Faculty of Home Economics

Journal of Home Economics
Print ISSN: 2735-5934, Online ISSN: 2735-590X
Menoufia University, Shibin El Kom, Egypt
https://mkas.journals.ekb.eg

Menoufia University

Nutrition and Food Sciences

Article Type
Original Article

Potential Effect of Red Pitaya Fruit on Alloxan Induced Diabetic Rats

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DOI:*10.21608/MKAS.2022.162518.1175*

Cite as:
El-Shaer et al., 2023, Potential Effect of Red Pitaya Fruit on Alloxan Induced Diabetic Rats. J Home Econ. 33(1), 89-.101

Received: 12 Sep 2022
Accepted: 12 Oct 2022
Published: 1 Jan 2023

Printed in Menoufia University, Egypt.

Abstract:

This study aimed to discover pitaya fruit's potential health effects on alloxan-induced diabetic rats. Thirty mature albino rats (140-160 g) were divided into two main groups. The first group (n=5 rats) served as a negative control; the second group (n=25 rats) was injected with alloxan to induce diabetes, then divided into five groups (5 rats each), one of them kept as a positive control group. At the same time, the four left groups were given pitaya flesh juice 5 mg/kg BW., pitaya flesh juice 7.5 mg/kg BW., pitaya peels powder 2.5%, and pitaya peels powder 5%, respectively. The treatment lasted for 28 days. According to the findings, pitaya peel powder of 5 percent reduced serum glucose by 201.52 ±3.01 to 105.46 ±1.33 mg/dl in diabetes mellitus. Pitaya peels powder 5% recorded the highest effects in improving kidney parameters, liver enzymes, lipids profile, and antioxidant enzymes. The results suggested that pitaya flesh juice (5 mg/kg. BW), pitaya flesh juice (7.5 mg/kg. BW), pitaya peels powder (2.5%), and pitaya peels powder (5%) might be utilized to improve the health status of diabetes mellitus. According to the findings of this study, pitaya fruit is not only beneficial to the health of diabetic people, but it may also be beneficial to individuals with cardiovascular disease and liver and kidney disease. Pitaya fruit improved the biochemical indicators of diabetic rats and lowered Serum glucose. Therefore it can be considered an important dietary intervention method for diabetics.

***Keywords**: Hyperglycemia, Pitaya, Fruit Peels, Nutrition, Vitamin C.*

Introduction

Diabetes is defined as a state of hyperglycemia in either fasting or postprandial states. The chronic hyperglycemia of diabetes mellitus (DM) is associated with end organ damage, dysfunction, and failure in organs and tissues including the retina, kidney, nerves, heart, and blood vessels. The International Diabetes Federation estimates an overall prevalence in 2019 is estimated to be 9.3% (463 million people), rising to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045. The prevalence is higher in urban (10.8%) than rural (1). People with

diabetes have high blood sugar because their body cannot move sugar from the blood into muscle and fat cells to be burned or stored for energy, and/or because their liver makes too much glucose and releases it into the blood. This is because either:

- Their pancreases do not make enough insulin.
- Their cells don't respond to insulin normally.
- Both of the above (2).

Despite the development of the pharmaceutical industry in the post industrial revolution period, phytotherapy is still a resource among the therapeutic. The low cost and the cultural compatibility may encourage phyto-therapeutics and medicinal plants use in primary health care and they may compensate for the chronic lack of medicine in these services. Therefore, the professional qualification of health professionals in the understanding of phytotherapy and its indications is essential (3).

Pitaya fruit is considered as a medicinal plant, used in folk medicine in Asian countries, where traditional practitioners use herbal medicines to prevent and to cure diseases (4). Regular consumption of pitaya fruit helps in fighting against cough and asthma; also it helps for healing wounds and cuts quickly due to it contains high amount of vitamin C. However, the high level of vitamin C found in pitaya fruit plays an important role to enhance immune system and also to stimulate the activity of other antioxidant in the body (5).

