Effect of Bitter Melon (*Momordica charantia*) Juice on Blood Glucose Level and Lipid Profile in Diabetic and Prediabetic Rats

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ABSTRACT

This study aimed to evaluate the effect of bitter melon juice (BMJ) on blood glucose level and lipid profile of diabetic and prediabetic rats. Forty-two rats were separated into three group. 1st group, rats (n=6) was fed on basal diet and kept as negative control group, 2st group: (Diabetic): rats (n=18), were injected with a single dose of subcutaneous injection of alloxan (120 mg/kg) to induce diabetes. After diabetes induction rats were divided as follow: subgroup 1 served as the control positive group and 2 treated rat subgroups were fed on basal diet and orally administrated with 1and 2 ml/day of BMJ, respectively. 3st group: (Prediabetic): rats (n=18), High fat diet (HFD) group as induction of prediabetic rats. After prediabetic induction rats were divided as follow: subgroup 1 served as the control positive group and 2 treated rat subgroups were fed on HFD and orally administrated with 1and2ml/day of BMJ, respectively. Results revealed that diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significant decrease in blood glucose, increase of insulin. Furthermore, diabetic and pre diabetic rats treated with oral administration of BMJ had improved of body weight accompanied by a significant decrease in levels of lipid profile as well as in liver functions (ALT, AST and ALP), kidney function (Urea, Creatinine and Uric Acid), while were recorded a significant increase in a high-density lipoprotein-cholesterol (HDL-C). In addition, significantly reduced Malondialdehyde (MDA) while GP_X were significantly ($P<0.05$) increased. Conclusion, bitter melon juice could introduce a potential natural therapy against diabetic and prediabetic.

Keywords: *Momordica charantia*, Bitter Melon, hypoglycemic, Diabetes mellitus, prediabetic, Rats.

INTRODUCTION

Diabetes mellitus (DM) is a chronic and progressive metabolic disease that is described with hyperglycemia including impaired insulin secretion and insulin resistance that leads to hyperglycemia **(Végh *et al*., 2023)**. The prevalence of type 2 diabetes is rapidly growing with various complications. One of the most important difficulties of this metabolic disease is diabetic nephropathy, which is believed to be the main cause of end-stage renal failure **(Alhaider *et al*., 2011)**. However, the main mechanisms of the pathogenesis of Type 2 diabetes still remains to be elucidated, but it is shown that oxidative stress is involved in the progression of type 2 diabetes, which leading to increased lipid peroxidation and DNA damage **(Ece *et al*., 2012)**.

Prediabetes, with blood glucose concentrations higher than normal, but lower than the threshold of diabetes mellitus (DM), is a high-risk state of DM development (**Tabák *et al*., 2012**). Obesity is recognized as the most powerful environmental risk factor among several modifiable risk factors for diabetes **(Klein *et al*., 2004)**, which is associated with an increased insulin demand and increased likelihood of insulin resistance leading to prediabetes or hyperinsulinemia and ultimately T2DM **(Bray, 1992 and Després 1993)**. Plants have different compounds with various biological effects that make it possible to search for natural anti-hyperglycemic agents with minor side effects **(Balekari and Veeresham, 2013)**.

Momordica charantia (MC), a member of the Cucurbitaceae family, is known as bitter melon. It is a widely grown and consumed vegetable in Asia, East Africa, India and South America. Bitter Melon is frequently consumed as vegetable when it is unripe **(Lucas *et al*., 2010)**. Nutrition analyses of MC indicate that this vegetable is rich in fiber, calcium, potassium, iron and vitamin C and A, additionally the pulp around the seeds of the mature ripe fruits is a good source of the carotenoid lycopene. Compounds isolated from fruits and seeds of MC that are thought to contribute to hypoglycemic property of MC include charmtin, and polypeptide-p or plant insulin **(Saeed *et al*., 2018 and Mishra and Rashmi, 2021)**

Most of the studies to date examining the hypoglycemic property of MC have been conducted using animal models. MC can lower blood glucose in

normal animals, in animals fed a high fat diet, and in streptozotocin (STZ), alloxan and genetically induced animal models of diabetes. The results of animal studies to date indicate that MC has profound effects in lowering fasting" blood glucose levels. However, only limited data from controlled clinical trials are available **(Tan *et al*., 2015 and Rohajatien *et al*., 2018)**. Saudi patients suffering from type2 diabetes mellitus mostly use one of the herbal traditional therapies, such as bitter melon which has hypoglycemic protentional effect **(Ahmad *et al*., 1999)**.

