Abstract:

The present study aimed to investigate the effect of different concentrations of Prickly pear Cactus on rats suffering from diabetes. Twenty five male Albino rats Sprague Dawley Strain weighing (140±10g) were randomly divided into two main groups. The first main group (5 rats) fed on basal diet as a negative control group (healthy rats), while the second main group (20 rats) was induced by a single intraperitoneal injection of alloxan (150mg /Kg b.w). The second main group divided into four subgroups one of them fed on basal diet as positive control group, the other groups fed on basal diet containing different levels from Prickly pear cactus (10, 15 and 20%) for five weeks. Some biochemical analysis were estimating in this study including glucose, Aspartate Amine Transaminase (AST), Alanine Amine Transaminase (ALT),Alkaline Phosphates (ALP), uric acid and creatinine in addition to, estimated the consumption of diet, body weight gain% and feed efficiency ratio FER. Hyperglycemic rats which treated with the three level of Prickly pear cactus improved these parameters by (increased feed intake, body weight gain % and FER) and decreased the organs weight /body weight%, serum glucose, uric acid, AST, ALT and ALP, as compared to the positive control group. From these results it could be concluded that, Prickly pear cactus by the different levels 10, 15and 20% improved the biochemical parameters of diabetic rats, especially with high level.

Key Words: prickly pear cactus; rats; diabetes; kidney function and liver function.

Introduction:

Prickly pear cactus is a plant. The leaves, stem, flowers, and fruit are used for medicine. Some forms of prickly pear cactus seem to lower blood sugar levels in people who have type 2 diabetes (WWW.Emedicine health, 2015).

Cactus cladodes or pads a chemical composition that is similar to most vegetables: water (85-92%), carbohydrate (4-6%), protein (1%), fat (0.2%), minerals (1%), vitamin c (12.7mg/100g fresh weigh), and B-carotene (12.9 mg/100g fresh weigh) **(El Kossori et al., 2003).**

Prickly pear cactus contains fiber and pectin, which can lower blood glucose by decreasing the absorption of sugar in the stomach and intestine. Prickly pear cactus is used for type 2 diabetes, high cholesterol and obesity **(WWW.WebMd, 2015)**. Ingestion of prickly pear cactus might help lower serum cholesterol levels and perhaps augment the patient's sensitivity to insulin, as well as improve glucose tolerance curves **(Rayburn et al., 1998).**

The plants extract are administrated to rabbits before the hyperglycemia test. The cladodes extract (2ml/kg) reduces the glucose rate of 21.67% starting from 30 min. The whole obtained results can to a certain extent enable to explain the use of the Opuntia Ficus Indica in diabetes traditional therapy **(Halmi et al., 2012.)**

Patients currently taking hypoglycemic pharmaceuticals should not discontinue their therapy in favor of using prickly pear cactus as the sole treatment for any type of diabetes. Monitor blood glucose levels closely **(Kleiner et al., 2002).**

The raw plant contains abundant mucilage, which is a complex carbohydrate that may delay absorption of glucose that cactus also contain fiber, which is known to delay glucose absorption **(Wolfram et al., 2002).**

There is some preliminary clinical evidence that prickly pear cactus used orally can decrease blood glucose levels in patients with Type II diabetes. Single doses can decrease blood glucose levels by 17% to 46% in some patients. However, it is not known if extended daily use can consistently lower blood glucose levels and decrease HbA1c levels **(Klemens, 2006)**.

A single or repeated dose of cactus fruit juice (5 ml /once, twice, three or four times/rat) was orally administrated daily to alloxan-induced diabetic rats for five weeks. The levels of glucose, cholesterol, urea, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) and malondialdehyde (MDA) were significantly($P < 0.05$) increased, while levels of superoxide dismutase (SOD), reduced glutathione (GSH), HDL-cholesterol , protein, hemoglobin and liver glycogen were significantly decreased in serum of alloxan-induced,

diabetic rats. Treatment of the diabetic rats with single or repeated dose of cactus fruit juice (**Fatma and Amal, 2011).**

Therefore, this study aimed to investigate the effect of three levels of prickly pear cactus on diabetic rats.

MATERIALS AND METHODS:

- **Materials:**

Prickly pear cactus obtained from the Fruit Garden in Damietta. Alloxan obtained from El Gomhoria Company, Cairo, Egypt. Experimental animals, mal albino rats (Sprague- Dawley white) weighing 140±10g were obtained from the Research Institute of Ophthalmology Medical Analysis Department, Giza, Egypt.

- **Methods:**

Prickly pear cactus was washed and dried by solar energy minced.

