Faculty of Home Economics

Journal of Home Economics
Menoufia University, Shibin El Kom, Egypt
https://mkas.journals.ekb.eg

Menoufia University

Nutrition and Food Sciences

Potential Effect of Mulberry and Fig Leaves on Streptozotocin – Induced Diabetic Rats

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Abstract

Mulberry and fig leaves used as medicinal plants due to they contain high active compounds. Decoctions of plants leaves are used as folk medicine for the treatment of diabetes. The effects of different concentrations 2 and 4% of white mulberry (*Morus alba*) and fig (*Ficus carica*) leaves, as well as their mixture as powder, on glucose levels in diabetic rats were studied. A total of 48 rats were used in this experiment, which were divided into eight groups of six rats each. Streptozotocin (STZ) was used to induce rat's diabetic. Biochemical tests were performed to evaluate glucose levels, cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c), low-density lipoprotein cholesterol (VLDL-c), as well as liver and kidney functions. Results showed that rats fed on 4 % mixture powder recorded the lowest glucose level with significant differences being136.50 mg/dl. The lower liver functions (ALP, AST, and ALT) and kidney functions (urea, uric acid, and creatinine) of diabetic groups were recorded for the group fed on 4 percent mixture powder, but the highest value was recorded for the group fed on 2 percent fig leaves powder with a significant difference, while the lowest triglyceride and cholesterol values were recorded for the group fed on 4 percent mixture powder. The group fed on 4 percent combination leaves powder had the highest HDL-c of all the treated groups. The rats fed on 2% fig leaves powder had the highest LDL-c and VLDL-c of the treatment group. As conclusion, all biochemical analyses, particularly glucose levels, improve with a 4% mixture leaves powder.

Key words: *Plant leaves, Rats, Glycemic, Biochemical analysis.*

Introduction

Diabetes mellitus is a metabolic illness that health officials are concerned about, and its incidence is rising rapidly in both emerging and industrialized countries. In 1985, the

World Health Organization estimated that 30 million people had diabetes. In 1995, that figure grew to 135 million people, and by 2025, it is expected that 300 million people will be affected [(1)]. Diabetes mellitus is becoming more common over the world, and its principal effects (disability and hospitalization) are putting a significant financial strain on people [(2)]. Diabetes is one of the most common chronic diseases in the world, impacting over 100 million individuals. Hyperglycemia, improper lipid and protein metabolism, and distinct long-term consequences affecting the retina, kidneys, and nervous system characterize the two major kinds of diabetes mellitus [(3)].

In many nations, medicinal plants have long been used to treat diabetes. As a result, several medicinal plants have been studied in the hopes of discovering hypoglycemic drugs [(4)]. The World Health Organization (WHO) has advised that traditional herbs can be a good choice for the treatment of diabetes because of their activity, which is nontoxic and has few or no adverse effects [(5)]. Plants have been used as medicine, food, housing, clothing, hunting, and spiritual rites by ancient peoples to improve their quality of life. The utilization of plants as food and medicine are two of the most solid reasons for their widespread use. Many surveys around the world have reported on the health benefits and nutritional aspects of these plants [(6)].

Ficus carica, Linn. (Moraceae), commonly referred as figs or Anjir, is a tropical and subtropical plant cultivated for its nutritive and therapeutic characteristics in India and around the world. It is widely utilized in indigenous medical systems such as ayurveda, siddha, and homoeopathy. Jaundice, diarrhea, nutritional anemia, and as an anti-inflammatory agent have all been traditionally treated using fig leaves, bark, tender shoots, fruits, seeds, and latex [(7)]. Fig leaf decoctions are utilized as folk medicine in the treatment of diabetes [(8)]. It was discovered that the leaves of the fig plant contain significant levels of total phenol and flavonoid, which can operate as powerful antioxidants [(9)]. According to some researches, the leaves of the plant contain more phenolic compounds than the stem bark and fruit [(10)]. In diabetic rats, aqueous and organic extracts of fig leaves had equal hypoglycemic effects, and it was also investigated whether diabetes problems could be caused by oxidative stress [(11)]. Each portion of the fig plant has a variety of medical applications. The fruit of the fig has a strong flavor, high sugar content, and low acidity. Vitamin A, vitamin C, iron, and calcium are just a few of the many vitamins and minerals found in figs. Rutin, quercetin, sapogenin, coumarins, and psitaraxasteryl ester are abundant in the leaves of this plant. The dried leaves of the fig tree are used to treat asthma and severe conjunctivitis, while the fruit is said to have antidepressant, emollient, and digestive properties [(12)]. Antioxidant activity is strong in fig leaves. The highest overall phenol and flavonoid concentration was found in a water extract of fig leaves. However, it is still unclear which antioxidants have the greatest

