Potential Effect of Cantaloupe Waste (Peels and Leaves) on Improving Pancreatic Functions in Rats Treated with Alloxan

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Potential Effect of Cantaloupe Waste (Peels and Leaves) on Improving Pancreatic Functions in Rats Treated with Alloxan

By

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Abstract:

The primary objective of this study is to explore the potential impact of incorporating Cantaloupe peels and leaves powder, as well as their combination, into diets in alleviating hyperglycemia-related complications induced by Alloxan in rats with diabetes. A total of forty-eight male albino rats, weighing 150±10 g, were utilized and split into two primary groups. The initial group comprised 6 rats and served as the negative (-ve) control group, being fed the basal diet. The remaining 42 rats were induced with diabetes through alloxan injections and were further divided into seven equal sub groups. The second group continued to be fed the basal diet and served as the positive (+ve) control group. The remaining six groups were provided with the basal diet enriched with 2.5% and 5% of Cantaloupe peels and leaves powder, both separately and in combination. The administration of alloxan to animals resulted in a significant increase ($p \leq 0.05$) in serum insulin concentration, marking an 86.45% elevation compared to normal controls. However, supplementing rat diets with 2.5% and 5% of the specified plant components—CPP, CLP, and their Mix—led to reductions in this value by 36.92%, 73.84%, -118.46%, 196.92%, 296.15%, and 453.84%, respectively. Similar patterns were observed in C-peptide, fructose amine, lipid profiles

(TC, triglycerides, HDL-c, LDL-c, and VLDL-c), and histopathological changes in the pancreas of diabetic rats induced by varied rates due to the dietary supplementation with the examined plant components. These effects primarily stem from the potent antioxidant activities found in these plant parts, owing to their high content of bioactive compounds. These discoveries lay a foundation for considering the use of CPP and CLP in treating complications arising from type-2 diabetes.

Key Words:

Cucumis melo L, hyperglycemia, organs weight, insulin, C-peptide and fructose amine.

Introduction

Diabetes mellitus (DM) stands as one of the most prevalent endocrine disorders, impacting over 300 million individuals globally **(Mohammad and Abdul Haq, 2017).** It presents as a diverse metabolic disorder distinguished by hyperglycemia, stemming from compromised insulin secretion, impaired insulin function, or a combination of both factors **(Zubin *et al.*, 2018).** This condition, a serious and widespread chronic ailment, emerges from a complex interplay of genetic predisposition and environmental influences, compounded by risk factors like obesity and a sedentary lifestyle **(Nishita *et al.*, 2016).** Persistent hyperglycemia in diabetes is linked to particular long-term microvascular complications impacting the eyes, kidneys, and nerves, along with an elevated susceptibility to cardiovascular disease (CVD). The diagnostic benchmarks for diabetes rely on glycemic thresholds correlated with microvascular ailments, notably retinopathy **(Zubin *et al.*, 2018). Subhasis *et al* (2019).** demonstrated that diabetes mellitus manifests as a multifaceted metabolic disorder characterized by hyperglycemia, dysfunction of pancreatic beta (β) cells, and an aberrant lipid profile resulting from metabolic dysregulation, impaired insulin secretion and function, and inappropriate glucose utilization. This condition stands among the most prevalent chronic illnesses and leads to severe complications such as heightened production of reactive oxygen species (ROS), compromised antioxidant enzymes, elevated blood sugar levels, disordered lipid metabolism, disruptions in the insulin signaling pathway, and cellular damage caused by ROS. These alterations collectively contribute to secondary complications associated with diabetes, including nephropathy, retinopathy, neuropathy, and cardiovascular morbidity. Prolonged hyperglycemia leads to extensive organ damage and failure in various vital systems, impacting the heart, kidneys, eyes, nerves, and blood vessels. Cardiovascular complications linked to diabetes contribute significantly to the elevated morbidity and mortality rates observed in diabetic individuals. There's a heightened incidence of atherosclerotic cardiovascular diseases, cerebrovascular diseases, hypertension, and disturbances in lipoprotein metabolism among those with diabetes mellitus. Complications such as diabetic nephropathy, which culminates in renal failure, peripheral neuropathy carrying the risk of foot ulcers, amputation, and Charcot joint, and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms, alongside sexual dysfunction, underscore the challenges faced by individuals with diabetes **(Robert and Frank 2004).** Cantaloupe *(Cucumis melo L.)* belongs to the Cucurbitaceae family. Among cucurbits, muskmelon is renowned for its distinctive flavor and taste. Rich in vitamins A and C, muskmelon comprises 90% water and 9% carbohydrates**. (Pansare *et al.*, 2023).**

