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Antihyperglycemic, antihyperlipidemic and antioxidant activities of leaves and peels of eggplant on cisplatin-induced hepato-nephrotoxicity in rats

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ABSTRACT

The present study was designed to investigate the chemical composition and in vitro antioxidant activity of eggplant peels and leaves. Also, the effects of the powder and the ethanolic extract of eggplant leaves and peels on the nutritional status, blood glucose and lipid profile, in addition to liver and kidney function tests, were estimated in cisplatin hepato-nephrotoxicity rats. Thirty adult albino rats were used in this work; they are classified into six groups (5 rats each); one of them was left on a basal diet as normal control (-ve), and the other rats' groups were injected with cisplatin (IP) in a dose of 10 mg/kg b.wt. One of these groups served as a positive control group. The remaining four groups were treated with the powder and the ethanolic extract of eggplant leaves and peels. Rats were sacrificed after 28 days, and their blood was drawn for analysis. The obtained results indicated that the eggplant leaves are a good source of protein, with a percentage of 19.17. The leaves and peels of eggplant contain most of the essential amino acids, which raise their nutritional value. The extract of leaves and peels with a concentration of 150 mg/ml had the highest DPPH scavenging activity with a percentage of 42.17% and 43.1%, respectively. The reducing power of the leaves and peel extracts was increased by increasing the concentration, the EC50 values reached 540.41 mg/ml for leaves extract, and 564.71 mg/ml for peels extract. The cisplatin drug caused disturbances in all the examined parameters. It was observed that the peel powder, peel extract, and leaves extract showed significant

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increases in body weight gain and the feed efficiency ratio compared to the positive control. The extracts of the leaves and peels caused significant decreases in serum glucose levels with a percentage of 25.6 and 20.6, respectively. The cisplatin-injured groups, which were treated with leaves and peels extracts in addition to the peels powder group, exhibited significant improvements in their serum lipid profile.

Keywords: nephrotoxicity, hepatotoxicity, cisplatin, eggplant, leaves, peels, extract, rats.

1. INTRODUCTION

Eggplant (*Solanum melongena*) is an important agronomical plant that is widely distributed throughout temperate and tropical regions and belongs to the Solanaceae family **(Eun *et al*., 2011)**. In Sub-Saharan Africa, it is a popular fruit. It comes in sorts of colors and shapes and is found in many different regions. It's usually eaten raw as a snack or cooked into a stew. The eggplant is rich in polyphenol compounds and some essential vitamins **(Hanson *et al*., 2006)**. Because of its high content of vitamins, phenolics, and antioxidants, aubergine is a vegetable crop that grows all over the world and can supply significant alimentary benefits. Furthermore, eggplant has potential pharmaceutical applications that are only now being recognized **(Gürbüz *et al*., 2018)**. Eggplant peel is typically discarded as a waste product, ignoring its potential health benefits. Eggplant peel could be used as a natural ingredient in the formulation of functional products due to its higher vitamin C and phenolic compounds content **(Cao *et al*., 1996; Esther *et al*., 2013 and Sepideh *et al*., 2016).** The key phenolic compounds in eggplant peel are anthocyanins, a significant category of naturally occurring pigments in red or purple-colored fruits that include a range of health benefits including lowering blood glucose levels, regulation of postprandial hyperglycemia associated with type two diabetes mellitus, and removal of free radicals, thus strengthening memory deficiencies induced by Diabetes mellitus **(Nanda *et al*., 2013; Esther *et al*., 2013 and Sepideh *et al*., 2016).** Eggplant peel extract can be used as a natural product to reduce weight and decrease triglycerides, thereby reducing the risk of diabetes,