AIM OF THE STUDY

The present study was conducted to evaluate the effect of bitter melon juice on blood glucose level and lipid profile of diabetic and prediabetic rats.

MATERIALS AND METHODS

A. MATERIALS:

- **Plant:** Fresh bitter melon fruit was purchased from the Agriculture Research Center, Giza, Egypt.
- **Chemicals**: Ingredients of basal diet (AIN-93) and alloxan were purchased from El-Gomhoria Company, Cairo, Egypt.
- **Kits** for blood analysis were purchased from Alkan Company for Biodiagnostic Reagents, Dokki, Cairo, Egypt.
- **Experimental Animals:** Forty-two adult male rats (Sprague Dawley strain), weighing about 150±10 g b.wt. were obtained from the Laboratory Animal Colony, Helwan, Egypt. They were housed at constant conditions of room temperature and 55 ± 5% humidity under 12-hr light/12-hr dark cycles. All rats have continuous access to feed and water and will acclimated to laboratory conditions for 1 week.

B. METHODS:

1- Preparation of Bitter Melon Juice (BMJ):

Bitter melon fruit juice was prepared as described by **Sharma *et al*., (1995)**. Briefly, fresh fruit (1 kg) was washed thoroughly. The juice was

obtained by using a commercial juice extractor (Moulinex, France). The fresh juice was centrifuged at 5000 rpm for 30 min and the clear supernatant was considered as 100%. Bitter melon fruit juice was diluted with autoclaved distilled water to make 50% juice according to **Sitasawad *et al*., (2000)**. It was stored at 4 °C and administered to rats.

2- Preparation of Basal Diet:

The basal diet will consist of protein (14%), corn oil (5%), mineral mixture (3.5%), vitamin mixture (1%), fiber (5%), sucrose (10%), choline chloride (0.25%) and the remainder will be Corn starch up to 100%. These constituents will be thoroughly mixed together and formulated according to **Reeves *et al*., (1993)**.

Experimental Design

The experiment was carried out at the Post Graduated Lab of Home Economics Faculty, Helwan University. Animals were housed in well aerated cages under hygienic condition and feed on basal diet for one week for adaptation. After the adaptation period, rats were divided into three main groups, as follows:

• **First group:** Negative control group, rats (n=6) were fed on basal diet only during the experimental period.

• **Second group (Diabetic rats):** Rats (n=18), were injected with a single dose of subcutaneous injection of alloxan (120 mg/kg) to induce diabetes **(Ashok *et al*., 2007)**. Fasting blood glucose levels was assessed everyday by glucometer strips. After three days, the rats with plasma glucose level > 250 mg/dL was considered diabetic **(Zangeneh *et al*., 2018)**, then the animals were divided as follow:

Subgroup (1):	Rats (served as positive control group) were fed on basal diet only.
Subgroup (2):	Rats were fed on basal diet and orally administrated with 1 ml/day of BMJ.
Subgroup (3):	Rats were fed on basal diet and orally administrated with 2 ml/day of BMJ.

• **Third group:** High fat diet (HFD) group as induction of prediabetic rats: Rats (n=18), were fed on high fat diet according to **Min et al., (2004)** (Sheep fat 19%, soybean oil 1% to provide essential fatty acids, sucrose 10%, casein 20%, cellulose 5%, vitamin mixture 1%, salt mixture 3.5%, choline chloride 0.25% and the remainder is corn starch), and divided as follow:

Subgroup (1): Rats were fed on HFD only.