Cantaloupe *(Cucumis melo L.)* commonly referred to as Kharbooja, holds significant importance as a dessert fruit. This crop, highly reliant on cross-pollination, features monoecious or andromonoecious vines. Muskmelon enjoys consistent global demand throughout the year (**Pansare *et al.*, 2023).**

Cucumis melo L., specifically its byproducts such as peels and leaves, have exhibited a range of health benefits. Consequently, these byproducts hold the potential to be integrated into various culinary and nutraceutical applications, creating innovative functional foods or dietary supplements. In the development of novel food items, it is essential to assess the bioavailability of bioactive compounds and sensory characteristics to ensure both efficacy and sustainability. This approach can enhance people's health and well-being, contributing to an improved quality of life. Simultaneously, the pressing issue of food waste can be addressed through the utilization of *Cucumis melo L.* by-products **(Ong *et al.*, 2019).**

Cantaloupe (*Cucumis melo L.*) harbors abundant phenolic compounds found both in its peels and leaves. Tocopherols were notably high in cantaloupe, while the flesh contained significant levels of β-carotene and vitamin C. The presence of these bioactive compounds accounted for various beneficial health effects, encompassing antioxidant, anti-inflammatory, anti-ulcer, anti-angiogenic, anti-diabetic, anti-bacterial, and anti-hypothyroidism properties. The diverse health advantages presented by *Cucumis melo L.*, particularly its peels and leaves, showcase the potential for integrating these byproducts into various culinary and nutraceutical applications, crafting innovative functional foods or dietary supplements (**Ong *et al.*, 2019).** Cantaloupe (*Cucumis melo L.*) belongs to the melon, pumpkin, and cucumber family, featuring a green exterior with distinct markings and yellowish flesh. Its properties have been harnessed to enhance endurance, fortify kidney and spleen function, and lower blood pressure. Rich in beta-carotene, Cantaloupe contributes significantly to health benefits. Beta-carotene supports various physiological functions including eyesight, cell differentiation, immune response, growth, development, and aids in the prevention of cancer and heart disease **(Sucita *et al.*, 2023)**. Consequently, this study aims to explore the potential impact of different concentrations (2.5% and 5%) of Cantaloupe peel and leaf powder, as well as their blend, on hyperglycemia in diabetic rats.

Material and Methods

Materials

Cantaloupe peels and leaves were procured from the local markets of the Sharqia Governorate in 2023.

Experimental animals

For the experimental animals, 48 adult male albino rats of the Sprague Dawley strain, with an average weight of 150±10 g, were acquired from the Vaccine and Immunity Organization at the Helwan Farm, Cairo, Egypt.

The chemical kits

The chemical kits were sourced from Al-Gomhoria Company for Drugs, Chemicals, Medical Instruments in Cairo, Egypt.

Methods

Chemical Composition

Total nitrogen and crude protein: As outlined by **A.O.A.C. (2010),** he assessment of total nitrogen involved the application of the Marco Kjeldahl techniques, subsequently calculating crude protein by multiplying the total nitrogen value was calculated as **T.N.X 6.25.**

Fat content: The fat content was determined following the **A.O.A.C. (2010)** procedure, utilizing the Soxhlet device. Extraction was conducted over 16 hours using n-hexane as the solvent for extraction.

The ash content was determined post-charring, following the **A.O.A.C. (2010)** guidelines. Samples were heated in a muffle furnace at 525°C until reaching a state of white or light grey ash.

Crude fibre: For the determination of crude fiber, the technique outlined by Holst and Associates in 1982 was employed. The sample underwent digestion in boiling 0.128 M sulfuric acid for 45 minutes, followed by triple rinsing with distilled water. Subsequently, it was digested again in boiling 0.223 M sulfuric acid.

Characterization of phenolic acid from various cantaloupe waste (peels and leaves) powder by HPLC

The quantification of specific phenolic compounds in different cantaloupe waste samples (peels and leaves) was conducted utilizing an HPLC system (Waters Alliance 2690, Chromatograph Separation Module) equipped with a photodiode array (PDA) detector (Model 2998, Waters). The analysis was shielded by a Phenomenex 4.0 2.0 mm i.d., C18 ODS guard column, preserving a Synergi Hydro-RP (250 4.6 mm i.d.) reversed-phase column, featuring a 4 µm particle size (Phenomenex, Lane Cove, NSW, Australia). The mobile phase consisted of water/acetic acid (98:2, v/v; eluent A) and acetonitrile/water/acetic acid. The mobile phase composition comprised acetonitrile/water/acetic acid (100:1:99, v/v/v; eluent B). The gradient profiles, as per the methodology outlined by **Cho et al. (2011),** progressed as follows: 10-25% B

(0-20 min), 25-35% B (20-30 min), 35-40% B (30-40 min), 40-55% B (40-70 min), 55-80% B (70-75 min), and finally, 80-90% B.