heart disease, and arteriosclerosis. The extract of eggplant peel can also help diabetics to lower their blood glucose levels and protect their bodies from the side effects of diabetes, such as a high oxidation rank in their blood, high liver enzyme levels, and urea in blood **(Rehab., 2018).** Eggplant leaves are discarded as waste. Although *S. melongena* leaves contained high levels of phenolic compounds with a high antioxidant potential, it was found that ethanol and water extracts had the highest total flavanol content in leaves **(Jung *et al*. 2011).** The leaves of eggplant were found to have high flavonoid and phenolic contents, indicating that they have potent antioxidant activity that can protect some body tissues from oxidative damage **(Adewale *et al*., 2014).** Caffeic acid, chlorogenic acid, cryptochlorogenic acid, panasenoside, and (6R, 7E, 9R)-4,7-megastigmadien-3-one-9-D-glucopyranoside, the main components in the eggplant leaves (*Solanum melongena*), found to prevent noncommunicable diseases like diabetes and hypertension. Its antiviral properties and cytotoxic activity on cancer cell lines are also noteworthy **(Kwon *et al*. 2008).** Hepatotoxicity means chemical-induced liver damage. About 900 drugs are related to liver damage, making it the most popular reason for a drug's withdrawal from the market. Chemicals frequently damage the liver, which can only be detected through abnormal liver enzyme tests. Drug-induced liver damage accounts for 50% of all acute liver failures and 5% of all hospitalizations. Idiosyncratic drug reactions lead to liver death or transplantation in about 75% of cases **(Ostapowicz *et al*. 2002)**. When kidney function is damaged or destroyed by endogenous or exogenous toxicants, nephrotoxicity occurs. Drug exposure frequently causes toxicity in the kidney, which serves as the body's primary control system for maintaining homeostasis and is thus particularly vulnerable to xenobiotics. Examples of nephrotoxicity mechanisms caused by drugs are changes in tubular glomerular hemodynamics, crystal nephropathy, inflammation, cell toxicity, thrombotic microangiopathy, and rhabdomyolysis **(Kim and Moon 2012)**. Cisplatin is a highly toxic medicine that can cause severe tissue damage despite its effectiveness in reducing tumour burden. Cisplatin has a lot of dangerous

side effects, including neurotoxicity, nephrotoxicity, ototoxicity, and vomiting, all of which reduce its effectiveness **(Paksoy *et al.* 2011)**.

2. MATERIALS AND METHODS

2.1. Materials:

2.1.1. **Plant:** Fruits and fresh leaves of *Solanum melongena* were collected from the garden of the Faculty of Science affiliating the department of botany at Mansoura University.

2.1.2. **Chemicals:** All chemicals were purchased from Elgomhoria Company in Mansoura City, Dakahlia Governorate, Egypt.

Cisplatin drug (Mylan S-A-S-France) was purchased from a pharmacy in Mansoura at a concentration of 50 mg/50 ml.

2.1.3. **Animals:** Thirty healthy adult male white albino rats, weighing 110 ± 5 g, were purchased from Vaccines and Drug company (VAC), Giza, Egypt.

2.2. Methods:

2.2.1. Preparation of the powder of eggplant peel and leaves:

The eggplant and fresh leaves were thoroughly washed in water, and the peels were separated by using a knife. Then it was dried at 40 °C in the oven (to avoid spoilage of the phenol content) to a constant weight. The leaves were dried in the open air. After drying, the peels and leaves were ground into a powder.

2.2.2. Preparation of the ethanolic extract of eggplant peel and leaves:

250 g of each powder of peels and leaves of eggplant were soaked in 1L ethanol and mixed well, then left overnight and filtered through filter paper. The filtrate was kept in a dark bottle. Another portion of ethanol was added to the residue, shaken well, left overnight, then filtered and the filtrate was added to the previous filtrate. The residue was resoaked in ethanol overnight and filtered. All the three filtrates were collected to make the ethanolic extract solution. The solvent was removed by means of evaporation using a rotary evaporator. The obtained extract was collected and dried in a desiccator to a constant weight, then kept in dark bottles until use.

2.2.3. Chemical analysis:

- A previously detailed methods by **(A.O.A.C, 2000)** were adopted for determining the chemical composition (Moisture, Ash, Protein, Lipids and Fibers) of eggplant leaves and peels. Carbohydrates were calculated by difference.
- The antioxidant potential of the leaves and peel extract of eggplant was evaluated by using two antioxidant testing methods; DPPH and reducing power, according to **Dasgupta *et al*. (2016) and Debnath *et al*. (2011),** respectively.
- The acid hydrolyzed amino acids by amide bond breakage were determined by using an automatic amino acid analyzer S 433, according to **Pellet and Young (1980)**.

2.2.4. The basal diet:

The basal diet was prepared according to the **NRC (1995)**. All the biological experimental procedures were applied in accordance with internationally guidelines for the care and use of laboratory animals. Ethical guidelines were maintained during animal handling and permission was obtained from the concerned department.

2.2.4. Induction of nephrotoxicity and hepatotoxicity:

Hepato-nephrotoxicity was induced in rats by injecting a single dose of cisplatin intraperitoneally in a dose of 10 mg/kg b.wt. on the first day, according to **Un *et al*. (2020)**.

