

ORIGINAL ARTICLE

PHYSIOLOGICAL IMPACT OF POWDERED AND WATER-SOAKED EGGPLANT IN MALE RATS: GLYCEMIA, LIPIDS, AND MINERAL BALANCE

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ABSTRACT

Background: Metabolic conditions, such as diabetes and high blood pressure, are considering as the main problems that face health systems around the world. Researchers strongly work to find alternative treatment options, such as herbs, to fight these health conditions. This study aimed to investigate the effects of powdered and water-soaked eggplant on glycemic status, lipid profile, and selected serum electrolytes in male rats.

Materials & Methods: This study included the recruitment of 20 male albino rats (10 for eggplant powder experiment and 10 for water-soaked eggplant experiment), each 10 animals were divided randomly and equally into treatment and control groups. The treatment groups received either powder or a suspension of eggplant powder at 0.0143gm/5ml, each male rat was given 0.5 ml of the suspension daily for 48 days by oral gavage. Control group received distilled water only by the same route and for the same amount of time. At the end of the experiment, blood samples were collected from all rats, and glucose, electrolytes (Na, K, Ca, and Cl), and lipid profile were measured.

Results: The blood glucose levels significantly ($p < 0.05$) decreased in treatment groups. The Cl significantly ($p < 0.05$) decreased in treatment group from the liquid application. While, K and Ca significantly ($p < 0.05$) increased in the treatment group from the soaked powder. Lipid profile analysis showed that triglycerides and VLDL significantly ($p < 0.05$) decreased in the treatment group from the soaked powder, while HDL and LDL significantly ($p < 0.05$) increased in the treatment group from the liquid application. However, a significant ($p < 0.05$) increase in the VLDL was seen in the powder experiment.

Conclusion: Eggplant powder effect by reduction in blood glucose and LDL levels, alongside an increase in beneficial minerals such as potassium and calcium. These findings suggest a potential metabolic benefit of eggplant as a dietary supplement

KEY WORDS: Albino; Blood Glucose; Electrolytes; Lipid Metabolism; Metabolic Syndrome; Rats; *Solanum melongena*; .

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INTRODUCTION

Metabolic syndrome (MetS) is not a distinct medical condition. However, diabetes, abdominal obesity, hyperlipidemia, and hypertension are common in

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people with this disorder.¹ MetS predominantly affects older adults; however, accumulating evidence indicates that its impact is no longer confined to advanced age and is increasingly observed among younger population. The presence of MetS significantly elevates the risk of cardiovascular disease and is associated with increased mortality rates. Consequently, early intervention through pharmacological treatment and comprehensive lifestyle modifications, including caloric restriction, regular physical activity, and adequate sleep, is essential for reducing adverse health.² Investigations have carried out to evaluate the effectiveness of therapeutic plants or their extracts in combating this disorder and its sequelae.

vious studies have highlighted the potential role of plant-derived compounds in the management and prevention of metabolic syndrome (MetS). For example, a review published by³ in 2017 suggested that mangosteen may exert beneficial effects in the management of MetS and improve quality of life. In addition, other plant-derived compounds, including avocado, cinnamon, silymarin, rosemary, and *Abelmoschus esculentus*, have reported to play a preventive role in the development of MetS. Recent clinical evidence suggests that curcumin may have beneficial effects in the management of metabolic syndrome (MetS).⁴ Recent review reported improvements in insulin resistance, lipid profile, and inflammatory markers following curcumin supplementation.⁵

One of the most frequently encountered herbs found all over the globe is *Solanum melongena* name for common eggplant which is particularly abundant in different Asian nations, the countries of the Middle East, and the sea region of the Mediterranean. The main genus *Solanum* and the family *Solanaceae* include this plant.⁶ The wide variability among eggplants in their phenotypic and nutritional characteristics emphasizes the importance of traditional varieties as a key source of agricultural biodiversity.⁷ Also referred to as aubergine, it is a valuable supplier of dietary fibers, ascorbic acid, thiamin, niacin, vitamins B6 and B12, lipid-soluble vitamins, as well as an extended range of minerals, such as iron, potassium, calcium, magnesium and phosphorous.⁸ Numerous illness, such as type 2 diabetes, respiratory tract infections, arthritic conditions allergies, and high cholesterol levels, have been treated with eggplant.⁹ Because of its phenolic and alkaloid components, eggplant is used in medicine. The primary phenolic chemicals found in the outer layer and core of eggplant are the phenolic acids chlorogenic acid and anthocyanin delphinidin.¹⁰ This study aimed to investigate the effects of powdered and water-soaked eggplant on glycemic status, lipid profile, and selected serum electrolytes in male rats.