impact. Various studies have demonstrated that flavonoids, quercetin, and ferulic acid, which are prevalent in fig leaves, have hypoglycemic properties [(13)].

Sugar-mimicking alkaloids known to have hypoglycemic characteristics, such as 1,4-dideoxy-1,4-imino-D-arabinitol, 1-deoxynojirimycin, and 1,4-dideoxy-1,4-imino-D-ribitol, are abundant in the leaves of many types of Morus [(14)]. Mulberries can block all or some intestinal disaccharidases and pancreatic amylases via controlling monosaccharide uptake, making them useful in the treatment of type 2 diabetes mellitus [(15)]. Mulberries' fruits, roots, and leaves are commonly used to treat dizziness, sleeplessness, premature ageing, and DM2. They also protect against atherosclerosis, liver and renal disease, as well as inflammation [(16)]. White mulberry leaves are high in nutrients. There is a high amount of polysaccharides, which improves glucose metabolism and protects the body from oxidative stress by increasing insulin sensitivity and preserving the pancreatic islets from the consequences of diabetes. Furthermore, because their deregulation causes alterations in insulin levels and glucose metabolism, they improve lipid metabolism [(17)]. It's also interesting to note that the hypoglycemic properties of mulberry extracts, whether derived from their fruits or leaves, are beneficial in the treatment of people with impaired glucose tolerance or diabetes. They also help by reducing the impact of metabolic abnormalities that occur during the condition, such as hypercholesterolemia and hypertriglyceridemia [(18)]. Inflammation has been noted frequently in obese and diabetic people, and different portions of the mulberry have traditionally been utilized to treat these symptoms [(19)]. In type 2 diabetic patients, mulberry leaf powder reduced blood glucose, triglycerides, VLDL cholesterol, LDL cholesterol, and fatty acids. In addition, in healthy people, mulberry leaf ethanol–water extract (used in confections) successfully reduced postprandial blood glucose and insulin levels [(20)].

The purpose of this study was to see how diabetic rats responded to varying amounts of white mulberry and fig leaves, as well as their mixture powder.

Material & Methods

Materials

White mulberry (*Morus alba*) and fig (*Ficus carica*) leaves were obtained from local farms, Beheira Governorate, Egypt.

Diet ingredients

Pure white crystalline cholesterol powder and saline solutions were purchased from SIGMA Chemical Co., USA. Casein, DL methionine, choline, and chloride cellulose, were purchased from Morgan Co. Cairo, Egypt.

Experimental animals

A total of 48 adult normal male albino rats Sprague Dawley strain weighing 140±10 g was obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

The chemical kits

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP, urea and creatinine) were obtained from Al-Gomhoria Company for Chemical, Drugs Trading and Medical Instruments, Cairo, Egypt.