2.2.5. Experiment design:

After the adaptation period, rats were classified into six groups (five rats each), one of them remained on the basal diet only and served as normal control (Group1). The rest 5 groups were injected by cisplatin (10 mg/kg. bw) intraperitoneally to induce hepato-nephrotoxicity. One of these injured groups remained on the basal diet and considered as positive control (Group2). The other four injured groups were treated with the powder and extract of the eggplant leaves and peels as follows:

Group 3 (leaves powder): Fed on a diet containing leaves powder at a concentration of 35 gm/kg feed.

Group 4 (peels powder): Fed on a diet containing peels powder at a concentration of 35 gm/kg feed.

Group 5 (leaves extract): Received leaves extract daily in a dose of 250 mg/kg b.wt. orally through a stomach tube.

Group 6 (peels extract): Received peels extract daily in a dose of 250 mg/kg b.wt. orally through a stomach tube.

Daily food intake and weekly body weight gain were recorded. After 28 days, the rats were anesthetized, and blood samples were collected in clean centrifuge tubes to obtain serum.

2.2.6. Biological estimations:

2.2.6.1. ***Body weight gain and feed efficiency ratio (FER). They*** were calculated according to **Chapman et al. (1959).**

$$\text{Body weight gain \%} = \frac{\text{Final weight (g)} - \text{Initial weight (g)}}{\text{Initial weight (g)}} \times 100$$

Feed efficiency ratio (FER) = Body weight gain daily (g) / Feed intake daily (g)

2.2.6.2. biochemical analysis of serum:

- Serum glucose level was determined by an enzymatic method according to **Kaplan (1984)**.
- Serum total cholesterol was estimated according to **Thomas (1992)**.
- Serum triacylglycerol was determined according to **Fossati (1982)**.
- High density lipoprotein (HDL-c) was determined according to the methods of **Warnick *et al*. (1983)**.
- LDL-c and VLDL-c were calculated by using the method of **Friedewald *et al*. (1972)**.

VLDL-c= TG / 5

LDL-c = Total cholesterol – (HDL-c +VLDL-c)

2.2.7. Statistical analysis:

All tests were accomplished using the computer package of the statistical analysis program (SPSS, version 24, 2016)., the collected data was presented as means ± standard deviations (means ± SD), statistically analyzed using one way analysis of Variance (ANOVA), and the means between groups were compared by least significant difference (LSD) statistic test, according to **Artmitage and Berry (1987).**

3. RESULTS AND DISCUSSION

3.1. Proximate chemical analysis of leaves and peels powder of eggplant

The data in Table (1) showed the percentage of chemical composition content of eggplant peel and leaves. The eggplant leaves composition was (8, 19.17, 11, 2, 4 and 59.83%) for moisture protein, ash, fat, fibers, and carbohydrates, respectively. In comparison, their values were (5, 12.23, 7, 1, 2 and 74.77%) in the eggplant peels, respectively.

The results revealed that eggplant leaves are a good source of protein, ash, and fibres compared with the eggplant peel. Results were in harmony with those of **Doulabi *et al*. (2020)**, who reported that the moisture, fat, protein, carbohydrate, crude fibre, and ash contents of the eggplant peel were 89.6%, 0.2%, 1.9%, 4.3%, 0.9%, and 3.1% (on wet weight bases), respectively. Also, **Oboh *et al.* (2005)** found that the unprocessed leaves of eggplant had 1.4% raw fibre, 0.6% fat, 4.3% protein, 89.7% moisture, and 1.3% ash content. Meanwhile, **Mohamed *et al*. (2019)** compared eggplant peels and pulp and the whole eggplant flour. He found that the peel contained the highest amount of total dietary fibre (43.31%), insoluble dietary fibre (29.31%), and ash (6.20%) and the lowest energy value (172.96 Kcal/100g DW) compared with other parts.

Table (1): Proximate chemical analysis of leaves and peels powder of eggplant (g/100g)

components / samples	Moisture %	Protein %	Ash %	Fat%	Fibers%	Carbohydrates %
Leaves	8	19.17	11	2	4	59.83
Peels	5	12.23	7	1	2	74.77

3.2. Amino acids content of eggplant leaves and peels:

Data in Table (2) show that both eggplant leaves and peels are rich sources of essential amino acids, which raise its nutritional value. Aspartic acid and glutamic acid recorded the highest amount of non-essential amino acids as their values reached (14.88% and 15.96%) in leaves and (12.15% and 11.05%) in peels, respectively. Cysteine was not detected in the leaves; however, it was found in peels in low concentrations.

