

## Hypolipidemic Effect of Eggplant Peels (*Solanum melongena*, L) Powder on Obese Rats

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### Abstract

Eggplant, (*Solanum melongena*, L.) is one of the vegetables ranked highest in total antioxidant capacity, it is contains high concentrations of phytochemicals such as phenolic acids and flavonoid compounds that have high antioxidant activity, In this paper, the effect of Eggplant Peels Powder (EPP) on reduce cholesterol and lipid profile in obese rats and improve their health were investigation. Twenty five male albino rats weighting  $140 \pm 10$  g were used in this study and divided into 5 groups, each group contain 5 rats. Rats were treated by high fat diet (30% animal fat) to induce obese and to raise cholesterol level and lipid profile in blood. First (control group), second, third and fourth group received basal diet + 0, 1, 2 and 4 % of dried eggplant peels powder (EPP), respectively for 4 weeks. Animals were sacrificed, blood samples were collected. Serum was then removed by centrifuging for analysis. Chemical composition and phenolic compounds in eggplant peels were determined. Total cholesterol (TC), triglycerides (TG), lipoprotein fraction (HDL-c, LDL-c, VLDL-c), atherogenic indices (AIP, CRR, CRI,AF and AC), and serum liver functions (ALT, AST, and ALP) were also determined. Data from obese rats revealed that the eggplant peel showed significant changes in the tested biochemical parameters. As conclusion, obese rats treated with 4% eggplant peel powders had improved lipid profile levels and showed markedly significantly decreased of hyperlipidemic effect compared with other concentrations.

**Keywords:** Rats, eggplant peel, hyperlipidemic effect, lipid profile and Pytochemicals.

## INTRODUCTION

Hyperlipidemia is abnormally elevated levels of any or all lipids or lipoproteins in the blood (**Fung et al., 2011**). Hyperlipidemia refers to increased levels of lipids (fats) in the blood, including cholesterol and triglycerides. Although hyperlipidemia does not cause symptoms, it can significantly increase your risk of developing cardiovascular disease, including disease of blood vessels supplying the heart (coronary artery disease), brain (cerebrovascular disease), and limbs (peripheral vascular disease). These conditions can in turn lead to chest pain, heart attacks, strokes, and other problems. (**Sameer et al., 2011**). Hyperlipidemias are divided into primary and secondary subtypes. Primary hyperlipidemia is usually due to genetic causes (such as a mutation in a receptor protein), while secondary hyperlipidemia arises due to other underlying causes such as diabetes (**Helmja et al., 2007**). Lipid and lipoprotein abnormalities are common in the general population and are regarded as modifiable risk factors for cardiovascular disease due to their influence on atherosclerosis. In addition, some forms may predispose to acute pancreatitis. Since cholesterol is insoluble in water, it is transported in the blood plasma within protein particles (lipoproteins), Lipoproteins are classified by their density: Very low density lipoprotein (VLDL), intermediate density lipoprotein (IDL), low density lipoprotein (LDL) and high density lipoprotein (HDL) (**Biggerstaff and Wooten, 2004**). All the lipoproteins carry cholesterol, but elevated levels of the lipoproteins other than HDL (termed non-HDL cholesterol), particularly LDL cholesterol are associated with an increased risk of atherosclerosis and coronary heart disease (**Carmena et al., 2004**). In contrast, higher levels of HDL cholesterol are protective (**Kontush and Chapman, 2006**). Elevated levels of non-HDL cholesterol and LDL in the blood may be a consequence of diet, obesity, inherited (genetic) diseases (such as LDL receptor mutations in familial hypercholesterolemia), or the presence of other diseases such as diabetes and an underactive thyroid (**Varghese, 2014**).

Reducing dietary fat is recommended to lower total blood cholesterol and LDL in adults (**Hooper et al., 2012**). In people with very high cholesterol (e.g. familial hypercholesterolemia) diet is often insufficient to achieve the desired lowering of LDL, and lipid lowering medications which reduce cholesterol production or absorption are usually required. If necessary other treatments, including LDL special treatment or even surgery (for particularly severe subtypes of familial hypercholesterolemia) are performed (**Ito et al., 2011**).