Subgroup (2): Rats were fed on HFD and orally administrated with 1 ml/day of BMJ.

Subgroup (3): Rats were fed on HFD and orally administrated with 2 ml/day of BMJ.

Biological Evaluation:

Feed intake was recorded daily; animals were weighed at the beginning and twice a week throughout the experimental period (6 weeks). Body weight gain and feed efficiency ratio were calculated at the end of the experiment according to **Chapman, (1959)** using the following equation:

$$\textbf{BWG } \% = \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Initial body weight}} \times 100$$

FER = Weight gain (g) / Feed intake (g)

Blood Collection and Serum Separation:

At the end of the experimental period (6 weeks), rats were fasted overnight, then the blood were collected under slight ether anesthesia. Serum were separated by centrifugation at 3000 rpm for 15 min. The obtained serum were used immediately for routine laboratory investigation.

Biochemical Analysis:

Determination of glucose: Serum glucose measured by enzymatic GOD / POD kits according to **Asatoor and King, (1954)**. **Determination of insulin:** Insulin estimated using enzyme-linked immunosorbent assay ELISA method as described by **(Clark and Hales, 1994)**.

Serum Lipid Profile:

Serum total cholesterol (TC) **(Richmond, 1973)**, triglycerides (TG) **(Wahlefeld, 1974)**, High density lipoprotein (HDL) **(Albers *et al*., 1983)** were determined. Meanwhile, low density lipoprotein (LDL) and very low density lipoprotein (VLDL) were calculated according to **Fridewald *et al*., (1972)**.

LDL-c = TC-[HDL-c + (TG/5)] **VLDL-c = TG/5**

Liver Function:

Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured according to (**Bergmeyer *et al*., 1978)**, Alkaline phosphates (ALP) was determined according to **Belfield and Goldberg (1971)**.

Kidney functions:

Serum urea **(Kaplan, 1984)**, uric acid **(Patton and Crouch, 1977)** and creatinine were measured according to **(Murray, 1984)**.

Antioxidant Enzymes

The plasma level of malondialdehyde (MDA) was calculated to measure lipid peroxidation was determined according to **Draper and Hadley (1990).** Glutathione peroxidase (GP_X) were measured methods by **Moin, (1986).**

Statistical analysis:

All data obtained results were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows, version 20 (SPSS Inc., Chicago, IL, USA). Collected data were presented as mean± standard deviation (SE). Analysis of Variance (ANOVA) test were used for determining the significances among different groups according to **(Armitage and Berry, 1987)**. All differences will consider significant if P-values were ($P< 0.05$).

RESULTS AND DISCUSSION

As shown in **Table (1)** there had been no significant variation in IBW among all groups. Regarding FBW, FI; BWG% and FER of +ve control

(diabetic rats) had significant ($p<0.05$) decrease in FBW as compared to the –ve group. While, diabetic rats treated with oral administration of 1 and 2 ml/day of Bitter Melon Juice (BMJ) caused a significant increase in FBW as compared to +ve control group.

These findings were consistent with a number of studies by **Akhter et al., (2018)** obtained that treatment of diabetic rats with bitter melon induced a significant increase in body weight as compared to diabetic control rats. Regarding prediabetic groups feeding on (HCD), the results show FBW, FI; BWG% and FER of +ve control (prediabetic rats) had significant ($p<0.05$) increase in FBW as compared to the –ve group. While, prediabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significant decrease in FBW as compared to +ve control group. The best outcomes of improve body weight status had been found in the diabetic and prediabetic groups treated with oral administration of 2 ml/day of BMJ.

These findings were consistent with a number of studies by **Phimarn et al., (2018)** found a significant reduction in body weight as a result of bitter melon supplementation. **Sohn et al., (2018)** observed that M. charantia fruit water extract significantly decreased obesity-related changes, and the water extract showed the most dramatic and synergic obesity-inhibiting effects. In addition, **Bai et al., (2016)** reported that subcutaneous and perirenal fat decreased in obese rats fed a high-fat diet and bitter melon.

