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Antidiabetic Effect of Marshmallow and Psyllium Leaves in Alloxan Induced Diabetic Rats

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Abstract

The effect of 5% marshmallow *(Althaeaofficinalis*) and psyllium*(Plantago ovate*) leaves as powderon biological and biochemical changes of diabetic rats were evaluated. Diabetic rats induced by injection with alloxan (150 mg/kg body weight). A total of 30 rats were divided into 5 groups.6 rats per each as following, first one kept as negative control, second one kept as positive control, third group was fed on 5 % marshmallow leaves, fourth group fed on 10% psyllium leaves, fifth group fed on 10 % marshmallow leaves and six group fed on 10% psyllium leaves. The results showed that group fed on 5% herbal mixture showed the highest values of body weight gain, feed intake and feed efficiency ratio compared with other groups. The highest reduction with significant difference ($p \leq 0.05$) in glucose, alkaline phosphatas , and glutamic oxaloacetate transaminase (GOT) levels showed for group as fed on 5% of mixture herbal with values 109.1± 0.40mg/dl, 90± 0.80 µ/l and 17.21± 0.90 µ/l, VS 197± 0.90 and 55.82± 1.35, µ/l respectively.A markedly reduction in glutamic pyruvate transaminase (GPT) levels by different rates in hyperglycemic rats fed on different herbs and its mixtures was observed. Also, group fed on 5% herbal mixture showed the highest decreasing with significant difference($p \leq 0.05$) in serum triglycerides (TG) and total cholesterol values compared with other tested groups. The maximum reduction of lipid fractions with significant

difference also ($p \leq 0.05$) in HDL-c, LDL-c and VLDL-c values recorded with group fed on 5% herbal mixture. As conclusion, 5% herbal mixture improvement glucose level, lipid profile, liver and kidney function compared with each herb alone.

Key words: Herbal leaves,Biochemical analysis, Diabetic disease and Rats.

Introduction:

Diabetes is the world's largest endocrine disease associated with increased morbidity and mortality rate. Diabetes mellitus is also associated with long term complications including retinopathy, nephropathy, neuropathy , angiopathy and several others **(Sharma *et al.*, 2010)**. Diabetes mellitus (DM) is common endocrine disorder affecting more than 200 million people worldwide. According to the International Diabetes Federation, India has been declared as the diabetes capital of the world. Plant materials which are being used as traditional medicine for the treatment of diabetes are considered one of the good sources for a new drug or a lead to make a new drug **(Nadkarnim and Nadkarni , 1995)**. Since, ancient times, plants have played an important role in the treatment of many diseases. Different parts of medicinal plants such as leaf, root, flower and seed are used as extracts and bioactive compounds to produce drugs **(Ozgen *et al.*, 2009)**. According to world Health Organization (WHO), 80% of the World's population is dependent on the traditional medicine **(Maiyo *et al.*, 2010)**.A variety of ingredients present in medicinal plants are thought to act on a variety of targets by various modes and mechanisms. They have potential to impart therapeutic effects in complicated disorders like diabetes **(Tiwari and Rao, 2002)**. Medicinal plants are gradually gaining global acceptability given their potential as bioactive agents to be used as pharmaceuticals. New hypoglycemic agents derived from plants have shown both hypoglycemic action and the ability to improve some of the secondary complications of diabetes such as kidney damage, fatty liver, and oxidative stress. In addition, some tropical herbs offer both benefits as it has been recently informed in experimental models **(Fonseca *et al.*, 2012).**

It is well known that type 2 of diabetes is associated with a significantly increased risk of macrovascular disease. Supplementation of the diet with soluble fiber or consumption of a high fiber diet has

