Biological Activities of Passion fruit (Passiflora Edulis L.) in Impediment of Alloxan Induced Cataract in Rats

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Abstract:

Background: Symptoms of diabetes affect vision, and high levels of blood glucose draw fluid from tissues, including the lenses of the eyes. The aim of this study is to study the chemical and biological properties of Passion fruit as a protective effect on oxidative stress, blood sugar level, insulin sensitivity, HOMA-index, lipid profile, and cataract formation in alloxan-induced diabetic rats.

Methods: Twenty-eight male rats were randomly divided into 4 groups (7 rats in each group). groups were divided into a negative (-ve) control group, positive control (+ve), and 2 groups. All groups were injected with alloxan (120 mg/kg body weight) except a negative (-ve) control group. The first and second groups were fed on a basal diet, while treated groups (3&4) were fed on a basal diet and given orally 2 and 4 ml of concentrated Passion fruit juice/ day, respectively.

Results: The results of the analysis of phenolic compounds showed a high amount of rutin, trans-cinnamic, and p-coumaric acids in Passion fruit . After 8 weeks of the biological experiment, the animals treated with Passion fruit juice showed a significant decrease in the level of blood glucose, insulin, BMI, HOMA-index of triacylglycerols, total cholesterol, LDL-C, VLDL-C, Lipid peroxidation in blood and lens, and a significant decrease in the concentration of lens Fas ligand compared with the positive control (+ve). Also, the treated groups showed a significant increase in the level of HDL-C, glutathione ,the activity of superoxide dismutase , and a significant decrease in the levels of nitric oxide concentration. Slit lamp examination revealed that supplementation with levels at 2 and 4 ml of

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Passion fruit juice delayed the progression and maturation of cataract in the treated groups compared the positive control (+ve).

Conclusion: The importance of consuming Passion fruit is due to its preventive effect which reduces the complications of diabetes and the formation of new blood vessels in the retina of the eye. The current study recommends the inclusion of Passion fruit juice in our daily dishes, beverages, and pharmaceutical compounds.

Key words*:* Cataracts- *Passiflora edulis* - HOMA-index - Body mass index - lens proteins.

INTRODUCTION

Passion fruit ***(Passiflora edulis L.)*** cocktail tree or Miss Flora is called cocktail fruit, and it is a fruit that combines several flavors and shapes at the same time, as it combines citrus, mango, and pomegranate with many fruits, so it can be used in large fruits, easy to use and quickly, and it is one of the climbing trees. The Cocktail tree or Miss Flora is one of the oldest trees on earth (**Eliza et al., 2019**).

It is an aromatic fruit with a sweet sour flavor. This fruit is native to the subtropical regions of South America and is said to have originated in Paraguay. It is oval in shape and soft on the inside, filled with many seeds. Generally, there are two main varieties of Miss Flora fruits, yellow and purple, yellow fruits are usually larger than purple but purple fruit pulp is less acidic and has a richer aroma and flavor. Moreover, the purple fruit has a high content of juice pulp (**Gil et al., 2014)**. This fruit can be eaten as is or it can be juiced. Its juice is often added to other fruit juices to enhance its aroma. Passion fruit has amazing healing properties and aroma. It has a strong calming effect. Low in fat and an extraordinary source of vitamin A, vitamin C, iron, dietary fiber, potassium, carbohydrates ,and proteins, this fruit can fulfill almost all needs. On a daily basis, even its seeds are edible and highly nutritious (**Nadeem et al., 2020)**. It is a great source of vitamins C and A. Vitamin C boosts the immune system, thus protecting the body from various types of cancer and heart disease **(Jeong et al., 2017).** Vitamin A improves vision and protects against many diseases, and infections, This

plant is a mild sedative that helps in the treatment of easily nervous children, bronchial asthma, nervous digestive disorders, and menopausal problems. Passion fruit is also useful in treating chronic allergy symptoms and facilitates recovery of sick liver and kidneys, as well as boosting immunity and the strength of antibodies in the blood. Also,it has anti-cancer properties because it contains carotenoids and polyphenols present in the fruit are powerful antioxidants that can inhibit the growth of cancer cells. Promotes relaxation, treat insomnia, treat digestive problems , infectious diseases, relieve osteoporosis, treat anemia , cardiovascular disease, and reduce weight (**Jiaet al., 2018).**