MATERIALS AND METHODS

Experimental Animals: The present study was conducted in accordance with institutional, national, and international guidelines for the Prior to the experiment, all animals were acclimatized for 14 days. Care and use of laboratory animals. A total of 20 healthy male albino rats aged 1.5-2.5 months and weighing 70-80 g were used in this experiment. The animals were obtained from an accredited animal facility and housed under standard laboratory conditions (temperature 22 ± 2 °C, 12 h light/12 h dark cycle). Rats were allowed free access to standard pellet diet and tap water ad libitum. Prior to the experiment, all animals were acclimatized for 14 days.

Experimental Design.

Preparation of eggplant powder

Fresh eggplants (*Solanum melongena*) were purchased from local markets. Fruits were thoroughly washed with distilled water, sliced, and air-dried under sunlight for four days until complete dehydration. The dried material was then ground into a fine powder using an electric blender and stored in airtight containers at room temperature until use.¹¹

Preparation of eggplant Suspension: A suspension was prepared by dissolving 0.0143 g of eggplant powder in 5 ml of distilled water, producing a homogenous mixture. Each rat in the treatment group received 0.5 ml/day of this suspension via oral gavage.

Preparation of water-soaked eggplant: Fresh eggplants were washed, cut into small pieces, and soaked in distilled water for 24 hours at room temperature. The aqueous extract was then used immediately for administration according to the calculated dose.

Dose Calculation and Justification: The administered dose was calculated based on body weight proportionality between humans and rats using the direct ratio (proportional scaling) method. The dose was adjusted to correspond to the average body weight of the experimental rats, ensuring physiological relevance. Based on this proportional conversion, the calculated daily dose for rats was equivalent to approximately 28-30 mg/kg body weight, which falls within the range commonly used in nutritional and phytochemical experimental studies. This approach allows for translational relevance while maintaining safety for the animal model.

Experiment Treatment: Rats in the treatment groups received 0.5 ml/day of either eggplant powder suspension or water-soaked eggplant extract via oral gavage for 48 days. Control groups were administered an equal volume of distilled water using the same route and duration.

Blood sample Collection: At the end of the experimental period, animals were fasted overnight and euthanized under appropriate anesthesia. Blood samples were collected by cardiac puncture and allowed to clot at room temperature. Serum was separated by centrifugation at 3000 rpm for 10 minutes and stored at -20 °C until biochemical analysis.

Biochemical Analysis: Serum samples were analyzed for glucose, electrolytes :Sodium Na, potassium K, calcium Ca, and chloride Cl, and lipid profile total Cholesterol, triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), and very low density lipoprotein (VLDL) were measured manually according to previously published methods.¹²⁻¹⁴

Statistical Analysis: Data are presented as mean values. Statistical comparisons between control and

treatment groups were performed by SPSS version 23 using the independent sample t-test. A value of $p < 0.05$ was considered statistically significant.

RESULTS

The average weight of the tested rats was changed after the use of the eggplant to be 209.5gm and 503gm in the treatment and control groups, respectively. The results showed that the blood glucose levels significantly ($p < 0.05$) decreased in the treatment groups (Figure 1A and B). For the electrolytes, the Cl significantly ($p < 0.05$) decreased in the treatment group from the liquid application. On the other hand, K and Ca significantly ($p < 0.05$) increased in the treatment group from the soaked powder (Figure 2A and B).

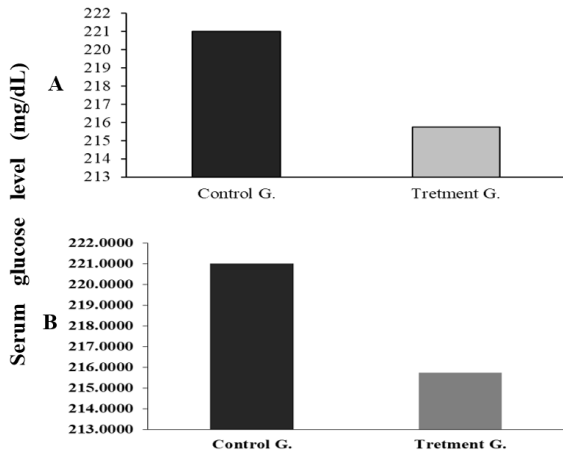


Figure 1: Random blood glucose levels in the control and treatment groups of male rats provided with A. Eggplant powder or B. Powder suspension. $p < 0.05$