Biological Part: male Albino rats weighing (140 ± 10g) were kept in individual stainless steel cages under hygienic conditions and fed one week on basal diet adlibitum for adaptation according to **(Reeves et al., 1993).**

Preparation of Diabetic Rats

Diabetic rats: Diabetes was indicted in normal healthy male albino rats by intraperitoneal injection of

alloxan 150mg/kg body weight. According to the method described by **(Desai and Bhide, 1985**). After one week from injection, blood samples were collected from each rat to determined serum glucose in order to insure the induction. Serum glucose more than 190mg/dI. were considered diabetics **(NDDG, 1994).**

Experimental Design:

Twenty five Sprague Dawley white male albino rats, weighting about140±10 g were used in this study. The animals were obtained from Giza. Rats (n=25 rats) were housed in wire cages under the normal laboratory condition and fed on basal diet for a week as adaptation period. Diet was given in non-scattering feeding cups to avoid loss or contamination of food, water was provided to the rats by means of glass tubes projecting through the wire cage from an inverted bottle supported to one side of the cage.

The rats divided into two main groups, the first mean group (5 rats) fed on basal diet and used as a negative control group. The second main group injected with 150mg alloxan to induce hyperglycemia, the hyperglycemic rats divided into four subgroups (n= 5) as a following:

Subgroup (1): Fed on basal diet as a positive control group.

Subgroup (2): Hyperglycemic group fed on basal diet containing 10% Prickly pear cactus. Subgroup (3):

Hyperglycemic group fed on basal diet containing 15% Prickly pear cactus. Subgroup (4): Hyperglycemic group fed on basal diet containing 20 % Prickly pear cactus.

Biological Evaluation:

During the experimental period (5weeks) the consumed feed was recorded every day, and body weight recorded weekly. The body weight gain (B.W.G %), food efficiency ratio (F.E.R.) and also organs weight were determined according to **Chapman et al., (1959)** using the following equations.

$$\text{B W G \%} = \frac{\text{Final weight (gm)} - \text{initial weight (gm)}}{\text{Initial weight}} \times 100$$

$$\text{FER} = \frac{\text{Gain in body weight (g)}}{\text{Feed Intake (g)}}$$

Organs Weight:

- Heart, liver and kidneys, of the sacrificed rats were carefully removed, washed in saline solution, dried with filter paper and weighted in dependently organs weight as percentage of final body weight were calculated

- Blood Sampling:

At the end of the experimental period blood samples were collected after 12 hours fasting from the portal vein; the rats were scarified after being ether anesthetized. Blood samples were received into clean dry centrifuge tubes, and left to clot at room temperature, then centrifuged for 10 minutes at 3000 rpm to separate the serum. Serum was carefully aspirated and transferred into clean curve t tubes and stored frozen at -20° C for analysis **Maihotra, (2003).**

Biological Analysis:

Serum glucose was measured in the serum according to **Trinder, (1969)**. Alkaline phosphatase: Enzymatic colori metric determination of alkaline phosphatase was carried out according to **Belfieled and Goldberg, (1971).** Determination of (ALT) was carried out according to the method of **Tietz, (1976).** Determination of (AST) was carried out according to the method of **Henry, (1974) and Yound, (1975).** Serum creatinine was determined according

to **Larsen, (1972).** Uric acid was determined according to **Carawy, (1955).**

Statistical Analysis:

Statistical analysis were performed by using computer program, statistical package for social science **(SPSS, 1998),** and compared with each other using the suitable tests.

Results:

Biological Evaluation:

Table (1) showed the mean value ± SD of body weight gain (BWG %) of control (negative and positive) & different groups of rat fed on basal diets containing three levels of Prickly pear cactus. The results indicated that, treating hyperglycemic rats with the three levels from Prickly pear cactus (10%, 15% and 20%) caused significant increase ($p \leq 0.05$) in BWG%, as compared to the positive control group (13.3±2.24, 13.60±1.99, 14.65±2.27 vs. -6.83±1.05), respectively. The same trend was observed in feed efficiency ratio (FER). The mean value ± SD of feed efficiency ratio increased significantly $p \leq 0.05$ in all treated groups, as compared to the positive control group.

The mean value of feed intake (FI) for all treated groups was significantly higher ($p \leq 0.05$) than the control

positive group, results were being (15.83 ± 0.30, 16.46 ± 0.27, 17.04 ± 0.45 vs.13.18 ± 0.89), respectively.

Table (1): Effect of different levels of Prickly pear cactus on body weight gain, feed intake and feed efficiency ratio of hyperglycemic rats.