Eggplant (*Solanum melongena*, L.) also is an important crop of subtropical and tropical regions. This fruit presents low caloric value and is a good source of minerals, vitamins and anthocyanins. Eggplant has also received great attention due to its high antioxidant activity and medicinal properties, and its consumption is recommended for diabetic patients (**Zaro et al., 2015**). Eggplant contains many bioactive

constituents capable of producing a range of health effects; in which it contains polyphenols, flavonoids, minerals, vitamins, etc which are reported to possess numeral medicinal properties as revealed by (Nisha *et al.*, 2009). It has also high fiber, low fat and hence low energy content (Zevnik, 2009). Furthermore, eggplant fruit contain ascorbic acid and phenolics, both of which are powerful antioxidants Oxidative stress can cause oxidative damage to large biomolecules such as proteins, DNA, and lipids, resulting in an increased risk for cancer and CVD. To prevent or slow down the oxidative stress, sufficient amounts of antioxidants need to be consumed (Temple *et al.*, 2006). Meanwhile, eggplant ranked among top ten vegetables for free radical scavenging activity (Nisha *et al.*, 2009). Eggplant is a good source of phenolics and anthocyanins-linked antioxidant activity by free radical scavenging or metal ion chelating that reduce risk of chronic disease as showed by several researches as (Nisha *et al.*, 2009). This in addition to induce phenolsulfotransferases (PSTs) activities, which are known as phase II detoxifying enzymes with cancer prevention potential by eggplant extract at 100 µg/ml; this correlated to phenolic content and antioxidant activity as found by Yeh and Yen (2005). Hanson *et al.*, (2006) pointed to the need to evaluate skin and pulp samples separately of eggplant due to specific types of phenols which differ between skin and pulp of eggplant and that revealed by Huang *et al.*, (2004) they reported that total phenolics content of eggplant skin is about two times greater than its pulp.

Eggplant has been known to be useful in many regions and folk medicine (Oboh *et al.*, 2005); and the use of eggplant have been suggested to treat different diseases (Capriles *et al.*, 2002). Although no controlled studies but eggplant can have a good effects related to diabetes and hypertension based on that showed by Kwon *et al.*, (2001) that phenolic-enriched extracts of eggplants had  $\alpha$ -glucosidase and angiotensin converting enzyme (ACE) inhibitory activities which provide a strong biochemical basis for management of type 2 diabetes by controlling glucose absorption and reducing associated hypertension, and that indicated by some authors of high fiber and low soluble carbohydrate content, as well as antioxidant activity of eggplant. This in addition to previously mentioned of a considerable K content of eggplant as found by chemical analysis of some researches as Ejoh *et al.*, (1996). Furthermore, eggplant has been used as hypocholesterolemic agent in many countries; however few controlled studies were addressed to this subject and atherogenesis Botelho *et al.*, (2004). Eggplant extract as a hypocholesterolemic agents has some support but needs more study (Lans, 2006). The results of eggplant or its components extract in lipid metabolism is controversial between studies showed beneficial effects, reducing the hypercholesterolemia in animals or showed antioxidant activity such as for example Kahlon. *et al.*, 2007, and on the other hand some studied found no significant effects as (Silva *et al.*, 2004). Moreover, eggplant was found to have anticarcinogenic and antimutagenic activity as found by some researches as Azevedo *et al.*, (2007). Also, Duke *et al.*, (2002), pointed

to previous and many other eggplant indications such as obesity, anaphylaxis, bleeding, hepatosis, dysuria, infection,.. and others, which all need further studies. Therefore, the objective of this study is to evaluate some potential therapeutic effects of eggplant.

This work was conducted to study the effect of Eggplant Peels Powder (EPP) on reduce cholesterol and lipid profile in obese rats and improve their health.