Pitaya fruit is associated with a reduced risk of diabetes. The pulp and the peels have high water content, are rich in fibers and contain many nutrient elements including a high amount of vitamins, minerals, and antioxidants (6). Pitaya fruit has great potential as a new crop for Mediterranean growers due to the requirement of little water and well adaption to the high temperatures (7). According to Saputri and Saraswati (8) shows that consume red Pitaya fruit as a non-pharmacological therapy can help lower blood glucose levels in patients with type 2 diabetes mellitus T2DM.

The purpose of this study was to see if pitaya fruit effected on alloxan induced diabetes rates. Diabetic rats will be injected with alloxan.

Materials and methods:

-Red pitaya was purchased from the local market of Shebin El-Kom, Menoufia, Egypt in November 2021.

-Fresh samples of the red pitaya were washed thoroughly under running tap water, peels and flesh were separated. Fruit flesh was squeezed. Fruit peels were dried under sunlight exposure and milled into fine powder by using a mill and kept in dark, stoppered glass bottles in a cool and dry location till use so as to reduce oxidation of them.

-Casein, all vitamins, all minerals, cellulose and alloxan were obtained from El-Gomhoria Company for Trading Drugs and Medical Instruments, Cairo, Egypt.

-Oil and corn starch were obtained from local market in Menoufia, Egypt.

-Thirty (30) male albino rats of the Sprague Dawley breed weighting (140-160 g) were obtained from the animal house of Research Institute Ophthalmology, El-Giza, Egypt.

-The work carried out at Faculty of Home Economic, Menoufia University, Egypt.

Rats were fed basal standard diet for 7 days as an adaptation period, this diet was formulated according to AIN (9), the salt mixtures and vitamin mixtures were prepared according to Hegsted *et al.* (10) and Campbell (11), respectively. The rats were kept in wire cages in a typical laboratory setting. To reduce feed loss and contamination, the meals were given to rats in special feed containers. Rats were also given water in special cups. The food and water provided were inspected on a daily and rats weighted weekly.

Induction of diabetes in rats:

Alloxan was obtained as powder from El-Gomhoria Company for Trading Drugs and Medical Instruments, Cairo, Egypt. Diabetes was induced in overnight fasted rats by a single intraperitoneal injection of freshly prepared alloxan monohydrate in normal saline (150 mg/kg body weight) according to the method described by Desai and Bhide (12).

Experimental design:

After adaptation period, rats were distributed into two main groups. The first main group (5 rats) kept as negative control group. The second main group (25 rats) injected with alloxan to induce diabetic rats, then divided into five groups (5 rats each), one of them kept as positive control group, while the left four groups were given as pitaya flesh juice 5 mg/kg. BW , pitaya flesh juice 7.5 mg/kg. BW , pitaya peels powder 2.5% and pitaya peels powder 5%.

Groups as follow:

Group (1): Control negative, normal rats fed on basal diet only.
Group (2): Control positive, diabetic rats fed on basal diet only.
Group (3): Diabetic rats fed on basal diet and 5 mg/kg. B.w. pitaya flesh juice orally.
Group (4): Diabetic rats fed on basal diet and 7.5 mg/kg. B.w. pitaya flesh juice orally.
Group (5): Diabetic rats fed on basal diet containing 2.5% pitaya peels powder.
Group (6): Diabetic rats fed on basal diet containing 5% pitaya peels powder.

During the experimental period, the body weight estimated weekly and feed intake was recorded daily.

Feeding and growth performance were carried out by determination of daily feed intake(g/d/r), body weight gain (BWG)(g\d\r) and feed efficiency ratio (FER) according to Chapman *et al*. (13) using the following equations:

$$BWG(g/d/r) = Final\ weight - Initial\ weight/28$$

$$FER = \frac{Body\ weight\ gain\ (g/d/r)}{feed\ intake\ (g/d/r)}$$

Blood sampling:

The experiment period was taking 28 days, at the end of the experimental period each rat weighted separately then, rats are slaughtered. 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 cuvette tubes and stored frozen at -20°C for analysis according to method described by Malhotra (14).