Methods

Experimental design

Forty- eight adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to [21] for 7 consecutive days. Following this acclimatization period, rats are divided into eight groups, each group which consists of 6 rats as follows: Group (1): A group rats fed on basal diet as negative control. Group (2): A group injected by streptozotocin a dose of 40 mg per kg of weight of the rat and used as a positive control group. Group (3): A group infected diabetics fed on the white mulberry leaves as powder by 2% of the weight of the diet. Group (4): A group infected diabetics fed on the white mulberry leaves as powder by 4% of the weight of the diet. Group (5): A group infected diabetics fed on the fig leaves as powder by 2% of the weight of the diet. Group (6): A group infected diabetics fed on the fig leaves as powder by 4% of the weight of the diet. Group (7): A group infected diabetics fed on the mixture white mulberry leaves and fig leaves as powder by 2% of the weight of the diet. Group (8): A group infected diabetics fed on the mixture white mulberry leaves and fig leaves as powder by 4% of the weight of the diet. During the experimental period, the body weight and feed intake were estimated weekly and the general behavior of rats was observed. The experiment will take 28 days, at the end of the experimental period each rat weighted separately then, rats are slaughtered and blood samples collected. Blood samples were centrifuged at (4000 rpm) for ten minute to separate blood serum, then kept in deep freezer till using.

Blood sampling

At the end of each experiment, blood samples were taken from the hepatic portal vein after a 12-hour fast. Blood samples were collected into dry, clean centrifuge glass tubes and allowed to clot for 28 minutes in a water bath (37°C), after which they were centrifuged for 10 minutes at 4000 rpm to separate the serum, which was carefully aspirated and transferred into clean cuvette tubes and stored frozen at -20°C until analysis according to the method described by [22].

Biochemical analysis

Lipids profile

Serum total cholesterol determined according to the colorimetric method described by [23]. Serum triglycerides determined by enzymatic method using kits according to [24] **and** [25]. HDL-c was determined according to the method described by [26] **and** [27]. While VLDL-c was calculated in mg/dl according to **(28)** using the following formula:

VLDL-c (mg/dl) = Triglycerides / 5

LDL-c was calculated in mg/dl according to [28] as follows:

LDL-c (mg/dl) = Total cholesterol – HDL-c – VLDL-c

Liver functions

Determinations of serum alanine amino transferase (ALT), serum asparatate amino transferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of [29], [30] **and** [31], respectively.

Kidney functions

Serum urea and serum creatinine were determined by enzymatic method according to [32] **and** [33]. While serum uric acid was determined calorimetrically according to the method of [34].

Determination of blood glucose

Enzymatic determination of plasma glucose was carried out calorimetrically according to the method of [35].

Statistical analysis

The data were analyzed using a completely randomized factorial design [36] when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

Results and discussion

Data presented in table (1) show the effect of white mulberry, fig leaves and their combinations on glucose levels of diabetic rats. The obtained data revealed that the positive control group had a higher glucose level, whereas the negative control group had a lower level, with a significant difference ($P \leq 0.05$). The mean values were 276.25 and 97.97 mg/dl, respectively.

When compared to the control positive group, diabetic rats fed a 4 % leaves mixture had the lowest glucose level with a significant difference ($P \leq 0.05$), the average level was 105 mg/dl. The highest glucose level in diabetic rats was reported for 2 % white mulberry leaves with a significant difference ($P \leq 0.05$) being 163 mg/dl. These findings were in accordance those of **Ren *et al.,*** [37] who found that biochemical parameters improved when compared to the untreated diabetes group and the control group. There was an improvement in glucose tolerance, a restoration of hepatic glycogen stores, an increase in

insulin levels, and a reduction in hepatic oxidative stress, among the observed effects. In addition, using mulberry leaf extract (125 and 250 mg) reduced serum blood sugar levels significantly **(38)**.

Active ingredients in mulberry leaves, have a highly positive effect on blood sugar levels with hyperglycemia. Mulberry leaves, in addition to treating and maintaining blood sugar levels in diabetics, have neuroprotective effects that help to avoid microvascular and macrovascular problems induced by hyperglycemia **(39)**.

The mulberry leaf powder (*Morus alba*) had a favorable effect on fasting blood glucose and insulin levels after 10 weeks of administration to streptozotocin-induced diabetic mice **(40)**.

An aqueous extract of fig leaves was discovered to have a considerable hypoglycemic impact in rats, however the mechanism behind this action has yet to be discovered **(8)**.