The Cantaloupe peels and leaves underwent washing before being dried in a hot air oven (Horizontal Forced Air Drier, Proctor and Schwartz Inc., Philadelphia, PA) at 75°C. This process continued until the moisture content in the final product reached approximately 8%. Subsequently, the dried leaves were finely powdered using a high mixer speed (Moulinex Egypt, ElAraby Co., Benha, Egypt). The resulting material that passed through an 80-mesh sieve was collected, packed in polyethylene pouches, and stored at 4°C until needed.

Induction of diabetes

Diabetes was induced in Forty-two healthy, normal rats through the injection of freshly prepared alloxan monohydrate in saline at a dosage of 150 mg/kg body weight (**Lazarow and Palay, 1954).** Following the injection, the animals immediately received a 5% glucose solution overnight to counteract the drug-induced hypoglycemia **(Wohaieb and Godin, 1987; Kakkar *et al.*, 1998).** After a five-day period of fasting, blood glucose levels (FBG) were assessed using a specific kit from AlGomhoryia Company for Trading Drugs, Chemicals, and Medical Instruments in Cairo, Egypt. A small blood sample was collected from the tail vein and subjected to the haemogluco test strip. Rats with FBG levels exceeding 126 mg/dl were categorized as diabetic and included in the study.

Experimental design

All biological experiments conducted adhered to the regulations set forth by the Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council **(NRC, 1996)**. The forty-eight rats were individually housed in wire cages within a controlled room environment maintained at 25±2°C, ensuring standard healthy conditions. Before commencing the experiment, all rats underwent a one-week acclimatization period on a basal diet. Following this acclimatization, the rats were divided into two primary groups. The first group (Group 1, comprising 6 rats) continued to be fed the standard basal diet (SD). The second main group (42 rats) was utilized for diabetes induction and further categorized into seven subgroups as follows: group (2) received only the standard diet as a positive control (rats with diabetes); group (3) consumed SD containing 2.5% (w/w) CPP; group (4) consumed SD containing 5% (w/w) CPP; group (5) consumed SD containing 2.5% (w/w) CLP; group (6) consumed SD containing 5.0% (w/w) CLP; group (7) consumed SD containing 2.5% (w/w) mix (a combination of CPP and CLP in equal parts), and group (8) consumed SD containing 5% (w/w) mix. Throughout the experimental phase, the rats' body weight and food intake were assessed weekly, and their general behavior was monitored.

Blood sampling

At the conclusion of the experimental period, which lasted 28 days, blood samples were obtained following a 12-hour fasting period using the abdominal aorta, and the rats were euthanized under ether anesthesia. These blood samples were collected into glass centrifuge tubes containing an oxalate solution (1.34%) as an anticoagulant. After centrifugation at 3000 rpm for 10 minutes, plasma was separated and utilized for vitamin analysis. The remaining erythrocyte residue underwent washing with three successive portions of sodium chloride solution (0.9%) and was subsequently hemolyzed using deionized water for 30 minutes. The resulting hemolysate underwent further centrifugation at 30,000 rpm for 30 minutes, after which the supernatant fractions were transferred to a clean test tube for analysis of antioxidant enzymes **(Stroev and Makarova, 1989).** The liver organ was excised and utilized for determining GSH and MDA levels.

Organs

The various organs of the rats, specifically the pancreas, were meticulously extracted, rinsed with a saline solution, dried using filter papers, and promptly weighed. These organs were then preserved in a buffered formalin solution (10%) for subsequent histopathological examination, following the method described by **(Kaack and Austed, 1998).** The relative organ weight was computed as follows:

$$Relative\ Organs\ Weight\ \% = \frac{Organ\ weight\ (g)}{Total\ body\ weight\ (g)} \times 100$$

Biochemical analysis

Blood Insulin

The enzymatic assessment of plasma insulin was conducted calorimetrically, following the procedure outlined by **Wilson and Miles (1977).**

Blood fructoseamine

The enzymatic measurement of plasma fructoseamine was conducted calorimetrically, following the procedure outlined by Scott (1935).