been shown to lower total serum cholesterol and triacylglycerol in type 2 diabetic patients. Psyllium *(P. ovate*) also reduced total cholesterol and LDL-cholesterol in animals and in human study, the efficacy and possible modes of action of hot-water extracts of husk of psyllium were evaluatedby **(Terpstra*et al.*, 2000)**.Psyllium leaves and husk taken orally seem to significantly reduce postprandial serum glucose, insulin levels, serum total cholesterol, and low density lipoprotein (LDL) cholesterol levels in patients with type II diabetes and hypercholesterolemia. Blond psyllium seems to reduce postprandial blood glucose levels about 14% to 20%, total cholesterol by about 9%, and LDL cholesterol by 13%. Blonde psyllium also seems to lower postprandial glucose levels in patients with type I diabetes. Blond psyllium's had maximum effect on the glucose levels occurs when it is mixed and consumed with foods. Blond psyllium does not lower postprandial glucose in people who do not have diabetes **(Jonathan,2006)**. **Ahmed*et al.*, (2010)** reported that the oral administration of psylliumpowder showed hypoglycemic and hypocholesterolemic effects in alloxan induced diabetic rats. Also, *Plantagopsyllium*powder is helpful to lower glucose and cholesterol level in treatment of hyperglycemia and hypercholesterolemia.Psyllium husk in the chow caused an important reduction in glucose levels and an important increase in insulin levels in mild diabetic rabbits **(Díez*et al.*, 2013)**.

Psyllium husk is the richest source of arabinoxylan. The molecular structure and composition of arabinoxylan varies amongst different sources. The arabinoxylan can be added in foods for the preparation of functional food to maintain the lipid profile and glucose concentration **(Qaisrani *et al.*, 2016)**.

Iauk *et al.*, (2003)reported that based on animal study, marshmallow may lower blood sugar levels. Caution is advised when using herbs or supplements that may also lower blood sugar. Blood glucose levels may require monitoring, and doses may need adjustment.A qualified healthcare professional should monitor patients taking drugs for diabetes by mouth or insulin closely. Medication adjustments may be necessary. Marshmallow may interfere with the absorption of other agents and therefore should be taken 1 hour before or 2 hours after other herbs and supplements.

Ali*et al.*, (2011) the leaves of the *Althaea. officinalis* plant as well as the root are used as medicine. Roots of *A. officinalis* contain mucilage, flavonoids and glycosides. Additionally the leaves contain the coumarinscopoletin. Due to having valuable secondary metabolites it exert potential therapeutic effects. *In vitro* and *in vivo* studies of *A. officinalis* indicates significant pharmacological activity in the cough, irritation of the throat, gastric inflammation, anti-diabetic, anti-tumor, antiviral and immune stimulant.

This work was conducted to study the antidiabetic effect of both 5% marshmallow and psylliumleaves powderin alloxan-induced diabetic rats.

Material and Methods:

Materials:

Marshmallow (*Althaeaofficinalis*) and psyllium (*Plantago ovate*) leaves were obtained from a herbalist local market, Shibin El-Kom City, Menoufia Governorate, Egypt.

Cholesterol powder

Cholesterol powders and saline solutions were purchased from SIGMA Chemical Co., St. Louis, MO.

Casein, cellulose, choline chloride, and DL Methionine:

Casein, cellulose, choline chloride powder, and DL methionine powder, were obtained from Morgan Company Chemical Industries. Cairo, Egypt.

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP, bilirubin, urea, creatinin, albumin) were obtained from Al- Gomhoria Company, Cairo, Egypt.

Experimental animals

A total of 30 adult normal male albino rats Sprague Dawley strain weighing 140±10 g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

Methods:

Preparations of herb leaves

To prepare the dried herbs, marshmallows and psyllium leaves were washed thoroughly under running tap water, shade dried, and ground to a fine powder using mill, high speed mixture (Molunix, Al-Araby, company, Egypt, then serving as powder seize.

Experimental design:

Rats were fed on basal diet (casein diet) prepared according to **American Institute of Nutrition (AIN) (1993)** for 7 consecutive days. After this adaptation period, rats are divided into 5 groups, each group consists of six rats as follows: Group (I): rats fed on basal diet as negative control. Group (2): Injected by alloxan(at dose of 150 mg /kg of rat's body weight) and used as a positive control group. Group (3): A group of inflicted diabetic rats fed on the leaves of marshmallow leaves as powder by 5% of the diet (feed) . Group (4): A group of rats inflicted diabetis fed on the leaves of psyllium as powder by 5% of the weight of the rat. Group (5): A group of diabetic rats fed on 5% of mixture leaves. During the experimental period, the body weight and food intake were estimated weekly. The experiment will take 28 days, at the end of the experimental period, rats are slaughtered and collect blood samples. Blood samples were centrifuged at 4000 rpm for ten minute to separate blood serum, then kept in deep freezer till using.

