، لا سيما مضاعفات مرض السكري. لذلك تهدف هذه الدراسه الى معرفة التأثير التحسينى لحرير الذرة و عشبة القيصوم على الخلل الكلوى الناجم عن مرض السكرى للفئران . وقد تم استخدام اثنين واربعون فأرا من ذكور فئران الالبينو البالغة وتم تقسيمهم إلى ٦ مجموعات (كل مجموعة = ٧فئران) وكانت مدة التجربة ٦ أسابيع . المجموعة الاولى تغذت على الغذاء الاساسى (المجموعة الضابطة). بينما تم حقن ٣٥ فأرا المتبقية بمادة الستربتوزوتوسين لاحداث الاصابة بمرض السكري . وتم تقسيمهم ٥ مجموعات . فرعية .المجموعة الاولى كانت المجموعة الضابطة الموجبة . و المجموعات الأخرى تم تغذيتها على وجبات تحتوي على نسب مختلفة من مستخلص حرير الذرة و عشبة القيصوم ٥٪ و١٠٪ على التوالي .وفى نهاية مدة التجربة، تم قياس مستويات الجلوكوز .بالإضافة إلى ذلك، تم قياسكلا من انزيمات الكبد والكلى وقياس إنزيمات MDA و SODالمضادة للأكسدة .كما تم عمل الفحوص التشريحية للكلى والبنكرياس . وقد أشارت النتائج إلى أن المجموعات المعالجة لديها مستويات أقل من إنزيمات الكبد ALT و ASTو ALP مقارنة بالمجموعة الضابطة الإيجابية. و بالمقارنة مع المجموعة الضابطة الإيجابية، كان لدى جميع المجموعات المعالجة التي تم فحصها تحسينات كبيرة في نيتروجين اليوريا والكرياتينين .واشارت نتائج الفحوصات النسيجية المرتبطة بالدراسة البيوكيميائية تحسن بشكل ملحوظ مع إضافة حرير الذرة و عشبة القيصوم . وتشير الدراسة إلى أن زيادة استهلاك حرير الذرة و عشبة القيصوم قد يكون مفيدا لمرضى السكري، ومن المحتمل أن يعمل كعامل مضاد للسكري.

الكلمات المفتاحية

حرير الذرة، عشبة القيصوم ، إنزيمات الكبد، مريض السكر، ، الانزيمات المضادة للأكسدة، الأنسولين.