On the other hand, leucine, valine, and phenylalanine represent the highest essential amino acids in both leaves and peels of eggplant, while methionine was the least.

The obtained results were close to those of **Mohamed *et al*. (2019)**, who stated that the Egyptian eggplant parts are a rich source of essential and non-essential amino acids. Leucine, valine, and arginine recorded the highest essential amino acids amounts in the peel, reaching (41.58, 33.12, and 31.50) g/kg protein, respectively. Meanwhile, the non-essential amino acids scores found in peels were (45.14, 28.14) g/kg protein for glutamic acid and aspartic acid, respectively.

Table (2): Amino acids content of eggplant leaves and peels

Amino acids		Leaves		Peels	
		%	[PPM]	%	[PPM]
Essential	Histidine	3.25	14.441	2.67	11.872
	Isoleucine	4.48	19.910	4.19	18.638
	Leucine	7.82	34.759	7.07	31.410
	Lysine	3.25	14.449	3.05	13.572
	Methionine	0.51	2.265	0.69	3.070
	Phenylalanine	5.05	22.462	4.06	18.055
	Threonine	4.88	21.686	3.97	17.634
	Valine	6.23	27.675	5.40	23.996
	Arginine	3.43	15.253	3.24	14.381
Non-Essential	Alanine	6.20	27.567	5.46	24.281
	Aspartic acid	14.88	66.153	12.15	53.993
	Cysteine	N.D	N.D	0.78	3.482
	Glutamine	15.96	70.944	11.05	49.089
	Glycine	6.55	29.093	5.38	23.925
	Proline	1.68	7.484	1.22	5.407
	Serine	5.60	24.893	4.58	20.351
	Tyrosine	2.64	11.713	2.52	11.218
	AMMONIA	3.77	16.734	2.55	11.355

3.3. Antioxidant activity of the leaves and peels extracts of eggplant

Free radicals are the initiation of many diseases that are caused because of the damage of lipids, proteins, and deoxyribonucleic acid in human cells. Natural antioxidants can prevent these damages, which are the consequence of oxidative stress they caused **(Joshi *et al.*, 2012)**.

3.3.1. DPPH assay

One of the well-known methods used for screening the antioxidant capacity of the active components of plants is DPPH scavenging activity.

The data in Table (3) showed that both the leaves and peel extracts of eggplant led to DPPH scavenging activity, where the scavenging activity of peel extract was better than that of the leaves extract.

The DPPH scavenging activity of the peels extract (with the concentrations of 50, 100, 150 mg/ml) were 39.24%, 41.8%, 43.1%, respectively, while they were 35.43%, 40.7% and 42.17% for leaves extract, respectively. It was noticed that the two extracts with the concentration of 150 mg/ml caused an inhibition percentage more than that of the concentration of 100 mg/ml a little bit. So, it is preferable to use a concentration of 100 mg/ml to save the extract.

3.3.2. Reducing power

From Table (3), the results revealed that the reducing power of the leaves and peel extracts increased by increasing the concentration.

The peel extract was better than the leaves extract, although the increase in reducing power is slight. The reducing power increases with the concentration increases. The reducing power of the leaves extract ranged from 0.160 to 0.372, while that of the peels extract varied from 0.216 to 0.380 in accordance with the extract concentration, which was 50, 100, 200, and 400 mg/ml.

The EC50 values reached 540.41 mg/ml for leaves extract and 564.71 mg/ml for peels extract.

The antioxidant activity of eggplant leaves and peels extracts is due to their content of phenolic compounds that provide hydrogen ions which increase their scavenging activity. Results are in accordance with **Basuny *et al*. (2012)** who demonstrated that anthocyanins from eggplant peel extracts resulted in a significant increase in scavenging DPPH radicals and the reducing power. Also, the results were in the same line with **Adewale *et al*. (2014)**, who stated that the aqueous extract of *Solanum macrocarpon* leaves possesses powerful antioxidant activity and can offer good protection against oxidative damage to body cells.