Blood C-peptide

The enzymatic measurement of plasma C-peptide was conducted calorimetrically, following the method outlined by **Kaplan (1984).**

Lipids profile

Serum total cholesterol (TC), serum triglycerides, serum high-density lipoprotein (HDL-c), serum very low-density lipoprotein, and serum low-density lipoprotein cholesterol (LDL-c) levels were determined using the methods outlined by Allain **(1974), Fossati and Prencipe (1982), Lopez (1977), and Lee and Nieman (1996),** respectively.

Statistical analysis

Treatment disparities were considered significant at ($P \leq 0.05$) utilizing the SPSS program. Biological findings underwent analysis via One-Way ANOVA.

Histopathological Examination:

At the conclusion of the 28-day experiment, all rats were euthanized, and tissue samples, including the pancreas, were collected for histopathological examination **(Carleton, 1978).**

Results and Discussion

Identification and Quantification of chemical composition of compounds in cantaloupe waste (peels and leaves).

Data given in Table (1) result showed that cantaloupe waste (peels and leaves) contained Moisture (81.01 and 75.01mg/100g) with Lipid was (1.20 and 0.08 mg/100g), Protein was (2.99 and 2.50) Soluble Carbohydrate (11.21 and 9.21 mg/100g) in addition to Fiber and Ash (9.00 and 8.55) and (2.55 and 1.99 %) respectively.

Table (1): Chemical composition (mg/100g)

Phenolic compounds	Concentration (mg/100g) Percent	
	peels	leaves
Moisture	81.01	75.01
Lipid	1.20	0.08
Protein	2.99	2.50
Carbohydrate	11.21	9.21
Fiber	9.00	8.55
Ash	2.55	1.99

The findings presented in Table (2) indicate that cantaloupe waste, comprising peels and leaves, contains a notable number of phytochemicals, particularly phenolic compounds, which attribute to their therapeutic properties **(Odekanyin *et al.*, 2023).** Performing qualitative and quantitative analyses on the specific phenolics found in spices allows for establishing correlations among their cumulative levels. These investigations illuminate the intricate relationship between the structural compositions of these phenolic compounds and their functional activities within spices.

High-performance liquid chromatography (HPLC) was utilized to characterize the phenolic components present in processed cantaloupe waste, including peels and leaves, in powder form. As indicated in Table (2), this waste material exhibits a notable concentration of phenolic compounds. Specifically, eighteen compounds were extracted from cantaloupe waste (peels and leaves), encompassing Gallic acid, Chlorogenic acid, Ferulic acid, Rutin acid, Ellagic acid, Kaempferol, and Quercetin.

Gallic acid exhibited the highest quantities among the phenolic compounds found in cantaloupe waste (peels and leaves), with concentrations of 2.59 mg and 0.06 mg, whereas the lowest levels were recorded for Quercetin acid, measuring 0.03 mg and being non-detectable (ND), respectively. The extraction of both nonpolar and semipolar soluble phenolic acids might elucidate the rationale behind the higher phenolic acid contents observed in Gallic acid extracts.

Table (2): Fractionation of phenolic compounds in cantaloupeand cantaloupe leaves using HPLC

Phenolic compounds	Concentration(mg/100g) Percent	
	peels	**leaves**
Gallic acid	2.59	0.06
Chlorogenic acid	0.09	0.04
Caffeic acid	<LOD	<LOD
Syringic acid	<LOD	<LOD
Ferulic acid	0.08	2.00
Rutin	0.07	ND
Ellagic acid	0.49	ND
Kaempferol	0.33	0.66
Quercetin	0.03	ND
Isorhamnetin	<LOD	<LOD

ND= Not detected.

The data presented in Table (3) illustrate the mean Pancreas weight (PW) of diabetic rats given CPP, CLP, and their combinations. It's notable that the mean Pancreas weight (PW) in grams of the positive control group exceeded that of the negative control group, measuring 0.715 and 0.417 respectively. Among the diabetic rats consuming various diets, a significant decrease in mean values was observed compared to the positive control group, except in groups (3 and 4) which displayed values of (0.692, 0.620 0.572, 0.552, 0.529, and 0.412) for CPP 2.5%, CPP 5%, CLP 2.5%, CLP 5%, and mixtures 2.5% and 5% respectively. Groups (1 and 8) exhibited nonsignificant differences between them. Rats fed a mixture of the tested plant parts displayed the most notable reduction in organ weight compared to the negative control group. These results align with those observed by **Azusa *et al.*, (2020)** regarding the feeding of certain plants to diabetic