Additionally, despite eating the same amount of food as the control group, they did not gain weight. Fruthermore, Flavonoids and phenolic chemicals found in bitter melon have been shown in animal experiments to have antiobesity properties **(Fan et al., 2019)**.

Table (1): Effect of oral administration of Bitter Melon Juice on Initial body weight (IBW), Final body weight (FBW), feed intake (FI), body weight gain (BWG%) and feed efficiency ratio (FER) in Diabetic and Prediabetic rats.

Groups \ Parameters		IBW g	FBW G	FI (g/d/rat)	BWG %	FER
Control (-Ve)		155.4±1.02a	202.6±0.92a	20	30.38±0.59a	0.056±0.001a
Diabetic Groups	**Control (+Ve)**	155.6±1.20a	178.8±0.99d	16	14.90±0.19d	0.034±0.001c
	1ml BMJ	156.6±0.81a	187.0±0.76c	18	19.41±0.22c	0.040±0.002bc
	2ml BMJ	154.2±0.85a	191.6±0.87b	20	24.25±0.22b	0.049±0.005ab
Control (-Ve)		155.4±1.02a	202.6±0.92ac	20	30.38±0.59c	0.056±0.001d
Prediabetic Groups HFD	**Control (+Ve)**	153.8±1.03a	223.2±1.39a	20	45.15±1.01a	0.082±0.001a
	1ml BMJ	153.4±0.59a	212.2±0.66b	19	38.33±0.77b	0.073±0.001b
	2ml BMJ	154.6±0.66a	203.8±0.83c	17	30.81±0.73c	0.067±0.001c

Data are expressed as mean ± SE.
Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

As shown in **Table (2)** results exhibited effect of oral administration of Bitter Melon Juice on blood glucose and Insulin Hormone of diabetic and pre diabetic rats. Alloxan injection and HFD significantly increased mean glucose value in control positive group compared to the control negative group according to results in diabetic and pre diabetic groups. Diabetes syndromes are defined by elevated blood sugar, changed fat and carbohydrate levels, and a higher chance of developing complications from the disease **(Galicia-Garcia et al., 2020; Negm, 2023)**.While, diabetic and pre diabetic rats treated with oral

administration of 1 and 2 ml/day of BMJ caused a significant decrease in blood glucose as compared to+ve control group. It was observed that highest glucose reduction of diabetic and pre diabetic had been recorded at the group fed on 2 ml/day of BMJ by 34.86% and 43.12% respectively. These results agreement with **Patel *et al.*, (2022)** suggested that bitter melon may help decrease Fasting Blood Glucose (FBG) by increasing insulin secretion and improving the body ability to utilize glucose. Also, **Khalid et al., (2025)** indicate that bitter melon supplementation can significantly lower blood glucose levels and provide a safe alternative to conventional diabetes treatments. This mechanism is also supported by the data presented in the current study, where the treatment group exhibited a significant decrease in two types of blood glucose measurements, namely FBG and Random Blood Glucose (RBG) **(Clouatre *et al.*, 2011)**. In addition, **Kim et al., (2020)** showed that bitter melon has effects of glucose lowering in patients with type 2 diabetes or those in a pre-diabetic state. In a study of 52 individuals with prediabetes, M. charantia fruit extracts lowered elevated fasting plasma glucose **(Krawinkel et al., 2018)**.