Biochemical analysis:

Serum glucose

Enzymatic determination of plasma glucose was carried out calorimetrically according to the method of Wang *et al.* (15).

Kidney parameters

Serum urea was determined according to the enzymatic method of Patton and Crouch (16). Creatinine was determined according to the method of Henry (17). Serum uric acid was determined calorimetrically according to the method of Barham and Trinder (18). Serum total protein was determined according to the method described by Weissman *et al.* (19). Serum albumin was determined as g/dl according to Doumas *et al.* (20) modified by Spencer and Price (21). Serum globulin was determined as g/dl according to Chary and Sharma (22).

Liver enzymes

Determination of serum alanine aminotransferase (ALT) and serum aspartate aminotransferase (AST). according to young (23), Serum alkaline phosphatase (ALP) was determined according to the method of IFFC (24).

Serum lipids profile

Serum total cholesterol was determined according to the colorimetric method described by Thomas (25). Serum triglycerides were determined by the enzymatic method using kits according to Young and Pestaner (26) and Fossati and Principle (27). HDL was determined according to the method described by Grodon and Amer (28). The determination of VLDL and LDL were calculated according to the method of Lee and Nieman (29) as follows:

$$VLDL\ (mg/dl) = Triglycerides\ /5$$

$$LDL\ (mg/dl) = (Total\ cholesterol - HDL) - VLDL$$

Antioxidant enzemes

Malondialdehyde (MDA) was estimated in plasma, using spectrophotometer technique according Ohkawa *et al.* (30). Catalase enzyme (CAT) enzyme was estimated in liver tissue using spectrophotometer technique according to Aebi (31). Glutathione s-transferase (GST) activity was determined in liver tissue according to the method of Habig *et al.* (32).

Statistical analysis:

The data were statistically analyzed using a computerized costat program by one-way ANOVA for a completely randomized design using a statistical analysis system (SAS). The results are presented as Mean+SD differences between treatments at $P<0.05$ were considered significant Freud and Little (33).

Results and Discussion

Table 1 shows that all rat groups fed with pitaya fruit had significantly higher body weight gain (BWG), food intake (FI) and feed efficiency ratio (FER) than the positive control. The significant increase in BWG for group 6 (5% pitaya peels powder) was 2.23(g/d/rat), compared to 0.88(g/d/rat) for the positive control. In addition, as compared to the positive control, rats treated with pitaya peels powder 5 percent had a significant decrease in FI, reaching 12.97, 16.25 (g/d/rat), respectively. On the same table, the results showed that

rats given pitaya peels powder (5%) had a much higher FER (0.137) than the positive control (0.068). Protective Effects of Luteolin on Diabetic were corroborated by Wang *et al*. (34) who found that BWG, FI and FER of diabetic rats were decreased significantly compared with negative control group. Also, Jamilah *et al*. (35) reported that the red pitaya peel contains a considerable amount of and total dietary fiber, where the percentage of insoluble and soluble dietary fiber is as high as 56.50% and 14.82%, respectively. Pitaya peel can be a good source of fiber content which can improve body weight.