Table (3): Effect of Cantaloupe peels, Cantaloupe leaves and their mixtures as Powder on Pancreas weight of diabetic rats

Groups	Organ's weight (g/100 g. B.Wt.) Pancreas
Control negative (-)	0.417 ±0.07[d]
Control positive (+)	0.715 ±0.12[a]
G3 Rats + (2.5 % Cantaloupe peels)	0.692 ±0.06[ab]
G4 Rats + (5 % Cantaloupe peels)	0.620 ±0.13[abc]
G 5 (2.5 % Cantaloupe leaves)	0.572 ±0.05[bc]
G 6 (5% Cantaloupe leaves)	0.552 ±0.03[c]
Group 7(2.5% Mixture)	0.529 ±0.06[cd]
G 8 (5 % Mixture)	0.412 ±0.04[d]

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly different at $p \leq 0.05$.

The data presented in Tables (4) delineate the impact of CPP, CLP, and their combinations on the Insulin levels of diabetic rats. Alloxan-induced treatment in animals led to a significant increase ($p \leq 0.05$) in serum insulin concentration by approximately -86.45% compared to the normal control. Introducing 2.5% and 5% of the selected plant parts—CPP, CLP, and their mixture—into the rats' diets notably reduced this value by rates of 36.92%, 73.84%, 118.46%, 196.92%, 296.15%, and 453.84%, respectively. Notably, group 8 (5% mixture) exhibited the most favorable treatment outcome compared to the negative control group. These findings align with **Odekanyin *et al.*, (2023),** suggesting that the antioxidant properties of cantaloupe peel and leaves, along with their inhibitory effect against alpha-amylase, are measurable. Consequently, cantaloupe peel could potentially serve as a supplementary treatment for diabetes. However, a comprehensive in vivo investigation is imperative to assess the impact of these extracts and their bioactive constituents.

Furthermore, **Azusa *et al.*, 2020** showed the effect of cantaloupe peel and leaves, have potential to minimize human postprandial blood glucose levels.

Table (4): Effect of CPP, CLP and their mixtures on Insulinof diabetic rats

Groups	Insulin (mg/dl)
Control negative (-)	19.2 ±4.13 [a]
Control positive (+)	2.60 ±0.22 [f]
G3 Rats + (2.5 % Cantaloupe peels)	3.56 ±0.36[fe]
G4 Rats + (5 % Cantaloupe peels)	4.52 ±0.30[fe]
G 5 (2.5 % Cantaloupe leaves)	5.68 ±0.71[ed]
G 6 (5% Cantaloupe leaves)	7.72 ±1.42[d]
Group 7(2.5% Mixture)	10.3 ±1.55[c]
G 8 (5 % Mixture)	14.4 ±2.57[b]

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly different at $p \leq 0.05$.

The data presented in Tables (5) highlight the impact of CPP, CLP, and their combinations on Fructosamine and C-peptide levels in diabetic rats. Observing the mean Fructosamine value, the positive control group exhibited higher levels compared to the negative control group, measuring 4.92±0.27 and 1.95±0.18 mg/dl, respectively, indicating a significant difference between them. Notably, all diabetic rats fed on different diets showcased significant decreases in mean values compared to the positive control group. These values were 4.12±1.27, 3.82±0.43, 3.20±0.38, 2.70±0.41, 2.48±0.42, and 2.22±0.43 for CPP 2.50%, CPP 5%, CLP 2.5%, CLP 5%, and their mixtures (2.5 and 5%), respectively. Groups (3 and 4) as well as groups (6 and 7) exhibited non-significant differences between them. The most effective treatment was noted for group (8) (hyperglycemic rats fed on basal diet +5% mixtures), displaying results almost similar to the negative control group. Similar trends were observed for C-peptide levels. These findings align with **Azusa *et al.*, (2020),** suggesting that CPP and CLP have the potential to reduce human postprandial blood glucose levels. Additionally, several studies in the literature affirm that CLP and CPP exhibit positive effects on fructosamine and C-peptide levels through various mechanisms, as highlighted by **Bahare *et al.*, (2021).** These studies suggest that CPP and CLP possess capabilities in reducing diabetes-induced hyperglycemia and oxidative stress. The plant comprises diverse phytochemicals such as aromatic compounds, polyphenols, and phytosterols, known for their antioxidant, anticancer, antidiabetic, antibacterial, and antimutagenic effects. Furthermore, these results imply that the bioactive substances found in CPP and CLP encompass anti-inflammatory and hypoglycemic agents, antimicrobials, antigens, and antioxidants. However, it's evident from the data that consuming cantaloupe peels and leaves may assist in managing blood glucose levels in diabetic individuals. According to **Ricardo *et al.*, (2020),** CP and CL contain notably high levels of beneficial bioactive compounds across their components (pulp, peels, leaves, and seeds), encompassing carotenoids (α-, β-carotene, and β-cryptoxanthin), polyphenols (flavonoids and phenolic acids), and fatty acids (oleic, linoleic, and palmitoleic acid).