Blood sampling:

After fasting for 12 hours, blood samples in initial times were obtained from retro orbital vein, while it obtained from hepatic portal vein at the end of each experiments . The first part of Blood samples were collected into a dry clean centrifuge glass tubes and left to clot in water bath (37°C) for 30 minutes, then centrifuged for 10 minutes at 4000 rpm to separate the serum, which was carefully aspirated and transferred into clean cuvette tube and stored frozen in deep freezer till analysis as described by **(Schermer, 1967).**

Body weight gain (BWG), feed intake (FI), and feed efficiency ratio(FER):

During the experimental period (28 days) the net feed intake was daily recorded, while body weight was weekly recorded. The net feed intake and gained body weight were used for the calculation of feed efficiency ratios (FER) according to **Chapman *et al.*, (1959)** as follow:

$$\mathbf{FER} = \frac{\boldsymbol{Body\ weight\ gain\ (g)}}{\boldsymbol{feed\ intake\ (g)}}$$

Biochemical Analysis:

Lipids profile:

Serum total cholesterol was determined according to the colorimetric method described by **Thomas (1992)**.

Determination of serum triglycerides

Serum triglycerides was determined by enzymatic method using kits according to the **Young, (1975) and Fossati and pricipe , (1982)**.

Determination of High density lipoprotein (HDL-c)

HDL-c was determined according to the method described by**Fredewaid (1972) and Grodon and Amer (1977)**.

Very low density lipoproteincholesterol (VLDL-c)

VLDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** using the following formula: **VLDL-c (mg/dl) = Triglycerides / 5**

Low density lipoprotein cholesterol (LDL-c)

LDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** as follows: **LDL-c (mg/dl) = Total cholesterol – HDL-c – VLDL-c**

Liver functions

Determination of serum alanine aminotransferase (ALT), serum asparatate amino transferase (AST), serum alkaline phosphatase (ALP) were carried out according to the methods of (**Hafkenscheid 1979; ClinicaChimicaActa 1980and Moss 1982)**, respectively.

Kidney functions

Serum urea and serum creatinine were determinated by enzymatic method according to **(Henry, 1974 and Patton & Crouch, 1977)**, respectively.

Determination of blood glucose

Enzymatic determination of plasma glucose was carried out colorimetrically according to the method of **Tinder (1969).**

Statistical analysis

The data were analyzed using a completely randomized factorial design **(SAS, 1988)** 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

Body weight gain (BWG), feed intake(FI) and food efficiency ratio(FER)

Data in Table (1) show the BWG, FI and FER of control negative and different diabetic group's of rats fed on 5% marshmallow, psyllium and their mixture. It's clear to notice that, BWG for control positive was lower than control negative group. The values were 8.4± 0.20 and 28± 0.40 g/28 day, respectively. Concerning BWG for group fed on 5% herbal mixture showed highest value with significant differences (P≤0.05) as compared with control positive being 36.4±0.50, and 8.4± 0.20 g/28 day, respectively while, the lowest value recorded with group fed on 5% psyllium group . The value was 16.8± 0.90 g/28 day.

Regarding FI, data indicated that feed intake of control positive was lower than control negative. Group fed on 5% herbal mixture showed highest value with significant differences (P≤0.05) as compared with the other groups (5% marshmallow and 5% psyllium) and the values were 509.6±0.70, 495.6±0.20 and 492± 0.50 g/day, respectively.

On the other hand, FER of control positive group recorded the lowest value being 0.019± 0.002 . While, the highest value of FER with significant difference (P≤0.05) recorded with group fed on 5% herbal mixture, and the value was 0.071±0.008 . Finally, it could be concluded that group fed on 5% herbal mixture showed the highest values of BWG, FI and FER compared with other groups. These results are in agreement with those of (**Sahu, 2004)**.