Outcomes also showed that there had been significant decreased at ($p<0.05$) in mean value of insulin in the control positive group as compared to the control negative group. While, diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significant increase in insulin as compared to+ve control group. Highest increasing of insulin were recorded at diabetic and pre diabetic by 63.09% and 66.67% respectively. These findings were consistent with a number of studies by **Mahmoud et al., (2017)** suggested that MC fruit juice caused a significant reduction in serum glucose with a significant elevation of serum insulin levels in diabetic and pretreated rats. This may be due to its pancreatic and/or extra-pancreatic effects. These findings are in agreement with that reported by **Sridhar et al., (2008)** showed

that M. charantia fruit extract supplementation together with a high-fat diet (HFD) improved the insulin. Similar, **Fernandes et al., (2007)** who found that MC extract administration to alloxan diabetic rats was able to reduce blood glucose and elevate the reduced serum insulin. The possible mechanism by which MC extract brings about a decrease in blood glucose may be via stimulation of surviving β cells to release more insulin **(Sathishsekar & Subramanian, 2005)**.

Table (2). Effect of oral administration of Bitter Melon Juice on fasting blood glucose and serum insulin levels of diabetic and prediabetic rats.

Groups \ Parameters		Glucose mg/dl	Glucose reduction (%)	Insulin Hormone uIU/ml	Insulin Increment (%)
Control (-Ve)		90.70±0.68c	-	1.71±0.03a	-
Diabetic Groups	**Control (+Ve)**	168.11±0.90a	**-**	0.55±0.02d	**-**
	1ml BMJ	113.94±0.43b	**32.22**	1.03±0.03c	**46.91**
	2ml BMJ	109.51±0.31b	**34.86**	1.49±0.04b	**63.09**
Control (-Ve)		90.70±0.68d	-	1.71±0.03a	-
Prediabetic Groups HFD	**Control (+Ve)**	116.98±0.93a	**-**	1.23±0.02c	**-**
	1ml BMJ	104.02±0.78b	**38.12**	1.36±0.04b	**59.74**
	2ml BMJ	95.62±0.56c	**43.12**	1.65±0.06a	**66.67**

Data are expressed as mean ± SE.
Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Outcomes recorded at **Table (3)** illustrated effect of oral administration of Bitter Melon Juice on lipid profile (TC, TG, HDL.C, LDL-C & VLDL-C) in diabetic and pre diabetic rats. Mean value of (TC, TG, LDL-C & VLDL-C) in the positive control groups had significantly higher ($p<0.05$) than in the negative control group. These results agreement with **Kamel et al., (2025)**

showed that Alloxan injection and HFD significantly increase (P≤0.05) the level of lipid profile in obese diabetic rats. Also, **Negm and El-Soadaa, (2020); El-Soadaa & Negm, (2019)** observed that fed on HFD significantly increase (P≤0.05) the level of lipid profile in obese rats. On the other hand, diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significant decrease (p<0.05) in (TC, TG, LDL-C & VLDL-C) as compared to+ve control group. The best outcomes of reduce lipid profile had been found in the diabetic and prediabetic groups treated with oral administration of 2 ml/day of BMJ groups. Moreover, it was observed a significant reduction at (p<0.05) in the mean value of HDL-C of the control positive group as compared to the control negative group. Diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ had significant increase at (p<0.05) in mean value of HDL-C as compared to the control positive. The best outcomes of increase HDL had been found in the diabetic and prediabetic groups treated with oral administration of 2 ml/day of BMJ.

These results were in harmony with several researches by **Gayathry and John, (2022)** showed that M. charantia juice can act as a hypolipidemic agent, reducing serum total cholesterol, low-density lipoprotein cholesterol, and triglycerides, with effects comparable to those observed in Norwegian rats treated with a statin drug. **Zeng et al., (2018)** demonstrated that dietary M. charantia could attenuate the development of atherosclerosis in mice by reducing triglycerides. Moreover, **Akhter et al., (2018)** obtained that administration of bitter melon juice was associated with a reduction in the serum levels of (TG), (TC) and (LDL-C) when compared with positive diabetic control (p<0.05). **Mahmoud et al., (2017)** demonstrated that MC fruit juice also possesses lipid lowering properties in diabetic animals; 2- or 4-fold

increase in serum TC and serum TG levels was observed in STZ-induced diabetic rats, but in MC treated and pretreated diabetic rats, these levels were significantly reduced with a significant elevation in serum HDL-c levels. This hypolipidemic effect may possibly mediated by controlling the hydrolysis of certain lipoproteins and their selective uptake and metabolism by different tissues. The anti-hyperlipidemic effect of MC may be due to the down regulation of NADPH and NADH cofactors in the fat metabolism **(Fernandes et al., 2007)**. A clinical RCT also confirms the improvement of dyslipidemia by bitter melon hot water extract **(Kinoshita and Ogata,2018)**.