Rashidi and Noureddini, (41) they reported that oral ingestion of fragrant water leaves of *Ficus carica* reduced blood glucose levels in normal and diabetic rats. Various sections of fig plants have been found to have anti-diabetic properties in several investigations. Fig leaves have a considerable hypoglycemic effect (42).

Table (1): Effect of white mulberry, fig leaves and their mixtures on glucose level of diabetic rats

Treatments / Groups	Glucose (mg/dl)
G1 (-)	97.97 ^{h} ± 1.285
G2 (+)	276.25 ^{a} ± 1.15
WML (2%)	163 ^{b} ± 0.9
WML (4%)	154 ^{d} ± 1.36
FL (2%)	159.5 ^{c} ± 0.89
FL (4%)	150 ^{e} ± 1.72
Mixture (2%)	136.5 ^{f} ± 1.45
Mixture (4%)	105 ^{g} ± 0.67
LSD (P ≤ 0.05)	**2.1142**

WML=White mulberry leaves, FL=Fig leaves. Each value represents the mean ± SD of three replicates.

Data tabulated in table (2) show the effect of white mulberry, fig leaves and their mixtures on serum liver functions (ALP, ALT and AST) of diabetic rats. It is clear to notice that the (ALP) of positive control group recorded the higher value when compared with negative control group with a significant difference. The mean values were 71.7 and 29.085 U/L, respectively.

While the group fed 2% fig leaves had the highest serum ALP, the group fed 4% fig leaves had the lowest, with a significant difference (P≤0.05), which were 55.25 and 37.5 U/L, respectively.

On the other hand, the serum ALT of positive control group was significantly (P≤0.05) higher than that of negative control group. The average values were 92.85 and 28.76 U/L, respectively. While, the group fed on 2% fig leaves had highest serum ALT. While 4% leaves mixture had the lowest with a significant difference (P≤0.05). The mean values were 71.8 and 45.5 U/L, respectively.

In the case of serum AST, the positive control group had a significantly (P≤0.05) higher value when compared to the negative control group, which were 74.25 and 19.33 U/L, respectively. The group fed 4 % white mulberry leaves had the highest serum AST, whereas the 4 % leaves mixture had the lowest, with a significant difference (P≤0.05), which were 44.55 and 24 U/L, respectively. These findings are consistent with Xu *et al.,* [43], which found that when a leaf hydroethanolic extract of *Morus alba* was given to rats on an HF diet for 12 weeks at a dose of 200 mg/kg of body weight, ALT and AST levels were reduced. They're vital serum indicators of liver function.

Also, Hwang *et al.,* [18] they also found that diabetic rats given the leaf extract of mulberry (480 mg/kg) for 21 days had an acceptable reduction in ALT and AST values.

Table (2): Effect of white mulberry, fig leaves and their mixtures on serum (ALP, ALT and AST) of diabetic rats

Treatments / Groups	ALP (U/L)	ALT (U/L)	AST (U/L)
G1 (-)	29.085 ^{e} ± 1.57	28.76 ^{g} ± 1.55	19.33 ^{h} ± 0.987
G2 (+)	71.7 ^{a} ± 1.64	92.85 ^{a} ± 1.69	74.25 ^{a} ± 1.78
WML (2%)	40.15 ^{d} ± 1.67	62.35 ^{cd} ± 1.38	31.4 ^{e} ± 1.46
WML (4%)	39.3 ^{d} ± 1.47	57.5 ^{e} ± 1.532	44.55 ^{b} ± 1.57
FL (2%)	55.25 ^{b} ± 1.654	71.8 ^{b} ± 1.657	41.45 ^{c} ± 1.43
FL (4%)	48.45 ^{c} ± 1.904	64.7 ^{c} ± 1.2	38.34 ^{d} ± 0.908
Mixture (2%)	48 ^{c} ± 1.741	61.5 ^{d} ± 1.75	28.6 ^{f} ± 1.36
Mixture (4%)	37.5 ^{d} ± 1.29	45.5 ^{f} ± 0.98	24 ^{g} ± 0.769
LSD (P ≤ 0.05)	**2.815**	**2.575**	**2.293**

WML=White mulberry leaves, FL=Fig leaves. Each value represents the mean ± SD of three replicates.