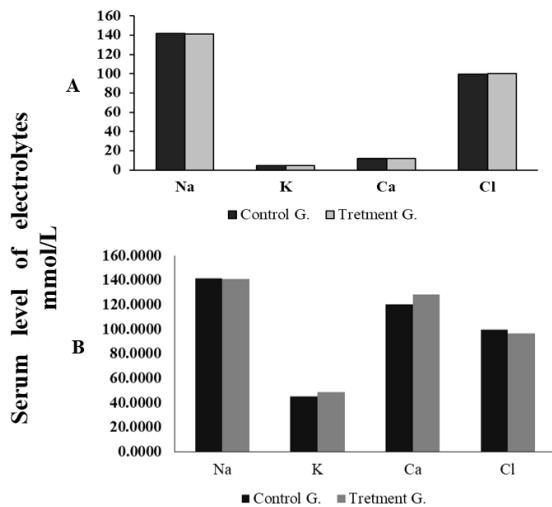


Figure 2: Blood levels of electrolytes in the control and treatment groups of male rats provided with A. Eggplant powder or B. Powder suspension. $p < 0.05$

The finding of the lipid profile revealed that triglycerides and VLDL significantly ($p < 0.05$) decreased in the treatment group from the soaked powder, while HDL and LDL significantly ($p < 0.05$) increased in the treatment group from the liquid application. However, a significant ($p < 0.05$) increase in the VLDL was seen in the powder experiment (Figure 3A and B).

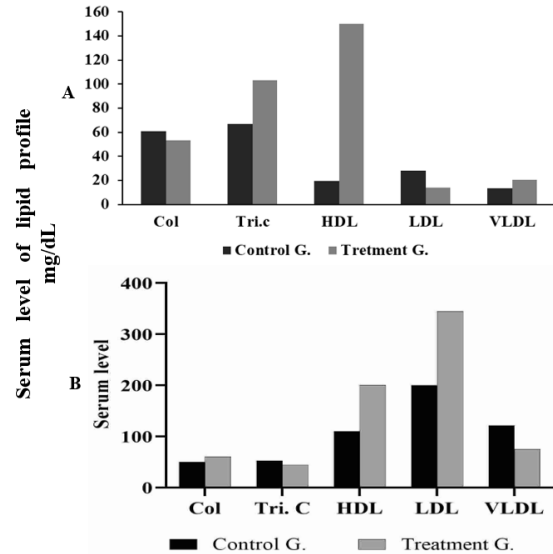


Figure 3: Blood levels of lipid profile in the control and treatment groups of male rats provided with A. Eggplant powder or B. Powder suspension. $P < 0.05$

DISCUSSION

The present study demonstrated that administration of the eggplant led to significant improvements in body weight, glucose levels, electrolyte balance, and lipid profile in rats.

The average weight of the tested rats was changed after the use of the eggplant to be 209.5gm and 503gm in the treatment and control groups, respectively. The reduction in body weight may be attributed to the biologically active compounds present in Solanum melongena, such as phenolics and flavonoids, which have been associated with improved lipid metabolism and anti-obesity effects in rodent models.¹⁵ Previous research has demonstrated that dietary supplementation with eggplant components can improve metabolic parameters and reduce obesity-related lipid profiles in obese rats fed a high-fat diet.¹⁶

In the current study, the findings revealed that eggplant powder was important in the decrease of blood glucose levels in the male rats. According to reports, delphinidin activates the nitric oxide (NO) pathway which in turn causes endothelial vasodilation. By blocking the signaling route that renin (an aspartyl protease)-angiotensin system (RAS) initiates, delphinidin has also demonstrated antihypertensive

benefits. One of the main causes for the onset of hypertension is the excessive stimulation of this pathway.¹⁷

The angiotensin-converting enzyme (ACE) is less expressed and activated when delphinidin is present. The pancreatic and salivary enzyme α -amylase is crucial for the breakdown of carbohydrates. The absorption of glucose can be decreased by inhibiting the α -amylase enzymes in the pancreas and saliva. Additionally, delphinidin has demonstrated inhibiting impacts on the α -amylase, suggesting that it might be helpful in the management of high blood sugar and its byproducts, including obesity and overweight, as well as circulatory problems.¹⁸