Table (3). Effect of oral administration of Bitter Melon Juice on Lipid Profile of diabetic and prediabetic rats.

Groups \ Parameters		T.Ch mg/dl	TG mg/dl	HDL-c mg/dl	LDL-c mg/dl	VLDL-c mg/dl
Control (-Ve)		137.47±0.44c	92.39±0.35d	33.10±0.39a	85.89±0.57c	18.48±0.07d
Diabetic Groups	**Control (+Ve)**	166.17±0.46ab	123.75±0.62a	20.86±0.35c	120.55±0.80a	24.75±0.12a
	1ml BMJ	167.69±0.53a	112.98±0.58b	26.93±0.24b	118.16±0.54ab	22.59±0.11b
	2ml BMJ	164.87±0.55b	104.22±0.52c	28.24±0.39b	115.78±0.39b	20.84±0.10c
Control (-Ve)		137.47±0.44d	92.39±0.35d	33.10±0.39a	85.89±0.57d	18.48±0.07d
Prediabetic Groups HFD	**Control (+Ve)**	178.42±0.73a	137.40±0.78a	18.21±0.34d	132.72±0.38a	27.48±0.23a
	1ml BMJ	172.01±0.81b	114.26±0.96b	20.97±0.28c	128.18±0.74b	22.85±0.19b
	2ml BMJ	161.04±0.95c	101.75±0.91c	24.20±0.76b	116.48±0.71c	20.35±0.23c

Data are expressed as mean ± SE.
Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Outcomes recorded at **Table (4)** illustrated effect of oral administration of Bitter Melon Juice on serum liver function of diabetic and pre diabetic rats. There was a significant increase at ($p<0.05$) in mean value of AST, ALT and ALP in the control positive group as compared to the control negative group. While, diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significant decrease ($p<0.05$) in (AST, ALT & ALP) as compared to+ve control group. The best outcomes of improve liver function had been found in the diabetic and prediabetic groups treated with oral administration of 2 ml/day of BMJ groups. These results are in agreement with the findings of **Akhter et al., (2018)** obtained that administration of bitter melon juice was associated with a reduction in the serum levels of (ALT) and (AST) when compared with positive diabetic control. These findings are in agreement with studies of **Garau et al., (2003)**.

Table (5). Effect of oral administration of Bitter Melon Juice on Liver Function of diabetic and prediabetic rats.

Groups \ Parameters		AST (mg/dl)	ALT (mg/dl)	ALP (mg/dl)
Control (-Ve)		20.12±0.53d	33.33±0.37d	106.58±0.69d
Diabetic Groups	Control (+Ve)	36.78±0.62a	51.93±0.50a	158.39±0.74a
	1ml BMJ	29.01±0.41b	41.93±0.51b	137.26±0.94b
	2ml BMJ	24.78±0.66c	37.73±0.86c	124.98±0.48c
Control (-Ve)		20.12±0.53c	33.33±0.37c	106.58±0.69d
Prediabetic Groups HFD	Control (+Ve)	30.58±0.27a	42.42±0.38a	145.78±0.93a
	1ml BMJ	25.98±0.41b	39.73±0.97ab	137.78±0.86b
	2ml BMJ	21.98±0.52c	35.13±0.75bc	124.78±0.65c