Effect of marshmallow, psyllium and herbal mixture on glucose of diabetic rats:

Data in table (2) show the effect of marshmallow, psyllium and their mixture on glucose of diabetic rats. The highest decreasing with significant difference(P≤0.05) in glucose levels recorded with group fed on 5% herbal mixture with value 109.1± 0.40mg/dl. While, other groups fed on 5% marshmallow and psyllium recorded a moderate reduction with significant difference (P≤0.05) in glucose levels, and the values were 115.2± 0.80 and 124.5± 0.90 mg/dl,

respectively. These results are in agreement with those of **Qaisrani *et al.*,(2016),** who found thatarabinoxylans , the active ingredient in psyllium husk , had imperative physiological functions: Working as laxative, manages serum lipid profile in hypercholesterolemic people, decreases glucose and Hb A1c concentrations in patients with type 2 diabetes.

Effect ofmarshmallow, psyllium and herbal mixture on ALP, GOT and GPT of diabetic rats:

Data in Table (3) show the effect of marshmallow, psyllium and their mixture on (ALP) of diabetic rats. The highest decreasing with significant difference (P≤0.05) in alkaline phosphatas level recorded with group fed on 5% herbal mixture compared with positive control group, and the values were 90± 0.80 VS 197± 0.90 U/L, respectively. While other groups fed on 5% marshmallow and 5% psyllium recorded a moderate reduction with significant difference in ALP levels, and the values were 105± 1.10 and 123± 0.50 U/L, respectively. Finally, it could be concluded that group fed on 5% herbal mixture showed the highest reduction with significant difference in alkaline phosphatas level compared with other tested groups. These results are in agreement with those of **Kritchevsky*et al.*, (1995)**, who reported that the effects of psyllium seed on liver lipids were more pronounced than those of pectin. Defatted psyllium husk feeding virtually normalized liver size.

The effect of 5% marshmallow, psyllium and their mixture on GOTof diabetic rats is shown in table (3). It is obvious that a markedly decreasing in GOT levels in hyperglycemic rats fed on different herbs and its mixture was observed. The highest decreasing with significant difference (P≤0.05) in GOT levels recorded with group fed on 5% herbal mixture compared with positive control group, and the values were 17.21± 0.90 and 55.82± 1.35 U/L , respectively. While, other groups fed on 5% marshmallow and 5% psyllium recorded a moderate decreasing with significant difference (P≤0.05) in GOT levels, and the values were 31± 0.60 and 27.15± 1.25 U/L , respectively. Finally, it could be concluded that group fed on 5% herbal mixture showed the highest reduction with significant difference (P≤0.05) in GOT levels compared with other tested groups **Dorothy, and Shahidul, (2015)**, found that diabetas significantly increased serum ALT, as well as

significantly decreased serum total protein , albumin and raised serum uric acid.

The effect of 5% marshmallow, psyllium and herbal mixture on GPTof diabetic rats is shown in Table (3). It is clear to notice that a marked decreasing in GPT levels by different rates in diabetic rats fed on different herbs and its mixture was observed. The highest decreasing with significant difference (P≤0.05) in GPT levels recorded with group fed on 5% herbal mixture compared with positive control group, and the values were 6.0± 0.60 VS 20.70± 0.40U/L, respectively. While, other groups fed on 5% marshmallow and 5% psyllium recorded a moderate decreasing with significant difference(P≤0.05) in GPT levels, and the values were 10.93±0.90 and 8.81± 0.50 U/L , respectively. Finally, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in (GPT) levels compared with other tested groups. These results are in agreement with those of **(Mahmoud*et al.*, 2014)**.

The effect of marshmallow, psyllium and herbal mixture on serum triglycerides (T.G) and serum total cholesterol (TC) of diabetic rats:

The effect of 5% marshmallow, psyllium and herbal mixture on serum T.G and T.C of diabetic rats is shown in table (4). It is clear to notice that the serum triglycerides level of control positive group was higher than control negative group. The values were 135.15±3.81and 55.81± 0.52 mg/dl, respectively. On the other hand, the maximum decreasing with significant difference (P≤0.05) in serum triglycerides value recorded with group fed on 5% herbal mixture, and the value was 57.63± 2.66 mg/dl. While, other groups fed on 5% marshmallow and 5% psyllium showed high decreasing with significant difference (P≤0.05) in serum triglycerides when compared with control positive, and the value was 78.33± 1.10 and 70.14± 2.15 mg/dl, respectively. From the obtained result, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in serum triglycerides value compared with other tested groups. These results are in agreement with those of **(Anderson*et al.*, 1999)**.