The effect of white mulberry, fig leaves, and their mixtures on serum total cholesterol and triglycerides in diabetic rats is shown in table (3). The results showed that the cholesterol levels of the positive control group were greater than those of the negative control group, with a significant difference (P≤0.05). The mean values were 138.06 and 71.86 mg/dl, respectively. While the group fed the 4 % leaves mixture had the lowest cholesterol levels,

the 4 % fig leaves had the highest, with a significant difference (P≤0.05). The mean values were 85.0 and 110.1 mg/dl, respectively.

In the other hand, the triglyceride of positive control group recorded the higher value when compared with negative control group with a significant difference (P≤0.05). The mean values were 129.7 and 71.4 mg/dl, respectively. While, the lowest triglyceride recorded for group fed 4% leaves mixture, while the highest value recorded for 2% fig leaves with a significant difference (P≤0.05). The mean values were 71.5 and 93.8 mg/dl, respectively. These results are in agree with **Swathi *et al.,*** [44], who found that feeding diabetic rats an ethanolic extract from Morus alba leaves in two doses (150 and 300 mg/kg) for 12 weeks resulted in hypoglycemic effects. There was a decrease in serum lipid levels, such as total cholesterol (TC) and triglycerides, in addition to blood glucose reduction (TG). It also helped to protect the kidneys from oxidative damage. A study in which rats were given hydroethanolic extracts from the leaves of mulberry for 12 weeks saw a reduction in insulin, total cholesterol, and triglycerides [45]. In hyperlipidemia, in high fat diet-induced obese male rats, the hypolipidemic and protective effects of fig leaf extract 50 or 100 mg/kg for six weeks were investigated. TG was greatly reduced by fig leaf extract [46].

Table (3): Effect of white mulberry, fig leaves and their mixtures on serum total cholesterol and triglycerides of diabetic rats

Treatments / Groups	TC (mg/dl)	TG (mg/dl)
G1 (-)	71.86 ^{g} ± 1.96	71.40 ^{g} ± 1.86
G2 (+)	138.06 ^{a} ± 1.35	129.7 ^{a} ± 1.94
WML (2%)	98.55 ^{d} ± 1.72	85.45 ^{d} ± 1.153
WML (4%)	93.15 ^{e} ± 1.83	76.10 ^{f} ± 1.459
FL (2%)	105.9 ^{c} ± 1.57	93.80 ^{b} ± 1.63
FL (4%)	110.1 ^{b} ± 1.46	88.30 ^{c} ± 1.71
Mixture (2%)	95.85 ^{de} ± 1.25	81.00 ^{e} ± 1.56
Mixture (4%)	85.00 ^{f} ± 1.63	71.50 ^{g} ± 1.4
LSD (P ≤ 0.05)	**2.79**	**2.781**

WML=White mulberry leaves, FL=Fig leaves.Each value represents the mean ± SD of three replicates.

Data presented in table (4) show the effect of white mulberry, fig leaves and their mixtures on serum lipid profiles of diabetic rats. The results revealed that the HDL-c of negative control rats group recorded the higher value when compared with positive control group with significant difference (P≤0.05). The mean values were 42.35 and 26.1 mg/dl, respectively. While, the highest HDL-c of treated group recorded for group fed on 4% leaves mixture but, the lowest value recorded for group fed on 2% white mulberry leaves

with a significant difference (P≤0.05). The mean values were 40.15 and 28.75 mg/dl, respectively.

On the other hand, the LDL-c of positive control rats group recorded the higher value when compared with negative control group with a significant difference (P≤0.05). The mean values were 84.24 and 15.23 mg/dl, respectively. While, the highest LDL-c of treated group recorded for group fed on 2% fig leaves but, the lowest value recorded for group fed on 4% leaves mixture with a significant difference (P≤0.05). The mean values were 56.47 and 30.7 mg/dl, respectively.