Table (5): Effect of CPP, CLP and their mixtures on fructosamine and c-peptide of diabetic rats

Groups	Fructsamine (mg/dl)	C-peptide (mg/dl)
Control negative (-)	1.95 ±0.18 [e]	1.10 ±0.15 [f]
Control positive (+)	4.92 ±0.27 [a]	4.42 ±0.46 [a]
G3 Rats + (2.5 % Cantaloupe peels)	4.12 ±1.27 [b]	3.48 ±0.56 [b]
G4 Rats + (5 % Cantaloupe peels)	3.82 ±0.43 [b]	2.64 ±0.35 [c]
G 5 (2.5 % Cantaloupe leaves)	3.20 ±0.38 [c]	2.12 ±0.31 [d]
G 6 (5% Cantaloupe leaves)	2.70 ±0.41 [d]	1.76 ±0.23 [de]
Group 7(2.5% Mixture)	2.48 ±0.42 [d]	1.48 ±0.22[ef]
G 8 (5 % Mixture)	2.22 ±0.43[ed]	1.30 ±0.34[ef]

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly different at $p \leq 0.05$.

Data obtained from Tables (6) demonstrates the impact of CPP, CLP, and their combinations on serum total cholesterol (T.C), serum triglycerides (T.G), serum high-density lipoprotein cholesterol (HDL-c), serum low-density lipoprotein cholesterol (LDL-c), and serum very low-density lipoprotein cholesterol (VLDL-c) in diabetic rats. Notably, the mean value of total cholesterol (T.C) in the positive control group was notably higher than that in the negative control group, measuring (207.0 and 94.6) respectively, indicating a significant difference between the two groups. In contrast, all diabetic rats fed on CPP, CLP, and their mixtures exhibited significant decreases in mean values compared to the positive control group. These values were (194.6, 179.4, 147.6, 126.8, 118.2 and 108.2) for CPP 2.50%, CLP 5%, CPP 2.5%, CLP 5%, and their mixtures (2.5 and 5%), respectively. Group (8) (5% mixture) emerged as the most effective treatment concerning triglyceride activity, showcasing significant differences compared to the negative control group. A similar trend was observed for LDL-c and VLDL-c, while HDL-c exhibited an opposite direction. These outcomes align with the findings of **Tomoyasu *et al.*, (2023)** indicating that inedible cantaloupe sites, such as peels and leaves, possess antihypertensive capabilities due to their content of GABA, Cit, Nit, antioxidants, ACE inhibitory action, and antioxidant capacity. Utilizing these underutilized resources from cantaloupe for novel health foods and various extractions, such as powders and organic solvents, seems promising. Additionally, **Nazeem *et al* (2016)** suggests that Cucumis peel (CP) methanolic and aqueous extracts exhibit significant reductions (P<0.01) in body weight gain and serum lipid profiles, including TC, TG, LDL-C levels, atherogenic index, while enhancing HDL-C levels.

Table (6): Effect of CPP, CLP and their mixtures on Total cholesterol, Triglycerides, HDL-c, LDL-c and VLDL-c (Mean ± SD) of diabetic rats

Groups	Total cholesterol (mg/dl)	Triglycerides (mg/dl)	HDLc. (mg/dl)	LDLc. (mg/dl)	VLDLc. (mg/dl)
Control negative (-)	94.6±3.20^{h}	51.8±8.89^{g}	73.6±5.45^{a}	10.6±6.36^{g}	10.3±1.77^{g}
Control positive (+)	207.0±10.9^{a}	147.2±6.30^{a}	27.8±5.40^{e}	149.7±13.08^{a}	29.4±1.26^{a}
G3 Rats + (2.5 % Cantaloupe peels)	194.6±7.30^{b}	132.2±4.81^{b}	30.6±5.59^{de}	137.5±3.86^{b}	26.4±0.96^{b}
G4 Rats + (5 % Cantaloupe peels)	179.4±7.30^{c}	121.6±9.28^{c}	33.6±4.21^{de}	121.4±2.94^{c}	24.3±1.85^{c}
G 5 (2.5 % Cantaloupe leaves)	147.6±5.27^{d}	101.6±5.07^{d}	37.8±5.76^{d}	89.4±10.11^{d}	20.3±1.01^{d}
G 6 (5% Cantaloupe leaves)	126.8±4.86^{e}	86.4±5.07^{e}	47.6±5.27^{c}	61.9±6.27^{e}	17.2±1.01^{e}
Group 7(2.5% Mixture)	118.2±6.05^{f}	74.8±5.31^{f}	52.6±9.23^{c}	50.6±13.58^{e}	14.9±1.06^{f}
G 8 (5 % Mixture)	103.2±2.88^{g}	67.6±7.92^{f}	60.6^{b}±4.97	29.2±7.63^{f}	13.5±1.58^{f}