Concerning of total cholesterol, the obtained result indicated that the total cholesterol level of control positive group was higher than

control negative group, and the values were 140.00± 1.10 and 94.00± 0.70 mg/dl, respectively. On the other hand, the maximum decreasing with significant difference (P≤0.05) in total cholesterol value recorded with group fed on 5% their mixture, with value 103.00± 0.80 mg/dl. While, other groups fed on 5% marshmallow and 5% psyllium showed high decreasing with significant difference (P≤0.05) in total cholesterol value. The values were 128.00^{c} ± 0.50 and 130.00^{b} ± 0.30 mg/dl, respectively. From the obtained result, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in total cholesterol value compared with other tested groups. These results are in agreement with those of **Kritchevsky*et al.*, (1995)**, they reported that psyllium seed exerted an effect on total serum cholesterol equal to that of pectin but gave higher levels of HDL-cholesterol and serum triglyceride levels , and produced lower serum total cholesterol levels and higher HDL-cholesterol than observed in normal controls.

Effect of marshmallow, psyllium and herbal mixture on very low density lipoprotein cholesterol , high density lipoprotein cholesterol and lowdensity lipoprotein cholesterol of diabetic rats:

Data in Table (5) show the effect of 5%marshmallow, psyllium and herbal mixture on serum of very low density lipoprotein cholesterol, high density lipoprotein cholesterol and low density lipoprotein cholesterol of diabetic rats.It is worth to mention that the very low density lipoprotein cholesterol level of control positive group was higher than control negative group, and the values were 27.03± 1.20 and 11.16± 0.69 mg/dl, respectively. On the other hand, the maximum decreasing with significant difference (P≤0.05) in very low density lipoprotein cholesterol value recorded with group fed on 5% herbal mixture, and the value was 11.53±2.20 mg/dl, while other groups fed on 5% marshmallow and 5% psyllium showed moderate decreasing with significant difference (P≤0.05) in very low density lipoprotein cholesterol value, and the values were 15.67 ± 0.90 and 14.03± 1.60 g/dl, respectively. Finally, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in very low density lipoprotein cholesterol value compared with other tested groups. These results are

in agreement with those of **Ziai *et al.*, (2005)**, they indicated significant reductions in the following variants: Fasting blood glucose (FBG), HbA1C, and the ratio of low density lipoprotein/high density lipoprotein (LDL/HDL) in the psyllium treatment group.

In case of high density lipoprotein cholesterol, the obtained results indicated that the HDL level of control positive group was lower than control negative group, and the values were 27.67± 1.71and 43.05± 2.80 mg/dl, respectively. On the other hand, the maximum decreasing with significant difference (P≤0.05) in high density lipoprotein cholesterol value recorded with group fed on 5% herbal mixture, and the value was 45.51±1.9 mg /dl. While, other groups fed on 5% marshmallow and 5% psyllium showed decreasing with significant difference (P≤0.05) in high density lipoprotein cholesterol value when compared with control positive, and the values were 37.61±0.50 and 39.94± 0.90 mg/dl Vs 27.67 mg/dl, respectively. From the obtained results, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in high density lipoprotein cholesterol value compared with other tested groups. These results are in agreement with those of **(Rodríguez-Morán*et al.*, 1998)**.

On the other hand, data from table (5) also, indicated that the low density lipoprotein cholesterol level of control positive group was higher than control negative group, and the values were 85.30± 1.58 and 39.79± 0.93 mg/dl, respectively. The obtained results showed that, the maximum decreasing with significant difference (P≤0.05) in low density lipoprotein cholesterol value recorded for group fed on 5% herbal mixture, and the value was 45.96±2.15 mg/dl. While, other groups fed on 5% marshmallow and 5% psyllium showed no significant difference (P≤0.05) between marshmallow and psyllium at level 5 % while there was significant difference with other all groups. Values of serum LDL-c were 74.72±0.83 and 76.03±2.41mg/dl for G2 and G3, respectively. Finally, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in low density lipoprotein cholesterol value compared with other tested groups. These results are in agreement with those of **Tsuduki, *et al.*, (2009)**. Also, **Aygustin and Dwyer (1999)** mentioned thatsoluble and insoluble psyllium fibers have their role in

reducing total serum and LDL cholesterol, and consequently reduce the risk of heart diseases**.**