On the other hand, the VLDL-c of positive control rats group recorded the higher value when compared with negative control group with a significant difference (P≤0.05). The mean values were 25.95 and 14.28 mg/dl, respectively. While, the highest VLDL-c of treated group recorded for group fed on 2% fig leaves but, the lowest value recorded for group fed on 4% leaves mixture with significant difference (P≤0.05). The mean values were 18.76 and 14.3 mg/dl, respectively. These results are in harmony with **Chang *et al.,*** [47] who discovered that animals treated with mulberry leaves had significant reductions in total cholesterol (TC), low-density lipoprotein cholesterol (LDL-c), and triglycerides (TG) in blood circulation, as well as an increase in high-density lipoprotein cholesterol (HDL-c).

About 23 persons with elevated cholesterol were given mulberry leaf supplements containing 280 mg three times a day. Low-density lipoprotein (bad) cholesterol (LDL) decreased by 5.6 percent after 12 weeks, whereas high-density lipoprotein (good) cholesterol (HDL) climbed by 19.7% [48].

Moreover, Canal *et al.,* (7) they discovered that giving fig leaf decoction to rats with streptozotocin-induced diabetes resulted in lower total cholesterol levels and a lower total cholesterol/HDL-c cholesterol ratio, as well as a reduction in hyperglycemia, when compared to the control group.

Data given in table (5) show the effect of white mulberry, fig leaves and their mixtures on kidney functions of diabetic rats. The obtained results indicated that the urea level of positive control rats group recorded the higher value when compared with negative control group with a significant difference (P≤0.05). The mean values were 35 and 15.52 mg/dl, respectively. While, the highest urea level of treated group recorded for group fed on 2% fig leaves but, the lowest value recorded for group fed on 4% leaves mixture with a significant difference (P≤0.05). The mean values were 31.1 and 22.2 mg/dl, respectively.

Table (4): Effect of white mulberry, fig leaves and their mixtures on serum lipid profiles of diabetic rats

Treatments / Groups	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)
G1 (-)	42.35 ^{a} ± 1.11	15.23 ^{h} ± 0.9	14.28 ^{d} ± 1.5
G2 (+)	26.1 ^{f} ± 1.3	84.24 ^{a} ± 1.63	25.95 ^{a} ± 0.7
G3 WML (2%)	28.75 ^{e} ± 0.8	52.71 ^{d} ± 1.3	17.09^{bc} ± 0.9
WML (4%)	31.46 ^{d} ± 1.5	46.47 ^{e} ± 0.8	15.22 ^{cd} ± 1.4
FL (2%)	30.7 ^{d} ± 0.9	56.47 ^{b} ± 1.15	18.76 ^{b} ± 1.1
FL (4%)	34.85 ^{c} ± 1.4	54.59 ^{c} ± 1.2	17.66^{bc} ± 0.6
Mixture (2%)	38.7 ^{b} ± 1.2	40.95 ^{f} ± 0.7	16.2 ^{cd} ± 1.3
Mixture (4%)	40.15 ^{b} ± 0.6	30.7 ^{g} ± 0.5	14.3 ^{d} ± 0.8
LSD (P ≤ 0.05)	**1.496**	**1.571**	**1.877**

WML=White mulberry leaves, FL=Fig leaves. HDL-c = High density lipoprotein cholesterol, LDL-c = Low density lipoprotein cholesterol, VLDL -c = Very low-density lipoprotein cholesterol.Each value represents the mean ± SD of three replicates.

On the other hand, the uric acid level of positive control rats group recorded the higher value when compared with negative control group with no significant difference (P≤0.05). The mean values were 9.85 and 6.04 mg/dl, respectively. While, the highest uric acid level of treated group recorded for group fed on 2% white mulberry leaves but, the lowest value recorded for group fed on 4% white mulberry leaves with no significant difference (P≤0.05). The mean values were 7.8 and 6.85 mg/dl, respectively.