## **Material and Methods**

### **Materials**

The plant used in this study was eggplant peels (*Solanum melongena*, L.) which were obtained from the local market of Shebin El-Kom City, Menoufia Governorate, Egypt in 2017, while, Casein, cellulose, choline chloride powder and DL- methionine powder were obtained from Morgan Co. Cairo, Egypt.

### **The chemical kits**

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP) were obtained from Al-Gomhoria Company for Chemical, Medical and Instruments, Cairo, Egypt.

### **Experimental animals**

A total of 25 adult normal male albino rats Sprague Dawley strain weighing  $140 \pm 10$  g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

### **Methods**

#### **Preparations of eggplant peels**

Eggplant was obtained from local market. Plant was cleaning, washing, peeling and dehydrating at room temp ( $40^{\circ}\text{C}$ ) for 24 hours, the dried peels were ground in mixer and grinded for a soft powder without impurities.

To prepare the dried eggplant peels powder, peels were washed thoroughly under running tap water, shade dried, and ground to a fine powder using an air mill, high speed mixture (Molunix, Al-Araby, company, Egypt, and then serving as powder size.

#### **Chemical analysis of eggplant peels**

Samples were subjected to chemical analysis in order to determine: moisture, protein, fat, fiber, ash and some minerals (sodium, potassium and iron) according to AOAC method (2000). Total phenols content also were determined by the folinciocalteu method Meda *et al.*, (2005). In addition to the identification of phenolic compounds by HPLC according to the method outlined by Ben-Hammouda *et al.*, (1995).

#### **Induction of experimental obesity and hyperlipidemia**

Obesity was induces in normal healthy male albino rats by fed on high fat diet (30% animal lipid) supplemented in the basal diet and used as a positive control group.

#### **Experimental design**

Twenty five adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing ( $140 \pm 10$ g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to AIN, (1993) for 7 consecutive days. After this adaptation period, rats are

divided into 5 groups, each group which consists of five rats as follows: **Group (1):** Rats fed on basal diet and used as negative control. **Group (2):** Obese rats induced by fed on high fat diet (30% animal lipid) supplemented in the basal diet (0%) EPP and used as a positive control group. **Group (3):** Group infected obesity with rats was fed EPP by 1% of the weight of diet. **Group (4):** Group infected obesity with rats was EPP by 2% of the weight of diet. **Group (5):** Group infected obesity with rats was fed EPP by 4% of the weight of diet. During the experimental period, the body weight and feed intake were estimated weekly and the general behavior of rats was observed. The experiment period was take 28 days, at the end of the experimental period each rat weight separately then, rats are slaughtered and collect blood samples. Blood samples were centrifuged at 4000 rpm for ten minute to separate blood serum, and then kept in deep freezer till using.

### Blood sampling

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

### Biochemical analysis

#### Lipids profile

#### Determination of total cholesterol

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

#### Determination of serum triglycerides

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

#### Determination of high density lipoprotein (HDL-c)

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

Calculation of very low density lipoprotein cholesterol (VLDL-c)

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

$$\text{VLDL-c (mg/dl)} = \text{Triglycerides} / 5$$

Calculation of low density lipoprotein cholesterol (LDL-c)

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

#### The atherogenic ratios were calculated as follows:

Atherogenic Index of Plasma (AIP) =  $\log \text{ TG/HDLc}$ , Cardiac risk ratio (CRR) =  $\text{TC/HDLc}$  Castelli's Risk Index (CRI) =  $\text{LDLc/HDLc}$  Atherogenic Coefficient (AC) =  $(\text{TC} - \text{HDLc})/\text{HDLc}$  according to **Bhardwaj et al., (2013)** and Atherogenic fraction (AF) was calculated as the difference between TC and HDL-C according to **Aguilar et al., (2011)**.

## Liver functions

Determination of serum alanine amino transferase (ALT), serum aspartate amino transferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of **Hafkenschied (1979); Clinica Chimica Acta (1980), and Moss (1982)**, respectively.