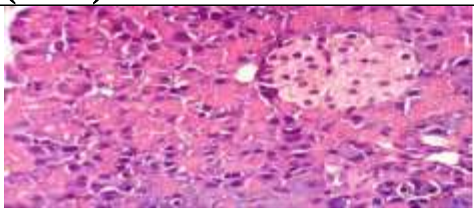
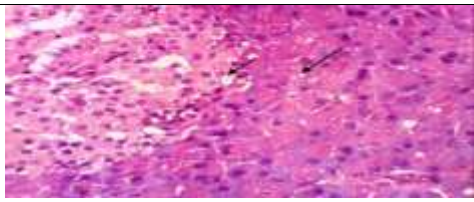
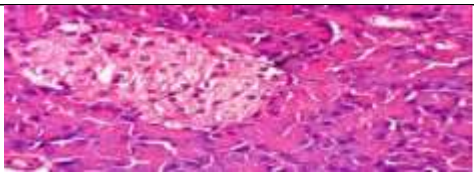
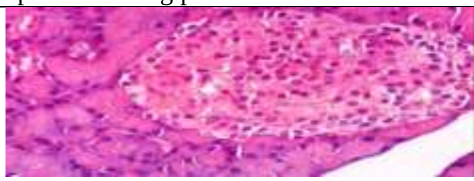
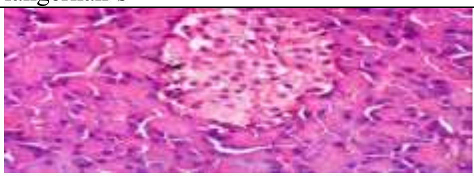
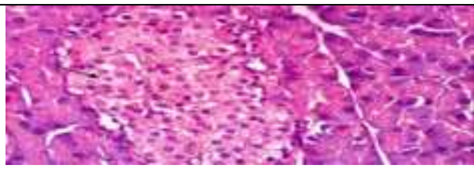
The data are presented as mean ± SD. Values in the same column with differing superscript letters indicate significant differences at p≤0.05.

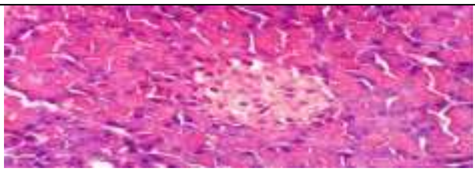
Moreover, **Dian *et al.*, (2019)** investigated the inhibition of ACE activity by the methanol extract obtained from C. melo var. cantalupensis leaves. They hypothesized that the presence of L-GSH (reduced) in the methanol extract from C. melo var. cantalupensis leaves might act as an antihypertensive agent by stimulating the GST pathway, known for its involvement in detoxification and radical scavenging. C-Histopathological results of hepatopathic rats fed on some plants diets:

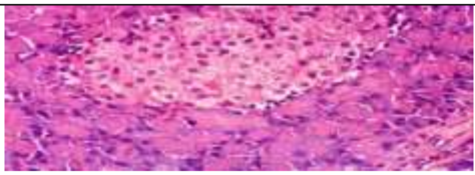
Histopathological investigation

The impact of a mixture of cantaloupe peels and leaves on the histological structure of diabetic rats was assessed.