Table (1): Effect of pitaya fruit on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of diabetic rats

Parameter Groups	BWG (g/day/r) (Mean ± SD)	Feed intake (g/day/r) (Mean ± SD)	FER (Mean ± SD)
G1: Control –ve	2.96^{a} ±0.12	16.34^{a} ±0.04	0.181^{a} ±0.0070
G2: Control +ve	0.88^{e} ±0.14	12.97^{e} ±0.01	0.068^{d} ±0.0100
G3: Pitaya flesh juice (5mg/kg. BW)	1.29^{d} ±0.08	13.09^{d} ±0.08	0.098^{c} ±0.0050
G4: Pitaya flesh juice (7.5mg/kg. BW)	1.46^{c} ±0.02	13.86^{c} ±0.02	0.105^{c} ±0.0015
G5: Pitaya peels powder (2.5%)	2.09^{b} ±0.05	15.62^{b}±0.09	0.133^{b} ±0.0025
G6: Pitaya peels powder (5%)	2.23^{b} ±0.09	16.25^{a}±0.07	0.137^{b} ±0.005
LSD	0.1620	0.1065	0.0105

*Means with the different superscript letters in the same column were significant different at (P<0.05). LSD: Least significant differences (P<0.05). *%Change of (+ve) control group.*

The obtained table (2) showed that the mean value of serum glucose of positive control group was significantly higher than negative control group, which was 201.52±3.01 and 98.21±1.03 (mg/dl), respectively. All treatments revealed a significant difference when compared to positive control group. On the other hand, the lowest serum glucose of treated groups (diabetic rats) were recorded for the group 6 fed on 5% red pitaya fruit powder, while the highest value was recorded for the group 3 fed on 5 mg/kg red Pitaya fruit juice with a significant difference (P≤0.05).The mean values of groups 3, 4, 5 and 6 showed a significantly lower than positive control group, it was 136.44±2.13, 125.83±1.24, 113.38±2.03, 105.46±1.33 and 201.52±3.01 (mg/dl), respectively.

Anti-diabetic activity of red pitaya were corroborated by Omidizadeh *et al*. (36) who found that red pitaya significantly improved insulin resistance in rats and 600 g amount of red pitaya fruit consumption every day decreased the blood glucose level in type 2 diabetes mellitus T2DM. Antioxidant and soluble dietary fiber contents of red pulp pitaya are responsible for its anti-insulin resistant capacity.

Saputri and Saraswati (37) shows that consume red pitaya fruit as a non-pharmacological therapy can help lower blood glucose levels in patients with type 2 diabetes mellitus T2DM. the average value of pre blood glucose levels was 177.97 mg/dl and post blood glucose levels were 159.50 mg/dl. There is effectiveness of red pitaya fruit in reducing blood glucose levels in type 2 diabetes mellitus T2DM patients

Table (2): Effect of pitaya fruit on serum glucose of diabetic rats

Parameter Groups	Glucose (mg/dl) (Mean ± SD)
G1: Control –ve	98.21^{f} ±1.03
G2: Control +ve	201.52^{a} ±3.01
G3: Pitaya flesh juice(5mg/kg. BW)	136.44^{b} ±2.13
G4: Pitaya flesh juice(7.5mg/kg. BW)	125.83^{c} ±1.24
G5: Pitaya peels powder (2.5%)	113.38^{d} ±2.03
G6: Pitaya peels powder (5%)	105.46^{e} ±1.33
LSD	3.5282

Means with the different superscript letters in the same column were significant different at (P<0.05). LSD: Least significant differences (P<0.05).%Change of (+ve) control group.*

Result of the effect of pitaya fruit on urea, creatinine, uric acid, T. protein, albumin and globulin of diabetic rats of experimental rats are presented in table (3). It showed that the urea and creatinine and uric acid of the positive control rats group recorded a higher value when compared with the negative control group with significant difference (P≤0.05). All treatments showed a significant difference when compared to positive control group. It could be noticed that there is non-significant difference between G3and G4, Also there is non-significant difference between G5and G6 . The groups 5 and 6 showed a lower value when compared with the positive control group with significant difference (P≤0.05). For uric acid, all treatments revealed a significant difference when compared to positive control group. The groups 5 and 6 showed a lower value when compared with the positive control group with a significant difference (P≤0.05). About T. protein and albumin, results revealed that the positive control rats group recorded a higher value when compared with the negative control group with a significant difference (P≤0.05). The mean values were 6.68±0.28 and 4.07±0.09 (g/dl), respectively. All treatments showed a significant difference when compared to positive control group. The highest mean value of T. protein of all treated groups was recorded for the group 3 but, the lowest value was recorded for the group 6 with a significant difference (P≤0.05). In connection with globulin, results disclosed that the positive control rats group recorded a higher value when compared with the negative control group with a significant difference (P≤0.05). The mean values were 2.67±0.11 and 1.63±0.035 (g/dl), respectively. All treatments detected a significant difference when compared to positive control group. It could be noticed that there is non-significant difference between G5 and G6. The best result was recorded for group 5and 6.