## Statistical analysis

The data were analyzed using a completely randomized factorial design (**SAS, 1988**) when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ( $P \leq 0.05$ ) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

## RESULTS AND DISCUSSION

Data presented in Table (1) show the percent of chemical composition content of eggplant peel which it was rich in water, fiber and protein, respectively on wet weight. The values were 90.3%, 30.3% and 8.1 %, respectively and that is good for lipid profile parameter where they were reducing their level of blood. Also, according to **Huang et al., (2004)** established high moisture content for eggplant meat and skin as 93.12% and 92.31%, respectively. Moreover, **Kala and Prakash (2006)** defined the chemical composition of brinjal (eggplant) per 100g dry weight basis as 92.7 g moisture, 12.69 g protein, 6.46g ash, 1.95% ether extract (crude fat), 37.2g fiber, 242 mg Ca, 338 mg P, 6.12 mg Fe, and 21.73 mg vitamin C. Also, **Kahlon et al., (2007)** reported that 36.9 g fiber, 15.5 g protein, 0.9 g fat, 7.9 ash, and 75.7g carbohydrate for 100 g eggplant on dry weight basis.

Data in Table (2) elucidated the results as fresh weight basis indicated similar trends and showed great lower levels than that as dry weight basis indicating that drying process lead to concentrate the nutrients and phenol content by deleting moisture. These results are in agreement with **Huang et al., (2007)**, they illustrated that total phenolics content of eggplant skin is about two times greater than eggplant pulp (267 and 118.1 g of gallic acid equivalents / 100g fresh weight respectively). Moreover, **Helmja et al., (2007)** they indicated that skin extract of eggplant have the highest total phenolic and flavonoid contents being 1.5g/l (900 mg/100g) and 1.1g/l (660mg/100g) respectively compared to vegetables of the solanaceae family (tomato, chilli pepper, and potato). Also, **Raigon et al., (2008)** reported that phenolics content of eggplant as 48.26mg/100g fresh weight. Furthermore, **Nisha et al., (2009)** examined the total phenolic content of four different varieties of eggplant and the mean value was 71.78 mg/100g.

Data given in Table (3) evident that a total number of 12 different phenolic compounds were estimated in eggplant peels, being 3 phenolic compound were (pyrogalllic acid, protocatechuic acid and orthocoumaric acid). The major phenolic compound for peels were

orthocoumaric acid then pyrogalllic acid finally protocatechuic acid (16.74258, 7.22519 and 2.06367 mg/100g., respectively)

**Helmja et al., (2007)** explained that eggplant skin extract have the highest total phenolic and flavoniod contents 1.5 g/L (900 mg/100g) and 1.1 g/L (600 mg/100g) respectively compared to vegetables of *Solanoceae* family (tomato, chilli pepper, and potato); and the polyphenols found in skin extract of eggplant are phenolic acids (chlorogenic acid, cinnamic acid, caffeic acid, and ferulic acid). Furthermore, the skin extract of *S. melongena* mainly phenolic compounds were determined using capillary zone electrophoresis (CZE) and liquid chromatography – diode array detection–tandem mass spectrometry (HPLC–MS/MS) by **Helmja et al., (2009)** who identified the following substances: (1) Cinnamic, caffeic, quinic and p-coumaric acids, (2) isomers of chlorogenic acid, (3) caffeicacid conjugate, (4) cinnamic acid derivative, (5) isomers of dihydroxycinnamoyl amide, (6) N,N- dicaffeoyl spermidine. The traces of quercetin rutinoside and various kaempferol glycosides were identified as well. Nasunin was determined by MS/MS only as a minor component of the extract. In this respect, it is worthy mention that Nasunin, a major anthocyanins in eggplant peel that responsible for its color, comprises two isomers, cis and trans isomers of the delphinidin 3-[ 4- (p- coumaroyal) - L - rhamnosyl (1-6) glucopyranoside ] -5- glucopyranoside.