Table (5): Effect of white mulberry, fig leaves and their mixtures on kidney functions of diabetic rats

Treatments / Groups	Urea (mg/dl)	Uric Acid (mg/dl)	Creatinine (mg/dl)
G1 (-)	15.52^{e} ± 1.26	6.04^{a} ± 0.22	0.91^{a} ± 0.32
G2 (+)	35.0^{a} ± 0.92	9.85^{a} ± 1.32	1.36^{a} ± 0.52
WML (2%)	31.01^{b}± 1.31	7.80^{a}± 1.75	0.99 ^{a}± 0.37
WML (4%)	24.71^{c}± 1.62	6.8^{a}± 0.921	0.98^{a} ± 0.24
FL (2%)	31.10^{b} ± 0.89	7.4.0^{a} ± 0.813	1.29^{a}±0.42
FL (4%)	29.40^{b} ± 1.09	6.9 ^{a} ± 0.591	1.01 ^{a} ± 0.166
Mixture (2%)	29.10^{b}±1.591	7.20^{a} ± 1.72	1.0^{a} ± 0.073
Mixture (4%)	22.2^{d}±1.87	6.85^{a} ± 1.50	0.92^{a} ± 0.273
LSD (P ≤ 0.05)	**2.353**	**2.541**	**0.563**

WML=White mulberry leaves, FL=Fig leaves.Each value represents the mean ± SD of three replicates.

When it came to creatinine, the positive control rats had a greater value than the negative control rats, although there was no significant difference (P≤0.05). The average values

were 1.361 and 0.91 mg/dl. While the greatest creatinine level of the treated group was found in the group fed on 2% fig leaves, the lowest value was found in the group fed on 4% leaves mixture, with no significant difference (P≤0.05), which were 1.29 mg/dl and 0.92 mg/dl, respectively. These findings are consistent with the findings of Aramwit *et al.,* [48], who discover that the leaves can be used as a decoction to treat diabetic patients and calcifications in the kidneys and liver.

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التأثير المحتمل لمسحوق أوراق التوت والتين على الفئران المصابة بالسكر المستحث بالأستربتوزتوسين

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الملخص العربي

تم تقييم تأثير تركيزات مختلفة (٢،٤٪) من مسحوق اوراق التوت والتين في الفئران المصابة بمرض السكر. واستخدم ٤٨ فأر في هذه الدراسة وتم تقسيمها إلى٨ مجموعات، كل مجموعة تحتوي على ٦ فئران. وتم إصابة الفئران بمرض السكر بواسطة الإستربتوزوتوسين. وأظهرت النتائج أن الفئران التي تغذت على مخلوط من مسحوق أوراق التوت الابيض والتين بتركيز٤% اظهرت أقل مستوى لسكر الجلوكوز مع وجود فرق معنوي، حيث كانت القيمة ١٠٥ملجم / ديسيلتر. أعلى انخفاض لإنزيمات الكبدALT,AST,ALPسجلت مع مجموعة الفئران التي تغذت على مخلوط من مسحوق أوراق التوت الأبيض والتين بتركيز٤٪، ولكن أعلى قيم كانت مع مجموعة الفئران التي تغذت على مسحوق أوراق التين بتركيز٢% مع وجود فرق معنوي. أقل قيمة من الدهون الثلاثية والكولسترول مع مجموعة الفئران التي تغذت على مخلوط من مسحوق أوراق التوت الأبيض والتين٤٪. أعلى قيم للكوليستيرول عالي الكثافة سجلت مع مجموعة الفئران التي تغذت على مخلوط من مسحوق أوراق التوت والتين بتركيز٤٪. في حين أعلى قيم من الكولسيتيرول منخفض الكثافة والكولسيتيرول منخفض الكثافة جدا سجلت مع مجموعة الفئران التي تغذت على مسحوق أوراق التين٢%.أقل قيم لليوريا وحمض اليوريك وللكرياتينين سجلت مع مجموعة الفئران التي تغذت على مخلوط من مسحوق أوراق التوت والتين٤٪.

الكلمات المفتاحية: أوراق النبات، الفئران، ارتفاع سكر الدم،التحاليل الكيميائية الحيوية .