Cataracts in the eye is the presence of opacity in the crystalline lens of the eye located behind the pupil resulting in increased blurring of vision without pain, the leading cause of blindness globally and one of the most prevalent eye diseases, events that lead to a loss of transparency in both cortical lens tissues Nuclear is the oxidation of membrane lipids, enzymatic or enzymatic proteins and DNA by peroxidase or free radicals caused by ultraviolet radiation, especially type B. falling and feeling depressed. Cataracts cause nearly 50% of blindness and 33% of visual impairment in the world. It is often caused by age, and can also be caused by trauma, radiation, and surgery due to other eye problems. A person may be born with cataracts **(Kyselova et al; 2004; and Shamsul et al., 2016).**

Adiabetic cataract is one of the major complications of diabetes**,** which affects most patients. Cataract genesis is one of the early secondary obstacle of diabetes mellitus which**,** is a severe metabolic disorder characterized by hyperglycemia. Cataracts may cause blindness in diabetic patients **(Chung et al., 2013).**

There are molecular mechanisms that seem to be involved in the development of diabetic cataracts: Non-enzymatic glycation of lens proteins, oxidative stress,and activated polyol pathway. In addition, glucose auto-oxidation, and the interaction between glycated products and their receptors, all are potential sources of hyperglycemia-induced oxidative stress **(Mohammad and Siamak, 2008).** The present study aimed to

analyze the effect of Passion fruit juice on blood glucose, insulin sensitivity, lipid profile, the oxidative stress induced by diabetes , and protection against cataract development in diabetic rats.

MATERIALS AND METHODS

Materials:

Passion fruit **(*Passiflora Edulis L.)*** were purchased from a local market in Cairo, Egypt.

Alloxan: Alloxan used was obtained from Hoffman La'roch Company. Alloxan has been used to produce diabetes in experimental animals by destroying the insulin-secreting islet cells of the pancreas (**Szkudelski, 2001).**

Experimenatal Animals and diet: Twenty-eight weanling male Sprague-Dawley rats weighing 80-90 g (at the age of 4 weeks) were purchased from the Giza Memorial Institute for Ophthalmic Research, Animal

House, Ministry of Health, Giza, Egypt. The animals were acclimatized for a1week before dietary manipulation and were housed individually in metallic cages under laboratory healthy conditions. The basal diet was prepared in accordance with AIN-93 formulation **(Reeves et al., 1993).**

Methods:

Preparation of Passion fruit **juice:** Whole fresh fruits were sorted, (1 kg of Passion fruit, about 10) and employed in the drink preparation but with some modifications (Peckham and Gladys, 1974). The healthy ripe fruit was washed and the bark removed. It was cut into four parts and weighed 752g of it was macerated in 1000 ml of water. This was juice followed by filtration to get the concentration. Using a centrifuge (3000 rpm for 10 min) to remove hard fibers and seeds. Aliquots of the supernatant were stored frozen at −20°C for the subsequent chemical analysis. For the biological experiment, the juice was concentrated to one-

fifth of the volume by lyophilization then aliquots were kept frozen at −20°C until used **(Gyamfi et al., 2011)**.

Total phenolic content: A weighed amount of sample extract (between 50 and 130 mg depending on the sample) was dissolved with acidified methanol (10 mL, 1% formic acid). The extract was kept at −20 °C in the dark before analysis. The content of phenolic compounds was determined using the Folin-Ciocalteu method; based on the reduction of phosphotungstate-phosphomolybdate complex by total phenols or phenolic content to a blue reaction product that absorbance was measured at 760 nm according to **Singleton and Rossi (1965).**The data were calculated according to the standard curve of catechin (0.01–0.20 mg/mL) and were expressed as mg of catechin equivalents (CE) per gram of extract.