Table (4) data of this table showed the effect of EPP on liver enzymes ALT /AST and ALP and found that the significant increase in group which feed rats on basal diet only (0%) EPP. The values were  $192.30 \pm 0.20$ ,  $57.62 \pm 1.14$  and  $22.80 \pm 0.10$  U/L., respectively. However, when adding the EPP for diet with varity level 1,2 and 4 % found that the significant decrease and the most effective group was feed rats on (4%) EPP. The values were  $(118.6 \pm 1.0)$ ,  $24.90 \pm 1.13$  and  $11.55 \pm 3.0$  U/L., respectively. **Duke et al., (2002)** pointed to indications of eggplant which involved hepatitis. Also, **Guimaraes et al., (2000)** indicated that eggplant infusion 2% were apparently harmless as suggested by normal levels of alkaline phosphatase and gammaglutamyl trans peptidase in individuals, in which some vegetables may cause hepatic injuries when administered in large amounts to rats and humans, probably due to antinutritional factors such as tannin or alkaloids. But, the finding by **Friedman et al., (1996)** showed that feeding of potato, tomato, and eggplant alkaloids affects liver weight in mice, since eggplant alkaloids increased relative liver weight, these finding should serve as guide for removal of the most toxic compounds from plant foods. This finding did not observed in the present groups with feeding on eggplant fruit parts inwhich there were insignificant changes in liver weight.

Table (5) elucidated the effect of EPP on total cholesterol and triglycerides on obese rats and found that rats which feed on basal diet alone (0%) EPP were high significantly than all groups in T.C and T.G ( $130.00 \pm 1.10$  and  $134.25 \pm 1.21$  mg/ dl., respectively). While feeding rats on basal diet added to it (4%) EPP were more effective to decrease T.C and T.G which recorded ( $110.00 \pm 0.10$  and  $62.55 \pm 0.30$  mg/dl, respectively). Eggplant flavonoids extract showed significant

hypolipidemic action in normal and cholesterol fed rats which showed in cholesterol fed rats significant reduction of serum and different organs cholesterol, serum TG level, liver and kidney phospholipids, and serum and liver free fatty acids as noticed by **Sudheesh *et al.*, (1997)** who also pointed to bile acids binding properties of flavonoids by observation of significant increase in hepatic and fecal bile acids and explain this effect; which come in agree with the results by **Kahlon *et al.*, (2007)** who pointed to bile acid binding capacity of vegetables as eggplant and explained that binding bile acids and increasing their fecal excretion has been hypothesized as a possible mechanism by which dietary fiber lowers cholesterol. Reducing bile acid recirculation lowers cholesterol by reducing fat absorption and use of synthesized cholesterol to synthesize bile acid. So, this property is related to lowering risk of heart disease. When used steam cooking for eggplant, a significantly improved *in vitro* bile acid binding of eggplant than uncooked one.

Table (6) showed the effect of EPP on lipid profile (HDL / LDL and VLDL) on obese rats, it is clear that the significantly increased for LDL and VLDL in groups which feed rats on basal diet without any addition (0%) which were ( $78.05 \pm 1.20$  and  $26.85 \pm 1.13$  mg/dl., respectively). per contra the level of HDL the significant decreased which was ( $29.35 \pm 1.41$  mg/dl). Maximum improvement of HDL /LDL and VLDL recorded for (4%) EPP groups which were ( $37.80 \pm 1.13$ ,  $59.69 \pm 0.20$  and  $12.51 \pm 0.20$  mg/dl., respectively).

Table (7) this table summarizes the effect of EPP on atherogenic indices (AI: Atherogenic Index in Plasmas, CRR: Cardiac Risk Ratio, AF: Atherogenic Fraction, AC: Atherogenic Coefficient, and CRI : Castellis Risk Index). It is showed the groups which were administrated EPP were significantly decrease in AIP, CRR, CRI, AF and AC than the groups which feed on basal diet alone (0%) group. More effective reduction in AIP, CRR, CRI, AF and AC were observed in rats feed on basal diet and 4% EPP which were ( $2.40 \pm 0.20$ ,  $2.91 \pm 0.10$ ,  $1.58 \pm 0.12$ ,  $72.20 \pm 0.35$  and  $1.91 \pm 0.12$  mg/dl., respectively). Atherogenic indices are powerful indicators of the risk of heart disease the higher the value, the higher the risk of developing Cardiovascular Disease (CVD) and vice versa (**Usoro *et al.*, 2006**). Also, Eggplant had activities of antioxidant, hypocholesterolemic, antiatherosclerotic and LDL peroxidation inhibition by at least 90% by its skin as observed by **Huang *et al.*, (2004)** which come in parallel to that suggested by