Treatments / Parameters	Control Negative	Control Positive	Prickly pear cactus10%	Prickly pear cactus15 %	Prickly pear cactus20%
BWG%	11.04	-6.83	13.3	13.60	14.65
Mean± SD	± 1.29	±1.05	±2.24	±1.99	±2.27
T .test			-20.55	-23.01	-14.62
Sig.			0.00	0.00	0.00
Feed intake(g)	14.54	13.18	15.83	16.46	17.04
Mean± SD	±0.26	±0.89	±0.30	±0.27	±0.45
T .test			-7.32	-11.03	-7.33
Sig.			0.002	0.00	0.002
F.E.R	0.76	−0.51	0.84	0.82	0.86
Mean± SD	±0.08	±0.07	±0.12	±0.12	±0.13
T .test			-20.16	-22.13	-15.82
Sig.			0.00	0.00	0.00

B.W.G.: Body weight Gain F.I : Feed Intake F.E.R. : Food efficiency ratio

Table (2) showed the mean value ± SD of different levels of Prickly pear cactus on organs weight / body weight% of hyperglycemic rats. The mean value of Kidney weight / body weight% decreased significantly ($p \leq 0.5$) in all treated groups, as compared to the positive control group. The mean value of liver weight / body weight% of all diabetic groups which treated with the three levels of Prickly pear cactus decreased significantly ($p \leq 0.001$), as compared to the positive control group. The same trend was observed in the results of heart weight/body weight%. On the other hand, the results indicated that, the mean values of organs weights / body weight % of diabetic rats treated with (10, 15 and 20%) Prickly pear cactus decreased gradually with increasing the level of Prickly pear cactus.

Table (2): Effect of different levels of Prickly pear cactus on organs weight/body weight% of hyperglycemic rats.

Treatments / Organs	Control Negative	Control Positive	Prickly pear cactus10%	Prickly pear cactus15%	Prickly pear cactus20%
Kidney weight Mean± SD	1.7 ±0.09	1.9 ±0.15	1.8 ±0.12	1.6 ±0.10	1.5 ±0.11
T .test			0.032	0.031	0.030
Sig.			0.02	0.03	0.01
Liver weight Mean± SD	4.96 ±0.05	5.80 ±0.012	5.38 ±0.14	5.16 ±0.16	4.76 ±0.05
T .test			-9.34	-5.16	-8.24
Sig.			0.001	0.007	0.003
Heart Mean± SD	0.75 ±0.02	0.78 ±0.08	0.82 ±0.08	0.78 ±0.08	0.77 ±0.04
T .test			-0.89	-0.04	-1.00
Sig.			0.35	0.29	0.00

The mean values ± SD of serum glucose of rats fed on diet containing (10%, 15% and 20% Prickly pear cactus) decreased significantly (P≤0.05), as compared with the control positive group (95.80 ±3.0, 80.3±2.37 and 75.10±4.95 vs. 230.8±2.17 mg/dl), respectively. Serum glucose decreased gradually with increasing the level of Prickly pear cactus in the diets. The best results in serum glucose recorded for the group treated with 20% Prickly pear cactus. This treatment decreased the mean value of serum glucose by about 67.461%, than that of the positive control group.

(Table 3) The mean value of serum creatinine of rats fed on diet containing (10%, 15% and 20% Prickly pear cactus decreased significantly (P≤0. 05), as compared with the control positive group. All Regarding the mean values of serum uric acid of rats fed on diet containing (10%, 15% and 20% Prickly pear cactus) was decrease significantly (P≤0. 05), as compared with the control (6.20±0.26 mg/dl) results were 3.00±0.17, 2.8±0.17 and 2.5±0.20 mg/dl, respectively. These results agree with that of **Halmi et al., (2012)** who reported that, Prickly pear cactus contains fiber which can lower blood glucose by decreasing the absorption of sugar in the stomach **(WWW.WebMb, 2015).** Prickly pear cactus improves glucose tolerance curves **(Rayburn et al., 1998).** The leaves of prickly pear cactus are used for medicine possibly effective for diabetes. Some forms of prickly pear cactus seem to lower blood sugar levels in

people who have type 2 diabetes **(WWW.Emedicine health, 2015).** The raw plant contains abundant mucilage, which is a complex carbohydrate that may delay absorption of glucose that cactus also contain fiber, which is known to delay glucose absorption **(Wolfram et al., 2002).** The authors did mention that ingestion of prickly pear cactus might help lower serum cholesterol levels and perhaps augment the patient's sensitivity to insulin, as well as improve glucose tolerance curves **(Rayburn et al., 1998).** Capsules containing dried Prickly Pear cactus are a popular item on both sides of the border and are used to treat diabetes, high cholesterol and obesity **(Bwititi, 2001).** Research with pigs suggests that a certain species of prickly pear cactus, Opuntia lindheimeri Engelm may be useful in the prospective treatment of type 2 diabetes mellitus. In this experiment, the hypoglycemic activity of the cactus was investigated in streptozotocin – induced diabetic pigs, employing an enteral route of administration. The results showed that the hypoglycemic effect of the cactus was evident 1 hour after ingestion, reaching its maximum effect 4 hours after ingestion **(Laurenz et al 2003**).