Effect of marshmallow, psyllium and herbal mixture on serum urea and serum uric acid of diabetic rats:

Data given in table (6) show the effect of 5% marshmallow, psyllium and herbal mixture on serum urea and serum uric acid of diabetic rats. It is worth mentioning notice that the urea level of control positive group was higher than control negative group, and the values were 73.65±3.20 and 42.20± 2.10 mg/dl, respectively. On the other hand, the highest decreasing with significant difference (P≤0.05) in serum urea value recorded with group fed on 5% herbal mixture, and the value was 46.25± 0.50 mg/dl. While, other groups fed on 5% marshmallow and 5% psyllium showed decreasing with significant difference (P≤0.05) in serum urea value, and the values were 58.27± 0.90 and 60.03± 1.30 g/dl, respectively. From the obtained result, it could be concluded that group fed on 5% herbal mixture showed the highest decreasing with significant difference (P≤0.05) in urea value compared with other tested groups. These results are in agreement with those of **Jarald *et al.*,(2008)** they showed that diabetic rats had a significant increase in creatinine and BUN levels as compared to the normal animals.

In case of serum uric acid values presented in table (6) the serum uric acid level of control positive group was higher than control negative group, and the values were 3.97± 0.90 and 2.11± 0.20 mg/dl, respectively. On the other hand, the maximum decreasing with nonsignificant difference (P≤0.05) in uric acid value recorded with group fed on 5% herbal mixture, and the value was 1.95± 1.10 mg/dl. While, other groups fed on 5% marshmallow and 5% psyllium showed high decreasing with nonsignificant difference (P≤0.05) in uric acid value between them . The values were 2.60± 0.30 and 2.91± 0.70 g/dl, respectively. From the obtained result, it could be concluded that group fed on 5% marshmallow plus psyllium mixture showed the highest decreasing with significant difference (P≤0.05) in uric acid value compared with other tested groups. These results are in agreement with those of **Dorothy and Shahidul(2015)**. They found significantly decreased serum ALT, as well as significantly increased serum total

protein and albumin with reduction of serum uric acid, when diabetic rats fed on mulberry (*morus alba*) leaves tea .

Table (1): Effect of marshmallow, psyllium and their mixture on BWG, FI and FER of diabetic rats

	Body weight gain		**Feed intake**		**Feed efficiency ratio**	
	(g)	**% Change of control (+)**	**(g/day)**	**% Change of control (+)**	**Ratio**	**% Change of control (+)**
	M±SD		**M±SD**		**M±SD**	
G_1 Control (-)	28^{b} ± 0.40	+ 233.3	504^{b}± 0.70	+13.26	0.056^{b} ± 0.007	+194.74
G_2 Control (+)	8.4^{f} ± 0.20	……	445^{f} ± 0.60	……	0.019^{e} ± 0.002	……
G_3 (5%Marshmallow)	25.2^{c}± 0.60	+200	495.6^{d} ±0.20	+11.37	0.051^{bc} ±0.003	+168.42
G_4 (5%Psyllium)	16.8^{e} ± 0.90	+100	492^{e} ± 0.50	+10.56	0.034^{d} ±0.004	+78.95
G_5 (5%Herbalmixture)	36.4^{a} ±0.50	+333.3	509.6^{a} ±0.70	+14.52	0.071^{a} ±0.008	273.86
LSD	1.092	----	1.18	----	0.009	---

Means under the same column bearing different superscript letters are significantly different at ($p < 0.05$).

Table (2): Effect of marshmallow, psyllium and theirmixture on serum glucose of diabetic rats

Groups	mg/dl	% Change of control (+)
G_1 Control (-)	$108^{e} \pm 0.70$	-53.04
G_2 Control (+)	$230^{a} \pm 1.10$	----
G_3 (5%Marshmallow)	$115.2^{c} \pm 0.80$	-49.91
G_4 (5%Psyllium)	$124.5^{b} \pm 0.90$	- 45.87
G_5 (5%Herbal mixture)	$109.1^{e} \pm 0.40$	- 52.57
LSD	**1.37**	----

Means under the same column bearing different superscript letters are significantly different at ($p < 0.05$).