Table (3): Antioxidant activity of the leaves and peels extracts of eggplant (inhibition%)

Reducing power			DPPH inhibition %		
Conc.mg/ml	Leaves	Peels	Conc.mg/ml	Leaves	Peels
50	0.160	0.216	50	35.43	39.24
100	0.201	0.247	100	40.70	41.80
200	0.279	0.292			
400	0.372	0.380	150	42.17	43.10
EC50 mg/ml	540.41	564.71			

3.4. Biological assays

3.4.1. Effect of the powder and extract of eggplant leaves and peels on body weight gain and feed efficiency ratio of cisplatin induced hepato-nephrotoxicity in rats:

The data in Table (4) showed no significant differences among all the groups regarding their initial weight at the beginning of the experiment. The results recorded in the Table showed that the cisplatin drug caused disturbances in all the examined parameters, as is evident in the positive group results. Significant decreases in the final weight, body weight gain, body weight gain percentage, feed intake, and feed efficiency ratio were observed compared to the normal control.

It was noticed that the peel powder, peel extract, and leaves extract groups showed significant increases in their final weights as compared to the positive control. On the other hand, the leaves powder group showed no significant difference in this respect. Accordingly, the weight gain percentage reached 15.16 ± 4.87, 14.24 ± 1.56, and 12.47 ± 2.11% in the groups of the peel powder, peel extract, and leaves extract, respectively, which is significantly increased than that of the positive group (8.31%).

Concerning feed efficiency ratio, the results revealed significant increases in the three groups of the peel powder, peel extract, and leaves extract 0.052 ± 0.001, 0.050 ± 0.005, and 0.044 ± 0.007, respectively, as

compared to the positive group (0.031 ± 0.007). The leaves powder group did not affect the FER, similar to the positive control group.

The results agree with **Abo-Elmaaty *et al*. (2020)**, who found that body weights in the cisplatin-treated group were significantly lower. The results also agreed with **Sarkar *et al*. (2020)** and **Ekweogu *et al*. (2020)**, who found that the extract of eggplant leaves and peels improved the body weight of rats.

Table (4): Effect of the powder and extract of eggplant leaves and peels on body weight gain and feed efficiency ratio of cisplatin-induced hepatonephrotoxicity in rats

Variables / Groups	Initial weight (g)	Final weight (g)	Weight Gain (g)	Weight Gain %	Feed intake (g)	feed efficiency ratio (FER)
Normal control (-ve)	127 ±1 a	156 ± 4.36 a	29 ± 4.36 a	22.84 ± 3.46 a	13 ± 0.36 a	0.074 ± 0.009 a
Positive control (+ve)	128.33 ± 0.58 a	139 ± 3 c	10.67 ± 2.52 d	8.31 ± 1.93 d	11.58 ± 0.25 c	0.031 ± 0.007 d
Leaves powder (35 gm/kg)	127.33 ± 0.58 a	139.33 ± 2.3 c	12 ± 1.73 cd	9.42 ± 1.31 cd	11.61 ± 0.19 c	0.034 ± 0.003 d
Peels powder (35 gm/kg)	127.67 ± 0.58 a	147 ± 5.29 b	19.33 ± 5.86 b	15.16 ± 4.87 b	12.25 ± 0.44 b	0.052 ± 0.001 b
Leaves extract (250 gm/kg bw)	128.33 ± 0.58 a	144.33 ± 2.08 bc	16 ± 2.65 bcd	12.47 ± 2.11 bcd	12.03 ± 0.17 bc	0.044 ± 0.007 bcd
Peels extract (250 gm/kg bw)	128.67 ± 0.58 a	147 ± 2.65 b	18.33 ± 2.08 bc	14.24 ± 1.56 bc	12.25 ± 0.22 b	0.050 ± 0.005 bc

Each value is the mean ± SD

The values in each column with different superscript are significantly different at ($p < 0.05$).

3.4.2. Effect of the powder and extract of eggplant leaves and peels on serum glucose and lipid profile of cisplatin-induced hepato-nephrotoxicity in rats:

The results in Table (5) showed that the cisplatin-injured rats have a high serum glucose level (121±3.5 mg/dl), which was statistically significant compared to normal rats (102± 6.7 mg/dl). Although the increase in serum glucose of the positive control was little, the extract of the leaves caused a substantial decrease in serum glucose, followed by the extract of the peel and peel powder. In contrast, the group treated with leaves powder showed no significant changes compared to the positive control. The ability of the eggplant leaves and peel extracts to significantly decrease the serum glucose is worth note and needs further studies.