Data are expressed as mean ± SE. Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Outcomes recorded at **Table (5)** illustrated effect of oral administration of Bitter Melon Juice on serum kidney function of diabetic and pre diabetic rats. There was a significant increase at ($p<0.05$) in mean value of Urea, Creatinine and Uric Acid in the control positive group as compared to the control negative group. In contrast, diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significant decrease ($p<0.05$) in (Urea, Creatinine and Uric Acid) as compared to+ve control group. The best outcomes of reduce kidney function had been found in the diabetic and prediabetic groups treated with oral administration of 2 ml/day of BMJ groups. These findings were consistent with a number of studies by In STZ-induced T2DM mice, the renoprotective nature of *Momordica* saponins is exerted by improving the level of uric acid and creatinine, while MC functions mainly through enhancing antioxidant capacity **(Wang et al., 2019)**.

Table (5). Effect of oral administration of Bitter Melon Juice on Kidney Function of diabetic and Prediabetic rats.

Groups \ Parameters		Urea (mg/dl)	Creatinine (mg/dl)	Uric Acid (mg/dl)
Control (-Ve)		21.92±0.28d	0.67±0.01c	2.72±0.02c
Diabetic Groups	Control (+Ve)	35.95±0.62a	1.74±0.03a	4.28±0.05a
	1ml BMJ	29.22±0.73b	0.85±0.01b	3.14±0.01b
	2ml BMJ	25.05±0.50c	0.79±0.01b	2.98±0.05b
Control (-Ve)		21.92±0.28c	0.67±0.01c	2.72±0.02c
Prediabetic Groups HFD	Control (+Ve)	32.08±0.75a	1.55±0.23a	3.84±0.07a
	1ml BMJ	30.77±0.26a	1.16±0.01ab	3.32±0.09b
	2ml BMJ	28.21±0.55b	0.96±0.02bc	2.95±0.01c

Data are expressed as mean ± SE. Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

As shown in **Table (6)** effect of oral administration of Bitter Melon Juice of diabetic and pre diabetic rats. The current study, compared to the control group, the level of oxidative stress parameters like MDA increase in diabetic and pre diabetic rats, while other antioxidant measures like GPX dropped. Oxidative stress has been shown in numerous studies to contribute to the development of diabetes, which is relevant to the disease since it impairs insulin function and raises the risk of complications **(Kamel et al., 2025)**. Oxidative stress appears to be more concerning in relation to metabolic diseases, particularly diabetes **(Ceriello *et al*., 2016 ; Negm, 2023a)**.

In contrast, diabetic and pre diabetic rats treated with oral administration of 1 and 2 ml/day of BMJ caused a significantly reduced MDA but, the antioxidants enzymes (GP_X) in comparison to the +ve control group. The best outcomes of improve antioxidants enzymes had been found in the diabetic and prediabetic groups treated with oral administration of 2 ml/day of BMJ groups. The results are consistent with the findings of **Mahmoud et al., (2017)** indicated that MC fruit juice possesses potent antioxidant activity, which may be directly or indirectly responsible for its hypoglycemic property.

In this study, MC significantly lowered pancreatic MDA in diabetic and pretreatment group. This may be due to reducing the rate of lipid peroxidation **(Sitasawad et al., 2000)** and its cytoprotective action **(Ahmed et al., 1998)**. The extract exerted rapid protective effects against lipid peroxidation by scavenging free radicals there and reducing the risk of diabetic complications. MC fruit juice was found to play a role in reducing levels of lipid peroxidation in vivo as well as in vitro models **(Sitasawad et al., 2000)**.

Table (6). Effect of oral administration of Bitter Melon Juice on antioxidants enzymes of diabetic and prediabetic rats

Groups \ Parameters		MDA ng/ml	GPx U/ml
Control (-Ve)		118.78±0.53d	136.62±0.70a
Diabetic Groups	**Control (+Ve)**	402.25±0.68a	83.23±0.40d
	1ml BMJ	355.81±0.97b	94.76±0.35c
	2ml BMJ	324.41±0.61c	111.31±0.77b
Control (-Ve)		118.78±0.53d	136.62±0.70a
Prediabetic Groups HFD	**Control (+Ve)**	391.14±0.48a	93.23±0.43d
	1ml BMJ	302.19±0.74b	121.18±0.63c
	2ml BMJ	287.34±0.71c	129.18±0.34b