**Table 1: The Chemical Composition of Eggplant Peel(EP) (g/100g)**

Quantity	Compounds
Moisture	90.3 g/100g
Ash	7.6 g/100g
Fat	1.4 g/100g
Protein	8.1 g/100g
Fiber	30.3 g/100g
Carbohydrate	52.6 g/100g

**Table 2: Total Phenol content in eggplant peels powder(EPP) (g/100g).**

Phenolic compounds	Fresh weight	Dry weight
Eggplant peel	1.94 (g GAE/100g)	4.15 (g GAE /100g)

GAE = Gallic acid equilibrium

**Table 3: Identification of eggplant peels powder (EPP) Phenolic compounds**

Phenolic compounds (mg/100g)	Concentration mg/100g
Pyrogalllic acid	7.22519
Gallic acid	----
Protocatechuic acid	2.06367
Catechin	---
Para hydroxy benzoic acid	---
Para coumaric acid	----
Phenol	----
Ortho coumaric acid	16.74258
Salicylic acid	-----
Coumarin	-----
Quercetin	-----
Cinnamic acid	-----

**Table 4: Effect of eggplant peels powder (EPP) on on liver functions of obese rats**

Groups / Parameters	G1 (-ve) Control	G2 (0%) EPP	G3 (1%) EPP	G4(2%) EPP	G5(4%) EPP
ALT(U/L)	90.60± 1.20d	192.30±0.20a	138.5 ±.15b	120.4± 1.30c	118.6 ± .10c
AST(U/L)	11.00± 1.10e	57.62± 1.14a	41.20± 1.05b	32.8± 0.20c	24.90 ± 1.13d
ALP(U/L)	8.60 ± .40e	22.80± 0.10a	17.30± .20b	15.9± 1.00c	11.55± .30d

Each value represents mean ± SD. value the same column with different superscript letters significantly different ( $p \leq 0.05$ ).

**Table (5): Effect of eggplant peels powder (EPP) on serum triglycerides, and serum total cholesterol levels of obese rats.**

Groups / Parameters	G1 (- ve) Control	G2 (0%) EPP	G3 (1%) EPP	G4(2%) EPP	G5(4%) EPP
TG mg/dl	54.91 ± 0.10 e	134.25 ±1.21 a	89.24 ± 1.10 b	74.73± 1.23 c	62.55 ± 0.30 d
T.COL mg/dl	95.00 ± 0.10 h	130.00 ± 1.10 a	122.00 ±0.40 b	113.00 ±0.10 d	110.00 ±0.10 e

Each value represents mean ± SD. value the same column with different superscript letters significantly different ( $p \leq 0.05$ ).

**Table (6): Effect of eggplant peels powder (EPP) on HDL-c, LDL-c and VLDL-c levels of obese rats.**

Groups / Parameters	G1 (- ve) Control	G2 (0%) EPP	G3 (1%) EPP	G4(2%) EPP	G5(4%) EPP
HDL-C mg/dl	45.50 ± 2.10 a	29.35 ± 1.41 e	32.65± 0.30 d	35.50 ±1.50 d	37.80 ±1.13 c
LDL-c mg/dl	38.52± 0.10 d	78.05± 1.20 a	71.50 ± 1.40 b	62.55 ± 0.10 c	59.69 ± 0.20 c
VLDL-c mg/dl	10.98± 0.32 c	26.85± 1.13 a	17.85 ± 1.11 b	14.95 ± 0.20 c	12.51 ± 0.20 c

HDL-c = High density lipoprotein

LDL-c =Low density lipoprotein

VLDL-c = Very low density lipoprotein.

Each value represents mean ± SD. value the same column with different superscript letters significantly different ( $p \leq 0.05$ ).