The similar results were obtained with Hor *et al*. (38) who found that biochemical analysis showed some significant changes, including creatinine, globulin, total protein and urea levels in the sub chronic toxicity study of red Pitaya fruit (*Hylocereus polyrhizus*).

Also, Prasetyo *et al*. (39) found that red Pitaya fruit juice administration can prevent or reduce the effects of doxorubicin (DOX)-induced nephrotoxicity in rats, as evidenced by a decrease in the number of glomerular with protein sediment and necrotic tubular epithelium cells, as well as improved kidney functions.

Table (3): Effect of pitaya fruit on kidney function (urea, creatinine, uric acid, T. protein, albumin and globulin) of diabetic rats

Parameter / Groups	Urea (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)	T. protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)
G1: Control –ve	22.48^{c} ±1.3	0.92^{c} ±0.03	1.13^{b} ±0.01	4.07^{f} ±0.09	2.44^{f} ±0.05	1.63^{e} ±0.03
G2: Control +ve	55.01^{a} ±3.9	1.5^{a} ±0.12	2.03^{a} ±0.65	6.68^{a} ±0.28	4.00^{a} ±0.16	2.67^{a} ±0.11
G3: Pitaya flesh juice(5mg/kg. BW)	34.01^{b} ±1.1	1.21^{b} ±0.02	1.54^{b} ±0.06	5.8^{b} ±0.35	3.48^{b} ±0.21	2.32^{b} ±0.14
G4: Pitaya flesh juice(7.5mg/kg. BW)	30.82^{b} ±1.1	1.16^{b} ±0.01	1.43^{b} ±0.02	5.32^{c} ±0.07	3.19^{c} ±0.04	2.12^{c} ±0.02
G5: Pitaya peels powder (2.5%)	26.48^{c} ±0.1	1.02^{c} ±0.06	1.13^{b} ±0.01	4.93^{d} ±0.08	2.95^{d} ±0.04	1.97^{d} ±0.03
G6: Pitaya peels powder (5%)	25.14^{c} ±1.0	0.98^{c} ±0.03	1.11^{b} ±0.02	4.55^{e} ±0.13	2.73^{e} ±0.07	1.82^{d} ±0.05
LSD	3.3395	0.1035	0.4746	0.3537	0.2122	0.1442

Means with the different superscript letters in the same column were significant different at (P<0.05). LSD: Least significant differences (P<0.05).%Change of (+ve) control group.*

The data presented in table (4) shows the effect of pitaya fruit on liver enzymes (AST, ALT and ALP) of diabetic rats. The groups fed with different concentrations of pitaya fruit were compared with the positive control group, and all treated groups showed a significant difference when compared. Also, there was no significant difference between G3 and G4. The obtained results are agreeing with those reported by Yeh *et al*. (40) who showed that red pitaya supplementation can reduce hepatic steatosis and inflammation by controlling lipid metabolism and modulating oxidative stress and the hepatic TLR4–MyD88 pathway. The peel of the red pitaya contains more bioactive compounds than the meat, making it a good source of dietary betacyanin.