Table (3): Effect of marshmallow, psyllium and their mixture on ALP, GOT and GPTof diabetic rats

Groups	ALP		AST		ALT	
	U/L	%	U/L	%	U/L	%
G_1 C (-)	$95^{e} \pm 1.70$	- 51.78	$9.22^{f} \pm 1.10$	- 83.48	$6.50^{d} \pm 0.80$	- 68.60
G_2 C (+)	$197^{a} \pm 0.90$	……	$55.82^{a} \pm 1.35$	----	$20.70^{a} \pm 0.40$	----
G_3(5%Marshmallow)	$105^{d} \pm 1.10$	-46.70	$31^{c} \pm 0.60$	-44.46	$10.93^{b} \pm 0.90$	- 47.20
G_4 (5%Psyllium)	$103^{c} \pm 0.50$	-47.71	$27.15^{d} \pm 1.25$	- 51.36	$8.81^{c} \pm 0.50$	- 57.44
G_5 (5% Herbal mixture)	$90^{f} \pm 0.80$	-54.32	$17.21^{e} \pm 0.90$	- 69.17	$6.0^{d} \pm 0.60$	- 71.02
LSD	**2.32**	----	**2.29**	----	**1.39**	----

Means under the same column bearing different superscript letters are significantly different at ($p < 0.05$).

Table (4) Effect of marshmallow, psyllium and their mixture on serum triglycerides (T.G) and serum totalcholesterol (TC) of diabetic rats

Groups	Triglycerides (TG)		Total cholesterol (TC)	
	mg/dl	%	mg/dl	%
G_1 Control (-)	55.81^{e} ± 0.52	- 58.70	94.00^{f} ± 0.70	- 32.86
G_2 Control (+)	135.15^{a} ±3.81	----	140.00^{a} ± 1.10	----
G_3 (5%Marshmallow)	78.33^{b} ± 1.10	- 42.04	128.00^{c} ± 0.50	- 8.57
G_4(5%Psyllium)	70.14^{c} ± 2.15	- 48.30	130.00^{b} ± 0.30	- 7.14
G_5 (5% Herbal mixture)	57.63^{de} ± 2.66	- 57.36	103.00^{e} ± 0.80	- 26.43
LSD	**3.67**	**----**	**1.27**	----

Means under the same column bearing different superscript letters are significantly different at ($p < 0.05$).

Table (5): Effect of mulberry, marshmallow, psyllium and their mixture on very low density lipoprotein cholesterol ($VLDL_C$),high density lipoprotein cholesterol(HDL_C) and low density lipoprotein cholesterol (LDL_C) of diabetic rats

	VLDL-$_C$		HDL-c		LDL-c	
	mg/dl	%	mg/dl	%	mg/dl	%
G_1 C (-)	11.16^{d} ± 0.69	- 57.08	43.05^{ab} ± 2.80	+ 55.58	39.79^{e} ± 0.93	- 53.35
G_2 C (+)	27.03^{a} ± 1.20	----	27.67^{d} ± 1.71	----	85.30^{a} ± 1.58	----
G_3(5%Marshmallow)	15.67^{b} ± 0.90	- 42.03	37.61^{c} ±0.50	+ 35.92	74.72^{b} ±0.83	+ 12.43
G_4 (5%Psyllium)	14.03^{bc} ± 1.60	- 48.09	39.94^{bc} ± 0.90	+ 44.34	76.03^{b} ±2.41	+ 10.86
G_5 (5%Herbal mixture)	11.53^{cd} ±2.20	- 57.34	45.51^{a} ±1.9	+64.47	45.96^{d} ±2.15	+ 46.12
LSD	**2.63**	**----**	**3.02**	**----**	**3.10**	**----**

Means under the same column bearing different superscript letters are significantly different at ($p < 0.05$).