**Table (7): Effect of eggplant peels powder (EPP) on atherogenic indices levels of obese rats.**

Groups / Parameters	G1 (- ve) Control	G2 (0%) EPP	G3 (1%) EPP	G4(2%) EPP	G5(4%) EPP
AI (mg/dl)	1.48± 0.10 d	4.46± 0.30 a	3.55± 0.10 b	2.30± 0.20 c	2.40± 0.20 c
CRR (mg/dl)	2.09± 0.13c	4.43± 0.11a	3.74± 0.12b	3.18± 0.15b	2.91± 0.10b
CRI (mg/dl)	0.85± 0.33c	2.66± 0.10a	2.19± 0.14a	1.76± 0.11b	1.58± 0.12b
AF (mg/dl)	49.50± 0.23e	100.65±0.61a	89.35± 0.50b	77.50± 0.26c	72.20± 0.35d
AC (mg/dl)	1.09±0.11d	3.43±0.15a	2.78±0.12a	2.18±0.14b	1.91± 0.12c

AI=Atherogenic Index in Plasms

CRR= Cardiac Risk Ratio

AF= Atherogenic Fraction

AC= Atherogenic Coefficient

CRI = Castellis Risk Index

Each value represents mean ± SD. value the same column with different superscript letters significantly different ( $p \leq 0.05$ ).

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## التأثير الخافض لدهون الدم لمسحوق قشور الباذنجان علي الفئران المصابة بالسمنة

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### الملخص العربى

الباذنجان يعتبر واحدا من الخضروات الغنية بمضادات الأكسدة. كما يحتوي علي تركيزات عالية من المركبات الكيميائية النباتية مثل الاحماض الفينولية ومركبات الفلافونيدات والمعروفة بنشاطها العالي كمضاد لأكسده. وفي هذا البحث، قمنا بدراسة تأثير مسحوق قشور الباذنجان المجفف في خفض مستوي الكوليستيرول ودهون الدم لدي الفئران المصابة بالسمنة والعمل علي تحسين صحتهم. تم استخدام خمسة وعشرون فأر ذكور من النوع الابينو وزن ١٤٠ جرام  $\pm$  ١٠ جرام وتم تقسيمهم علي خمس مجموعات كل مجموعة تحتوي علي خمسة فئران وتمت تغذيتهم علي غذاء عالي الدهون (٣٠% دهون حيوانيه) وذلك لإصابتهم بالسمنة ورفع مستوي كل من الكوليستيرول ودهون الدم لديهم. المجموعة الاولي (الكنترول) هي المجموعة السليمة وثاني وثالث ورابع وخامس مجموعة تم تغذيتهم علي الغذاء الاساسي مضاف اليه (٠، ١، ٢، ٤%) من مسحوق قشور الباذنجان المجفاف وذلك لمدة اربعة اسابيع. وفي نهايه التجربه تم تشريح الفئران وتجميع عينات الدم والسيرم تم فصله لعمل التحاليل اللازمه حيث تم تقدير التركيب الكيميائي لقشور الباذنجان وكذلك المركبات الفينولية به وتم عمل تحاليل بيوكيميائية لقياس مستويات الكوليستيرول الكلي والجليسيريدات الثلاثيه ومؤشرات دهون الدم وكذلك مؤشرات تصلب الشرايين وتم تقدير انزيمات وظائف الكبد، وكشفت البيانات الخاصه بالفئران المصابه بالسمنة العديد من التغيرات المعنويه في المؤشرات البيوكيميائية، وكانت الخلاصه ان الفئران المصابه بالسمنة والتي تم تغذيتها علي الغذاء الاساسي مضاف له مسحوق قشور الباذنجان المجفف بنسبه ٤% ادت الي تحسن في مستويات دهون الدم حيث كان له تأثير الخافض لدهون الدم المرتفعه مقارنة بغيره من التركيزات المستخدمه.

**الكلمات الدلاليه:** الفئران - مسحوق قشور الباذنجان - ارتفاع دهون الدم- دهون الدم.