Table (4): Effect of pitaya fruit on liver functions (AST, ALT and ALP) enzymes of diabetic rats

Parameter / Groups	AST(U/L) (Mean ± SD)	ALT (U/L) (Mean ± SD)	ALP (U/L) (Mean ± SD)
G1: Control –ve	29.16^{d} ±1.01	32.16^{d} ±1.02	61.16^{e} ±2.38
G2: Control +ve	61.47^{a} ±3.58	70.33^{a} ±3.94	99.54^{a} ±3.99
G3: Pitaya flesh juice(5mg/kg. BW)	42.06^{b} ±0.07	47.54^{b} ±1.15	76.91^{b} ±1.67
G4: Pitaya flesh juice(7.5mg/kg. BW)	40.55^{b} ±0.51	44.99^{b} ±0.92	72.48^{c} ±1.49
G5: Pitaya peels powder (2.5%)	35.25^{c} ±1.89	39.18^{c} ±2.87	68.81^{cd} ±1.06
G6: Pitaya peels powder (5%)	31.25^{d} ±1.02	34.42^{d} ±1.05	65.01^{de} ±1.28
LSD	3.1418	3.8480	3.9349

*Means with the different superscript letters in the same column were significant different at (P<0.05). LSD: Least significant differences (P<0.05). *%Change of (+ve) control group.*

Data of table (5) show the mean value of T.C, T.G, VLDL and LDL of positive control group was significantly higher than negative control group, The mean values of groups 3, 4, 5 and 6 showed a significantly lower than positive control group, On the other hand, the lowest total cholesterol levels of treated groups (diabetic rats) were recorded for the group 6 fed

on 5% red Pitaya fruit powder, while the highest value was recorded for the group 3 fed on 5 mg/kg red Pitaya fruit juice with a significant difference (P≤0.05). For HDL, the results revealed that the mean value of HDL of positive control group was significantly lower than negative control group, which was 25.56±3.45 and 52.25±1.56 (mg/dl), respectively. The mean values of groups 3, 4, 5 and 6 showed a significantly higher than positive control group, and therefore the lowest HDL of treated groups (diabetic rats) were recorded for the group 3 fed on 5 mg/kg red Pitaya fruit juice, while the highest value was recorded for the group 6 fed on 5% red Pitaya fruit powder with a significant difference (P≤0.05).

These result are agreeing with Song *et al*. (41) who reported that red pitaya consumption was decrease TC, TG and LDL levels while increasing HDL levels in type 2 diabetic. Setiawan *et al*. (42) pointed that pitaya peel powder supplemented in foods would contribute to preventing hyperlipidemia thanks to the benefits associated with its composition: a high content of crude fiber in the peel (69.30% total dietary fiber, divided into 56.50% insoluble food fiber and 14.82%. soluble food fiber) which helps to lower the energy intake since it traps cholesterol and bile acids in the small intestine, it can increase insulin sensitivity, and it also increases satiety a high content of antioxidants, phenol and particularly tocotrienol (vitamin E) reduces liver cholesterol levels and plasma total cholesterol and LDL-cholesterol concentrations.

Table (5): Effect of pitaya fruit on lipids fractions (T.C, T.G, VLDL, LDL and HDL) of diabetic rats

Parameter / Groups	T.C (mg/dl) (Mean ± SD)	T.G (mg/dl) (Mean ± SD)	HDL (mg/dl) (Mean ± SD)	VLDL (mg/dl) (Mean ± SD)	LDL (mg/dl) (Mean ± SD)
G1: Control –ve	78.81^{e} ±1.98	49.82^{d} ±1.01	52.25^{a} ±1.56	9.96^{d} ±0.204	16.59^{f} ±0.215
G2: Control +ve	155.62^{a} ±2.2	98.22^{a}±2.82	25.56^{d} ±3.45	19.64^{a} ±0.56	110.4^{a} ±1.79
G3: Pitaya flesh juice(5mg/kg. BW)	111.9^{b} ±2.08	82.21^{b} ±0.25	35.52^{c} ±1.01	16.44^{b} ±0.05	59.99^{b} ±1.02
G4: Pitaya flesh juice(7.5mg/kg. BW)	106.4^{c} ±1.04	80.26^{b} ±0.68	38.57^{c} ±1.18	16.05^{b} ±0.14	51.81^{c} ±0.280
G5: Pitaya peels powder (2.5%)	91.36^{d} ±2.05	56.62^{c} ±1.22	46.96^{b} ±1.02	11.32^{c} ±0.24	33.07^{d} ±0.78
G6: Pitaya peels powder (5%)	81.19^{e} ±1.11	51.45^{d} ±1.29	48.85^{b} ±0.66	10.29^{d} ±0.25	22.05^{e} ±0.19
LSD	3.2228	2.5831	3.1005	0.5176	1.6308