It has been discovered that chlorogenic acid improves NO background, enhances endothelial activity, and lowers arterial hypertension. In addition to slowing the absorption of glucose in the gut, chlorogenic acid has been demonstrated to have positive impacts on diabetes (Type 2) by boosting the glucose receptor movement to the target membrane, improving the transportation of glucose components to functioning cells, and suppressing the synthesis of glucose.¹⁹ The finding of the lipid profile revealed that triglycerides and VLDL significantly ($p < 0.05$) decreased in the treatment group from the soaked powder, while HDL and LDL significantly ($p < 0.05$) increased in the treatment group from the liquid application. However, a significant ($p < 0.05$) increase in the VLDL was seen in the powder experiment. It's been proposed that by lowering the concentration of serum triglyceride and free fatty acids, chlorogenic acids have anti-obesity and antihyperlipidemic properties²⁰. Furthermore, several research works have documented the pharmacological characteristics of eggplant, including its activities as an anti-oxidant and anti-inflammatory agent. Inappropriately high blood concentrations of lipids, such as cholesterol and triglycerides, are called hyperlipidemia.²¹ This condition is one of the top factors of death globally and is well recognized as the primary risk component for coronary artery disease. Due to its high content of dietary fiber, eggplant has the potential to beneficially alter an amount of blood lipids.²²

The impact of eggplant on the breakdown of lipid in rats given food including 1% eggplant has been documented in a research investigation. The findings demonstrated that rat blood and hepatic cholesterol pools were not lowered by eggplant.²³ On the other hand, it was noted that eggplant decreased the amount of lipid absorbed from a particular food serving, most likely via attaching bile salts to lipid. Additionally, LDL receptor mice with knockouts have been used to study the effects of eggplant extract (for three months) on cholesterol artery build-ups and lipid digestion. In this investigation, atherogenic lipid amounts and overall lipids were not reduced by eggplant.²⁴

In a different investigation, rats given cholesterol were used to assess the hypolipidemic impact of the extracted flavonoids from eggplant. It was shown that the plant reduced the amount of triglycerides in blood and increased lipase performance. Additionally, eggplant increased the efficiency of 3-hydroxy-3-methylglutaryl-coenzyme A reductase and reduced the level of blood lipid. This enzyme is responsible for catalyzing the conversion of the precursor to cholesterol. Thus, it is possible to propose that eggplant lowered lipid concentrations through additional methods, such as increasing the speed at which lipid is eliminated by breakdown procedures and effectively reducing the amount of lipid absorbed within the gut.²⁵

A study by Johnson et al. Investigated the effects of eggplant consumption on sodium levels in rats. The results showed that rats fed with eggplant extract had significantly lower sodium levels compared to the control group.²⁶ In a study by Chen et al. the effects of eggplant supplementation on potassium levels in healthy individuals were investigated. The participants consumed eggplant juice daily for four weeks and their blood samples were analyzed. The results revealed a significant increase in potassium levels suggesting that eggplants may be beneficial in maintaining potassium balance.²⁷ We noted an elevation in blood calcium levels in male rats administered Eggplant suspension relative to the control group. Despite eggplant containing a minimal quantity of calcium (~10 mg/100 g of raw fruit)²², it may enhance overall dietary calcium consumption, potentially leading to a slight increase in serum calcium levels relative to the control group. Eggplant flour was found to contain high concentrations of potassium on a dry weight basis, with values ranging from approximately 23,801.8 to 27,889.6 mg/kg depending on the part analyzed (whole fruit, pulp, or peel) in mineral composition analyses of eggplant.²⁸

CONCLUSION

The study revealed that administering eggplant powder led to a noticeable improvement in several blood biomarkers. Specifically, it contributed to lowering blood sugar levels and LDL cholesterol, which is considered harmful when elevated. Moreover, an increase was observed in essential electrolytes like potassium and calcium. These findings indicate that eggplant powder may play a supportive role in enhancing metabolic balance, suggesting its value as a natural supplement for individuals at risk of metabolic conditions. The outcomes also underscore the importance of exploring plant-based nutritional therapies in the broader context of preventive medicine.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	SRM, RAA
Acquisition, Analysis or Interpretation of Data:	SRM, RAA
Manuscript Writing & Approval:	SRM, RAA

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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