Data are expressed as mean ± SE.
Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Conclusion:

Bitter Melon (*Momordica charantia*) is a cheap, readily available vegetable with a wide range of medicinal uses and negligible drawbacks. The antidiabetic and prediabetic potential of BMJ aligns with the broader goal of maintaining a balanced diet and offers a novel, promising approach to broaden the therapy options for diabetes and prediabetic. In order to improve the future for diabetics and prediabetic, further research must be done on how to integrate the findings to clinical practice in a reasonable and sustainable manner.

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تأثيرعصير القرع المر على مستوى جلوكوز الدم ومستوى الدهون فى الفئران المصابة بمرض السكرى وما قبل السكرى

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الملخص العربي

هدفت هذه الدراسة إلى تقييم تأثير عصير القرع المر (BMJ) على مستوى السكر في الدم ومستوى الدهون في الفئران المصابة بمرض السكري وما قبل السكري. تم تقسيم اثنين وأربعين فأرًا إلى ثلاث مجموعات. المجموعة الأولى، عدد الفئران (ن = ٦) والتى تم تغذيتها على نظام غذائي أساسي وخصصت كمجموعة ضابطة سالبة، المجموعة الثانية: (المصابة بالسكرى): عدد الفئران (ن = ١٨) تم حقنها بجرعة واحدة تحت الجلد من الألوكسان (١٢٠ مجم / كجم) لتحفيز مرض السكر. بعد احداث مرض السكر تم تقسيم فئران هذه المجموعة على النحو التالي: المجموعة الفرعية الاولى كمجموعة ضابطة موجبة وتم تغذية مجموعتين فرعيتين اخرين من الفئران المعالجة على نظام غذائي أساسي وتم إعطاؤهما عن طريق الفم ١ و ٢ مل / يوم من عصير القرع المر، على التوالي. المجموعة الثالثة: (مرحلة ماقبل السكري): عدد الفئران (ن = ١٨)، مجموعة النظام الغذائي عالي الدهون (HFD) لتحفيز مرحلة ما قبل السكري لدى الفئران. بعد تحريض مرحلة ما قبل السكري، قُسِّمت الفئران إلى: المجموعة الفرعية ١ كمجموعة ضابطة موجبة ، ومجموعتان فرعيتين تغذوا على نظام عالى الدهون وتم إعطاؤهما عن طريق الفم ١ و ٢ مل / يوم من عصير القرع المر ، على التوالي. أظهرت النتائج أن الفئران المصابة بمرض السكري ومرحلة ما قبل السكري، والتي عولجت بإعطاء ١ و٢ مل يوميًا من عصير القرع المر عن طريق الفم، انخفاض ملحوظ في مستوى سكر الدم وزيادة في مستوى الأنسولين. علاوة على ذلك، شهدت الفئران المصابة بمرض السكري ومرحلة ما قبل السكري، والتي عولجت بإعطاء عصير القرع المر عن طريق الفم، تحسنًا في وزن الجسم، مصحوبًا بانخفاض ملحوظ في مستويات الدهون، وكذلك وظائف الكبد (ALT وAST وALP)، ووظائف الكلى (اليوريا والكرياتينين وحمض اليوريك)، كما سُجلت زيادة ملحوظة في كوليسترول البروتين الدهني عالي الكثافة (HDL-C). بالإضافة إلى ذلك، انخفض بشكل كبير مالونديالديهايد (MDA) بينما زادت GPX بشكل كبير ($P < 0.05$). الاستنتاج، يمكن أن يعتبر عصير القرع المر علاجًا طبيعيًا محتملاً ضد مرض السكري ومرحلة ما قبل السكري.

الكلمات المفتاحية: القرع المر، خافض لسكر الدم، داء السكري، ما قبل السكري، الفئران.