Table (6): Effect of marshmallow, psyllium and their mixture on urea and uric acid of diabeticrats

Groups	Serum urea % Change of control (+)		Serum uric acid	
	mg/dl	%	mg/dl	%
G_1 Control (-)	$42.20^{e} \pm 2.10$	- 42.70	$2.11^{b} \pm 0.20$	- 46.85
G_2 Control (+)	$73.65^{a} \pm 3.20$	----	$3.97^{a} \pm 0.90$	----
G_3 (5%Marshmallow)	$58.27^{b} \pm 0.90$	- 20.88	$2.60^{b} \pm 0.30$	- 34.51
G_4 (5%Psyllium)	$60.03^{b} \pm 1.30$	- 18.49	$2.91^{ab} \pm 0.70$	- 26.70
G_5 (5%Herbal mixture)	$46.25^{d} \pm 0.50$	- 37.20	$2.15^{b} \pm 1.10$	- 50.88
LSD	**3.24**		**1.26**	

Means under the same column bearing different superscript letters are significantly different at ($p < 0.05$).

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التأثير المضاد للسكر لأوراق الخطمية ولسان الحمل فى الفئران المصابة بالسكري بتأثير الألوكسان

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الملخص العربى :

تم فى هذا البحث تقييم تأثير تركيز ٥٪ لكل من مسحوق أوراق الخطمية ولسان الحمل بصفتها المنفردة أو المخلوط على التغيرات البيولوجية والبيوكيميائيةفى الفئران المصابة بالسكري المستسارباالألوكسان. حيث تم إصابة ٣٠ من الفئران بمرض السكري عن طريق الحقن بواسطة الألوكسان (١٥٠ ملجم / كجم من وزن الجسم), وتم تقسيم الفئران إلى ٥ مجموعات (٦فأر فى كل مجموعة), حيث استخدمت احداها كمجموعة ضابطة سالبة والثانية كمجموعة ضابطة موجبة وباقى المجموعات الثلاث تم اضافة الأعشاب ومخلوطهم بنسبة ٥%. وأظهرت النتائج المتحصل عليها أن مجموعة الفئران التى تغذت على مخلوط الأعشاب بتركيز ٥٪ قد أظهرت أعلى القيم من حيث الزيادة في وزن الجسم، وتناول الطعام ونسبة كفاءة الغذاء أكبر معدل انخفاض مع وجود فرق معنوى كبير ($P\leq0.05$) في مستويات جلوكوز السيرم تم تسجيلها مع مجموعة الفئران التى تغذت على مخلوط الأعشاب بتركيز ٥٪, حيث كانت القيم ١٠٩,١ ± ٠,٤٠ ملجم / ديسيلتر. كذلك كان أعلى انخفاض مع اختلاف كبير في درجة نشاط انزيم الفوسفاتيزالقاعدى سجلت مع مجموعة الفئران التى تغذت على مخلوط الأعشاب بتركيز ٥٪ مقارنة مع المجموعة الضابطة الموجبة. وكانت القيم ٩٠ ± ٠,٨٠ ,١٩٧ ± ٠,٩٠وحدة/ لتر، على التوالي. ومن ناحية أخرى كان أعلى انخفاض مع اختلاف كبير في مستويات GOT سجلت مع مجموعة الفئران التى تغذت على مخلوط الأعشاب بتركيز ٥٪ مقارنة بالمجموعة الضابطة الموجبة. حيث كانت القيم ١٧,٢١ ± ٠,٩٠ و ٥٥,٨٢ ± ١,٣٥ وحدة /لتر على التوالي. كذلك لوحظ وجود انخفاض بشكل ملحوظ في مستويات GPT بنسب مختلفة في الفئران المصابة بسكر الدم والتى تغذت على الأعشاب مخلوطهم معا. وأظهرت مجموعة الفئران التى تغذت على مخلوط الأعشاب بتركيز ٥٪ أعلى انخفاض مع اختلاف كبير في كل من الدهون الثلاثية في الدم والكوليسترول الكلى مقارنة مع المجموعات الأخرى المختبرة. وكان الحد الأقصى لانخفاض قيم كل من الكولستيرول منخفض الكثافة والكولستيرول مرتفع الكثافة ,الكولستيرول منخفض الكثافة جدامع وجود فروق معنوية سجلت مع مجموعة الفئران التى تغذت على مخلوط الأعشاب بتركيز ٥٪.

الكلمات الدالة: أوراق الأعشاب ـ مرض السكري ـ التحاليل البيوكيميائية- الفئران.