Regarding the lipid profile, the data in Table (5) revealed that the cisplatin drug caused disturbances in all the examined parameters, as evident in the positive group results. The serum levels of total cholesterol, triglycerides, and LDL-c increased while the serum level of HDL-c decreased significantly compared to the normal control. The increases percentages in TC, TG and LDL-c were 48.2%, 35.4% and 240%, respectively, while the decrease in serum HDL-c was 28.9%.

However, the cisplatin-injured groups which have been treated with leaves and peels extracts in addition to the peels powder group exhibited significant improvements in their serum lipid profile, while the leaves powder group improved only serum TC level. The eggplant peels, either in their raw powder or their extract were more effective than the eggplant leaves in modulating the lipid profile markers in cases of hepato-nephrotoxicity.

Rehab (2018) found that eggplant peel extract can be used as a natural source to reduce weight and triglycerides and thus protect against diabetes, heart disease and arteriosclerosis. Eggplant peel extract can also be used to lower blood glucose levels for diabetics and to protect the body from the symptoms resulting from diabetes, such as high levels of liver enzymes, urea, and high oxidation rate in serum.

Ekweogu *et al*. (2020) found that the administration of aqueous leaf extract of *S. aethiopicum* stimulated hypolipidemic effect in experimental animals irrespective of sex. While there was significant decrease in the levels of TC, TG, LDL-C, and VLDL-C in the experimental animals fed with aqueous leaf extract of *S. aethiopicum*, the treated animals showed a significant increase ($P < 0.05$) in the levels of high-density lipoprotein compared to the control. They suggested that *S. aethiopicum* has anti-hyperlipidemic properties.

Al-Jowari (2020) found that eggplant peel powder used in treating hyperlipidemia caused by antibiotics administration may be due to the high levels of anthocyanins in these peels, especially nasunin. Thus, these compounds minimize the high concentrations of lipids and return them to the normal level.

Sarkar *et al*. (2020) found that oral administration of SMHA (Extraction of *S. melongena* hydroethanolic extract) and SMAQ (Extraction of *S. melongena* aqueous) at 100, 200, and 400 mg/kg doses showed a significant reduction in serum glucose, triglycerides, and total cholesterol levels in comparison to hepatotoxic control rats ($p<0.05$). Meanwhile, the administration of extracts at the same doses resulted in a significant ($p<0.05$) increase in serum HDL as compared with hepatotoxic control rats.

Zaki and Amal (2018) found that feeding rats on the basal diet with (4%) EPP (Eggplant Peels Powder) were more effective to decrease T.C and T.G which were recorded (110.00 ±0.10 and 62.55 ± 0.30 mg/dl, respectively). Also caused maximum improvement of HDL, LDL and VLDL, which were (37.80 ±1.13, 59.69 ± 0.20 and 12.51 ± 0.20 mg/dl., respectively).

Eggplant peels anthocyanins significantly decreased, the levels of total cholesterol, LDL-cholesterol, accompanied by increasing cholesterol levels **(Basuny *et al*., 2012)**.

Oral administration (especially at the highest dose of 49.8 mg/kg) of aqueous extract of Solanum macrocarpon leaves demonstrates anti-

nephropathy by reducing the elevated glucose levels in the blood in diabetic rats to normal **(Ekakitie *et al.*, 2021).**

Table (5): Effect of the powder and extract of eggplant leaves and peels on serum glucose and lipid profile of cisplatin induced hepato-nephrotoxicity in rats

Parameter / Groups	**glucose** (mg/dl)	lipid profile				
		CH (mg/dl)	TG (mg/dl)	HDL (mg/dl)	VLDL (mg/dl)	LDL (mg/dl)
Normal control (-ve)	102 ± 6.7 bc	85 ± 9.5 c	96 ± 6.6 b	45 ± 4.1 bc	19 ± 1.3 b	20 ± 14.9 b
Positive control (+ve)	121 ± 3.5 a	126 ± 5.6 a	130 ± 4.7 a	32 ± 2.2 d	26 ± 0.9 a	68 ± 6.4 a
Leaves powder (35 gm/kg)	109 ± 8.3 ab	110 ± 6.2 b	122 ± 7.1 a	35 ± 2.8 d	24 ± 1.4 a	51 ± 9.7 a
Peels powder (35 gm/kg)	100 ± 4.73 bc	90 ± 9.6 c	90 ± 6.1 b	42 ± 1.3 c	18 ± 1.2 b	30 ± 10.6 b
Leaves extract (250 gm/kg/bw)	90 ± 6.8 c	89 ± 8.6 c	92 ± 6.7 b	51 ± 1.9 a	18 ± 1.3 b	20 ± 11.4 b
Peels extract (250 gm/kg/bw)	96 ± 6.2 c	81 ± 2.5 c	89 ± 2 b	48 ± 1.1 ab	18 ± 0.4 b	14 ± 3.9 b

Each value is the mean ± SD

The values in each column with different superscript are significantly different of ($p < 0.05$).