The findings indicated that the control group rats displayed no pancreatic alterations. Conversely, the positive control group rats exhibited vacuolation in the cells of the islets of Langerhans and epithelial lining of pancreatic acini. However, rats treated with 2.5% and 5% cantaloupe peels displayed no histopathological changes. Similarly, those treated with 2.5% and 5% cantaloupe leaves did not exhibit any histopathological alterations. Moreover, the group receiving a diet consisting of a mixture of peels and leaves also showed no histopathological changes. These outcomes align with the findings of Ricardo ***et al.* (2020).**

 Pancreas of rat from group 1 (control "-") showing normal pancreatic acini and normal islets of langerhan's	 Pancreas of rat from group 2 (control "+") showing vacuolations of cells of islets of langerhan's as well as vacuolation of epithelial lining pancreatic acini
 Pancreas of rat from group 3 (2.5 % Cantaloupe peels diet) showing normal pancreatic acini and normal islets of langerhan's	 Pancreas of rat from group 4 (5% Cantaloupe peels diet) showing no histopathological alterations
 Pancreas of rat from group 5 (2.5 % Cantaloupe leaves diet) showing vacuolations of some cells of islets of langerhan's	 Pancreas of rat from group 6 (5 % Cantaloupe leaves diet) showing vacuolations of some cells of islets of langerhan's


Pancreas of rat from group 7 (2.5 % Mixture peels and leaves diet) showing no histopathological alterations


Pancreas of rat from group 8 (5 % Mixture peels and leaves diet) showing no histopathological alterations

Conclusion

In summary, the current study's data highlights the effectiveness of the chosen plant components—CPP, CLP, and their blend—in partially improving hyperglycemia and its associated complications in diabetic rats. These positive outcomes can be attributed to the abundant presence of various bioactive compounds within these tested plant parts, showcasing potent antioxidant properties. These antioxidants significantly impacted parameters such as Pancreas weight, Insulin levels, Lipid profiles, C-peptide, and fructose amine in diabetic rats. These findings offer a foundation for considering the utilization of these selected plant components for preventing and managing type-2 diabetes.

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التأثير المحتمل لمخلفات الشمام (القشور والأوراق) على تحسين وظائف البنكرياس في الفئران المعالجة بالألوكسان

هدف الدراسة الأساسي هو استكشاف التأثير المحتمل لدمج مسحوق قشور وأوراق الشمام، بالإضافة إلى مزيجها، في الوجبات الغذائية لتخفيف المضاعفات المرتبطة بارتفاع السكر في الدم الناجم عن الألوكسان في الجرذان المصابة بالسكري. تم استخدام 48 فأرًا أبيضًا ذكرًا، بوزن 150±10جم، وتم تقسيمهم إلى مجموعتين أساسيتين. المجموعة الأولية من 6 فئران وكانت بمثابة مجموعة مراقبة سلبية (-ve)، يتم تغذيتها بالنظام الغذائي الأساسي. تم حث الفئران الـ 42 المتبقية على الإصابة بمرض السكري من خلال حقن الألوكسان وتم تقسيمها إلى سبع مجموعات فرعية متساوية. استمرت المجموعة الثانية في تغذيتها بالنظام الغذائي الأساسي وكانت بمثابة المجموعة الضابطة الإيجابية (+ve). تم تزويد المجموعات الست المتبقية بالنظام الغذائي الأساسي المدعم بنسبة 2.5% و5% من مسحوق قشور وأوراق الشمام، بشكل منفصل أو مجتمع. أدى إعطاء الألوكسان للحيوانات إلى زيادة معنوية (p<0.05) في تركيز الأنسولين في الدم، مسجلاً ارتفاعاً بنسبة 86.45% مقارنة بالضوابط الطبيعية. ومع ذلك، فإن استكمال النظام الغذائي للفئران بنسبة 2.5% و5% من المكونات النباتية المحددة - CPPوCLP ومزيجها - أدى إلى انخفاض في هذه القيمة بنسبة 36.92%، و73.84%، و-118.46%، و196.92%، و296.15%، و453.84% على التوالي. وقد لوحظت أنماط مماثلة في C-peptide، fructose amine، TC، triglycerides، وHDL-c، وLDL-c، VLDL-c والتغيرات النسيجية المرضية في البنكرياس لدى الجرذان المصابة بداء السكري الناجم عن معدلات متباينة بسبب النظام الغذائي. المكملات مع المكونات النباتية التي تم فحصها. تنبع هذه التأثيرات في المقام الأول من الأنشطة المضادة للأكسدة القوية الموجودة في هذه الأجزاء النباتية، وذلك بسبب محتواها العالي من المركبات النشطة بيولوجيًا. تضع هذه الاكتشافات الأساس للنظر في استخدام CPP وCLP في علاج المضاعفات الناجمة عن مرض السكري من النوع الثاني.

الكلمات المفتاحية:
الشمام، ارتفاع السكر في الدم، وزن الأعضاء، الأنسولين، السي بيبيتيد والفركتوز أمين.