Table (3) Effect of different levels of Prickly pear cactus on serum glucose and kidney functions of hyperglycemic rats.

Treatments / Parameters	Control Negative	Control POSITIVE	10%	15%	20%
Serum glucose mg/dl)) Mean± SD	123 ±3.35	230.8 ±2.04	95.80 ±3.00	80.3 ±2.37	75.10 ±4.95
T .test			97.0	120.7	78.4
Sig.			0.00	0.00	0.00
Creatinine mg/dl)) Mean± SD	0.70 ±0.19	0.9 ±0.30	0.82 ±0.10	0.86 ±0.07	0.88 ±0.05
T .test			-3.13	-6.50	-1.30
Sig.			0.03	0.00	0.06
Uric acid (mg/dl) Mean± SD	2.4 ±0.20	6.20 ±0.26	3.00 ±0.17	2.8 ±0.31	2.5 ±0.20
T .test			0.128	0.128	0.127
Sig.			0.02	0.02	0.01

Table (4) showed the mean values of serum AST of rats fed on 10%, 15%, 20% Prickly pear cactus were lower than the control (115.8±1.9IU/I) results were 102.1±8.8, 101±4.4 and 98.4±4.8IU/l, respectively .The mean value of serum ALT of rats fed on 10%, 15 %, 20% Prickly pear cactus were lower than the control (61.3±3.93IUI/I) results were being 46±4.44, 43.2±4.1 and 39.6±9.5 IU/l, respectively. As the mean value of alkaline phosphates (ALP) for all groups were lower than the control group (301±5.57IU/I) results were being 115±3.61, 107±4.58, 92±3.61 IU/I, were significant ($p \leq 0.001$). The mean values of serum AST, ALT and ALP of rats which suffer from hyperglycemia which were fed on diet containing (10, 15 and 20% Prickly pear cactus) decreased gradually with increasing the level of Prickly pear cactus. The mean values of AST, ALT and ALP decreased by about 15.025%, 35.399% and 69.435% when diabetic rats fed on diet containing 20% Prickly pear cactus. These results agree with that **(Fatma and Amal, 2011).** Who reported that a single or repeated dose of cactus fruit juice (5 ml /once, twice, three or four times/rat) was orally administrated daily to alloxan-induced diabetic rats for five weeks. The levels of glucose, cholesterol, urea, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) and malondialdehyde (MDA) were significantly ($P \leq 0.05$) increased, while levels of superoxide dismutase (SOD), reduced glutathione (GSH),

HDL-cholesterol , protein, hemoglobin and liver glycogen were significantly decreased in serum of alloxan-induced, diabetic rats. Treatment of the diabetic rats with single or repeated dose of cactus fruit juice improved these parameters in diabetic.

Table (4) Effect of different levels of Prickly pear cactus on liver enzymes of hyperglycemic rats.

Treatments / Parameters	Control Negative	Control Positive	10%	15%	20%
AST (IU/l) Mean± SD	104 ±8.8	115.8 ±1.9	102.1 ±8.8	101 ±4.4	98.4 ±4.8
T .test			-1.08	-0.40	-3.36
Sig.			0.33	0.33	0.02
ALT (IU/l) Mean± SD	40.1 ±1.88	61.3 ±3.93	46 ±4.44	43.2 ±4.1	39.6 ±9.5
T .test			2.06	2.08	1.85
Sig.			0.01	0.01	0.13
Alkaline phosphates (IU/l) Mean± SD	98 ±5.36	301 ±5.57	115 ±3.61	107 ±4.58	92 ±3.51
T .test			5.83	3.08	2.69
Sig.			0.000	0.000	0.000

Conclusion

The results in the present study that prickly pear cactus by different levels 10, 15 and 20% improved serum glucose, kidney function and liver function on diabetic rats, especially with high level. As prickly pear cactus contains fiber which can lower blood glucose by decreasing the absorption of sugar in the stomach.

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