4. CONCLUSION

It can be concluded that the peels and leaves of the eggplant are of good nutritional value because of their high content of protein, fibre and carbohydrates, in addition to their content of most amino acids, especially the essential ones. The findings also revealed that the powder and the methanolic extract of both peels and leaves exhibited good results in improving body weight and feed efficiency ratio in the rats injured with cisplatin. A noticeable improvement in blood glucose and lipid profile was

observed in the cisplatin-induced hepato-nephrotic rats. So, it is recommended to use eggplant peels in treating diabetic patients, especially those with type 2 diabetes. Although the eggplant leaves extract gave good results, it needs further studies to determine its active components and ensure its safety.

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الأنشطة الخافضة لنسبة السكر في الدم والمضادة لارتفاع نسبة الدهون في الدم والنشاط المضاد للأكسدة بواسطة أوراق وقشور الباذنجان في الفئران المصابة بالسمية الكلوية والكبدية الناتجة عن السيسبلاتين

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المستخلص:

صممت الدراسة الحالية لمعرفة التركيب الكيميائي والنشاط المضاد للأكسدة في المختبر لقشر وأوراق الباذنجان وكذلك دراسة تأثير مسحوق والمستخلص الإيثيلي لأوراق وقشور الباذنجان على الحالة التغذوية ونسبة الجلوكوز في الدم وصورة الدهون في الفئران المصابة بأمراض الكبد والكلية عن طريق الحقن بالسيسبلاتين ، بالإضافة إلى اختبارات وظائف الكبد والكلى. في هذه التجربة تم استخدام ثلاثين فأرًا بالغًا من الفئران البيضاء في هذا العمل، تم تصنيفهم إلى ست مجموعات (٥ فئران لكل منهما) ، تركت واحدة منهم على النظام الغذائي الأساسي وتم حقن المجموعات الأخرى من الفئران بالسيسبلاتين (١٠ جم/كج من وزن الجسم) عملت إحدى هذه المجموعات ككنترول موجب وعولجت المجموعات الأربع الباقية بالمسحوق وخلاصة أوراق الباذنجان والقشور. تم ذبح الفئران بعد ٢٨ يومًا ، وسحب دمائهم للتحليل. أشارت النتائج المتحصل عليها إلى أن أوراق الباذنجان تعتبر مصدر جيد للبروتين بنسبة ١٩,١٧٪. تحتوي أوراق وقشور الباذنجان على معظم الأحماض الأمينية الأساسية التي ترفع قيمتها الغذائية. كان لمستخلص الأوراق والقشور بتركيز ١٥٠ مجم / مل أعلى نشاط كسح (DPPH) بنسبة ٤٢,١٧٪ و ٤٣,١٪ على التوالي. أظهرت النتائج زيادة القدرة الاختزالية للأوراق ومستخلصات القشر بزيادة التركيز ، ووصلت قيم التركيز الفعال ٥٠ إلى ٥٤٠,٤١ مجم / مل لمستخلص الأوراق و ٥٦٤,٧١ مجم / مل لمستخلص القشور. تسبب عقار السيسبلاتين في حدوث اضطرابات في جميع المعايير التي تم فحصها. لوحظ أن مسحوق القشر ومستخلص القشر ومستخلص الأوراق أظهروا زيادة معنوية في زيادة وزن الجسم ونسبة كفاءة التغذية مقارنة بالاكنترول الموجب. تسبب مستخلص الأوراق والقشور في انخفاض معنوي في مستويات الجلوكوز في الدم بنسبة ٢٥,٦ و ٢٠,٦ على التوالي. أظهرت المجموعات المصابة بالسيسبلاتين والتي تم علاجها بمستخلصات الأوراق والقشر بالإضافة إلى مجموعة مسحوق التقشير تحسينات كبيرة في صورةالدهون في الدم.

الكلمات المفتاحية: السمية الكلوية ، السمية الكبدية ، السيسبلاتين ، الباذنجان ، مضادات الأكسدة

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