Means with the different superscript letters in the same column were significant different at (P<0.05). LSD: Least significant differences (P<0.05).%Change of (+ve) control group.*

Table (6) interpreting the mean value of MDA of positive control group was significantly higher than negative control group, which was 6.016±1.05 and 0.416±0.21 (nmol/ml), respectively. All treatments detected a significant difference when compared to positive control group. The obtained result showed that the mean values of groups 3, 4, 5 and 6 showed a significantly lower than positive control group, it was 3.82±1.01, 1.76±0.02, 2.25±0.03, 0.79±0.01 and 6.016±1.05 (nmol/ml), respectively. The results revealed that the mean value of CAT and GPX of positive control group were significantly lower than negative control group. on the other hand, the result showed that the lowest CAT of treated groups (diabetic rats) were recorded for the group 3 fed on 5 mg/kg red pitaya fruit juice, while the highest value was recorded for the group 6 fed on 5% red pitaya fruit powder with a significant difference (P≤0.05). The mean values were 2.73±0.68 and 7.84±1.03 (ng/ml), respectively.

These results in agreement with Poolsup *et al*. (43) who reported that red flesh pitaya fruit has greater content of antioxidant compared with white flesh pitaya fruit. The results of antioxidant activity tests, total phenolic content and total betacyanin content was highest in red peel, followed by white peel.

Putri *et a*l. (44) showed that the MDA levels decreased, which implies that at higher dose the natural antioxidants present in the extract may be responsible for decreasing the arterial stiffness. Pitaya fruit is a good source of several natural antioxidants like betalains, polyphenols and ascorbic acid, MDA levels increased significantly ($P < 0.05$) in group II after the induction of diabetes. Extract treatment significantly decreased the MDA levels, but not to the normal basal values. As reported in previous studies.

Table (6): Effect of pitaya fruit on antioxidant enzymes of diabetic rats

Parameter Groups	MDA (nmol/ml) (Mean ± SD)	CAT (ng/ml) (Mean ± SD)	GPX (u/ml) (Mean ± SD)
G1: Control –ve	0.416e ±0.21	10.51a ±1.47	216.8a ±4.51
G2: Control +ve	6.016a ±1.05	0.782e ±0.06	84.82f ±3.17
G3: Pitaya flesh juice(5mg/kg. BW)	3.82b ±1.01	2.73d ±0.68	121.36e ±3.85
G4: Pitaya flesh juice(7.5mg/kg. BW)	1.76cd ±0.02	6.14c ±1.01	169.88c ±3.42
G5: Pitaya peels powder (2.5%)	2.25c ±0.03	3.73d ±0.65	144.29d ±2.92
G6: Pitaya peels powder (5%)	0.79de ±0.01	7.84b ±1.03	186.12b ±2.67
LSD	1.0694	1.6450	6.1866

Means with the different superscript letters in the same column were significant different at (P<0.05). LSD: Least significant differences (P<0.05).%Change of (+ve) control group.*

Effect of pitaya flesh juice and pitaya peels powder indicated increase on body weight increase, feed intake, feed efficiency ratio. Serum glucose, liver enzymes (AST, ALT& ALP) and kidney parameters (urea, creatinine, uric acid, total protein, albumin & globulin) were decreased due to interference with the pitaya. Antioxidant enzymes (MDA, CAT&GST) were increased by pitaya. The lipid profile (TC, TG, HDL, LDL &VLDL) were improved by pitaya. The best treatment were group 5 fed on 2.5% red Pitaya fruit powder and group 6 fed on 5% red Pitaya fruit powder.

Conclusion

Pitaya fruit is an essential source of many healthy ingredients, including diabetes, obesity, and heart disease, according to this study. The antioxidants present in the pitaya fruit, protect against diabetes, neurodegenerative diseases, cardiovascular disease and cancer. Pitaya fruit plays an important role in boosting the immune system and also in stimulating the activity of other antioxidants in the body. Thus a result of these discoveries, we must use the pitaya fruit in our daily diets, beverages and nutritional supplements**.**

Conflict of interest

The authors state that the publishing of this work does not create a conflict of interest for them. This article is based on a Master thesis that was submitted to Menoufia University's Department of Nutrition and Food Science, Faculty of Home Economics, Shebin El-Kom, Egypt.

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التأثير المحتمل لفاكهة البتايا الحمراء على داء السكري المستحث بالألوكسان في الفئران

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الملخص العربي:

اظهر هذا البحث الآثار الصحية المحتملة لفاكهة البيتايا على الفئران المصابة بداء السكري التي يسببها الألوكسان. تم تقسيم ثلاثين من فئران الألبينو الناضجة (140-160 جم) إلى مجموعتين رئيسيتن , المجموعة الضابطه السالبة (5 فئران) كانت مجموعة ضابطه سالبة والمجموعه الثاني (25 فأرا) حقنت بالالوكسان للإصابة بداء السكري ، ثم قسمت إلى خمس مجموعات (5 فئران لكل مجموعة) ، واحدة منها بقيت كمجموعة ضابطة موجبة ، أما المجموعات الأربع الباقية فقد أعطيت عصير لحم بيتايا 5 مجم / كجم من وزن الجسم ، عصير لحم بتيايا 7.5 مجم / كجم من وزن الجسم ، 2.5٪ مسحوق قشور بيتايا و 5٪ مسحوق قشر بيتايا. استمرت المعاملة لمدة 28 يومًا وفقًا للنتائج خفض مسحوق قشور البتايا (5%) نسبة السكر في الدم من 201.52 ± 3.01 الي 105.46 ± 1.33 مجم / ديسيلتر. سجلت مسحوق قشر البيتايا (5%) أعلى التأثيرات من حيث تحسين مستويات إنزيمات الكبد ومؤشرات الكلي وانزيمات الاكسده ودهون الدم . وفي الوقت نفسه ، أشارت النتائج إلى أنه يمكن استخدام عصير لحم البيتايا (5 ملجم / كجم من وزن الجسم) وعصير لحم البيتايا (7.5 ملجم / كجم من وزن الجسم) ومسحوق قشر البيتايا (2.5٪) ومسحوق قشور البيتايا (5٪) لتحسين الحالة الصحية لداء السكري. التوصيات: وفقًا لنتائج هذه الدراسة ، فإن فاكهة البيتايا ليست مفيدة فقط لصحة مرضى السكري ، ولكنها مفيدة أيضًا لصحة المصابين بأمراض القلب والأوعية الدموية وأمراض الكبد والكلى. الخلاصة: حسنت فاكهة البتايا من المؤشرات البيوكيميائيه للفئران المصابه بالسكر ، وخفضت سكر الدم ، بالتالي يمكن اعتبارها وسيلة مهمه للتدخل الغذائي لمرضي السكر.

الكلمات المفتاحية: ارتفاع السكر في الدم، فاكهة التنين، قشور فاكهة، التغذية، فيتامين ج.