HPLC-ESI-MS/MS analysis of phenolic compounds were analyzed using a Water 2695 Alliance separation module equipped with a Micromass Quattro Micro API mass spectrometer fitted with an electrospray interface (ESI) (Waters, Milford, MA, USA). A preliminary investigation on phenolic profiles of selected plants was carried out by means of MS scan analysis, operating in negative ion mode from 100 to 1000 mass-to-charge ratio (m/z). Then, different Multiple Reaction Monitoring (MRM) methods were developed for all sample types, based on the obtained MS scan data. Separations were performed using a Waters Atlantis dC18 3 µm (2.1 × 150 mm) reverse phase column (Waters), with the mobile phase, pumped at a flow rate of 0.17 mL/min. The mobile phase was a 30-min linear gradient of 5 to 30% acetonitrile in 1% aqueous formic acid. The ESI source worked in negative ionisation mode. Source temperature was 120 °C, desolvation temperature was 350 °C, capillary voltage was 2.8 kV, cone voltage was 35 V, desolvation gas (N2) 750 L/h, cone gas (N2) 50 L/h. The collision energy for MS/MS identifications was set at 30 eV, and the collision gas used was argon.

Total antioxidant capacity: Passion fruit extract was analyzed for their antioxidant capacity by three different assays: 2,2′-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) radical-scavenging activity (ABTS

method) (**Pellegrini et al., 2003),** ferric reducing antioxidant power (FRAP) assay, (**Benzie and Strain, 1999)**, and total radical-trapping antioxidant parameter (TRAP) assay (**Ghiselli et al., 1995).**

Induction of diabetes: The experiment was performed in Animal at the Giza Memorial Institute for Ophthalmic Research, Animal House, Ministry of Health, Giza, Egypt.

. All rats were fed for one week prior to the beginning of the experiment on the basal diet, then injected with alloxan (120 mg/kg body weight) to induce diabetes in rats(**Szkudelski, 2001)**.

Experimental Design: Twenty-eight Male rats were randomly assigned into four groups (group= 7 rats) as follows:

Group I: Control group (- ve): normal control rats received a basal diet.

Group II: Control group (+ ve): positive control received basal diet and injected with alloxan (120 mg/kg body weight).

Group III: Diabetic rats with cataract fed on basal diet and treated with 2 ml concentrated passion juice/day/rat).

Group IV: Diabetic rats with cataract

fed on basal diet and treated with 4 ml concentrated : Passion juice/day/rat). Freshly prepared alloxan was administered by a single intraperitoneal injection of 120 mg/kg body weight. The diabetic state was confirmed by the measurement of blood glucose concentration after 3 days of alloxan injection using blood samples from the eyes. Animals with blood glucose levels of less than 165 mg/dl were excluded. Eyes were examined every week using a slit lamp biomicroscope on dilated pupil to investigate the lenticular opacity. At the end of the experiment (8 weeks), all rats were fast, and blood samples were taken from the eyes under ether anesthesia for biochemical analysis. The eyes were enucleated then the lenses were excised, carefully decapsulated and washed in 0.15 M isotonic sodium chloride solution. Lens homogenate was them prepared. Samples were kept in a deep freezer at −20°C until used.

Anthropometric measurements: The body weight of each animal was measured three times a week. The amount of food consumed by each animal was weighed three times a week. The length of the animals was determined once a month by measuring the naso-anal distance **Angeline *et al.*, (2006)**. Body mass index (BMI) was estimated once a month by the formula:

BMI = body mass (g) / (naso-anal distance (cm))2

Biochemical Parameters: Fasting serum insulin was measured using the ultrasensitive rat insulin ELISA according to **Thorell and Lanner (1973)** Insulin resistance was measured by the homeostasis model assessment of insulin resistance (HOMA-IR) calculated as the following formula: insulin (μU/mL) × glucose (mg/dl)/405 (**Matthews et al., 1985**). Concentrations of serum TG, TC, and HDL were determined enzymatically according to the colorimetric method of **Fossati and Prencipe (1982), Allain (1974), and Burstein et al. (1985) ,** respectively. Serum LDL value was calculated according to the equation of Friedewald **et al. (1972)**, [LDL=TC-(HDL + TG/5)]. Glucose was determined in serum as described by Change: **Howanitz and Howantiz (1984) .**Reduced glutathione (GSH) was determined in blood and lens according to **Beutler et al. (1963)**. Serum and lens superoxide dismutase activity (SOD) assessed by the method of **Marklund and Marklund (1974)** and nitric oxide (NO) according to **Moshage et al. (1995)**. Lens Fas ligand (FasL) was assessed as described by **Tanaka et al.(1996)**. Serum and lens lipid peroxidation as malondialdehyde (MDA) was determined according to the method of **Draper and Hadley (1990).**

Statistical analysis:

The obtained results were statistically analyzed according to statistical analysis system SAS User's Guide, **SAS (1999**). LSD at 5% level of significance was used to compare between means according to **Snedecor and Cochran (1980).**

RESULTS AND DISCUSSION

The results of the antioxidant activity of Passion fruit methanolic extract (Table 1) reveals the potent antioxidant activity represented by FRAP (1348.52 µmol Fe++/g) and TRAP (719.90 µmol TE/g) assays. The phytochemical screening of Passion fruit methanolic extract using HPLC-ESI-MS/MS analysis showed the presence of different phenolic compounds including quercetin, 4-hydroxybenzoic, caffeic acid , *p*-coumaric acids, β-carotene, rutin, and *trans*- cinnamic compounds as indicated by the retention times (tR/min) and maximum absorption (λmax/nm) of the phenolic acids standards (Table 2).

The data in Table (2) indicated hat the Passion fruit is a rich source of natural antioxidants. Passion fruit contained flavonoids, tannins, iridoids, and diterpenoids, which showed different pharmacological properties (**Tsao, 2010 ; Nadeem et al., 2020**).

The phytochemical screening revealed the presence of different phenolic compounds including gallic acid, chlorogenic acid, 4-hydroxybenzoic acid, rutin, caffeic acids , vanillic**,** and P- coumaric compounds (**Tal et al., 2016)**. Based on the obtained data, the Passion fruit has antioxidant activity, related to the remarkable phenolic content which ,promotes possible health benefits,thus it can serve as an excellent natural source of antioxidant agents.

Table (1): Antioxidant activity of fruit extract

Antioxidant assay	FRAP (µmol Fe++/g)	TRAP (µmol TE/g)
Passion fruit	1348.52	719.90

FRAP: Ferric reducing antioxidant power

TRAP: total radical-trapping antioxidant parameter

Table (2): Retention times (tR/min) and maximum absorption (λmax/nm) of the phenolic standards and their correlation with the compounds of in Passion fruit.

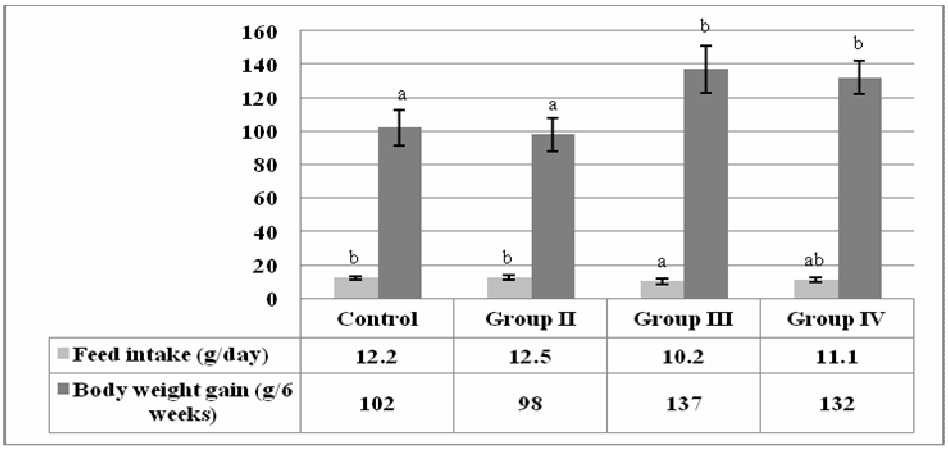
phenolic compound	**RT /min**	**λmax/nm**
4-hydroxybenzoic	9.3	31.47
caffeic acid	15.3	45.99
p-coumaric acids	17.9	87.11
β-carotene	18.5	31.21
Rutin	19.3	390.20
trans-cinammic	20.1	258.16
Quercetin	21.3	43.11

Analysis of the nutritional status indicators (Fig 1 & 2) revealed that the differences in feed intake, body weight gain, and body mass index (BMI) between rats belonging to different study groups except for group III treated with 2 ml Passion fruit juice group, which a showed significant ($p<0.05$) reduction in feed intake in addition to a significant ($p<0.05$) increase in body weight gain as well as the final BMI when compared to the control and group +ve.

Although the final BMI of group III was significantly ($p<0.05$) higher than group IV, the difference in both feed intake,and body weight gain was non-significant ($p>0.05$) indicating in other groups slight the effect of Passion fruit juice in decreasing the BMI in overweight rats.

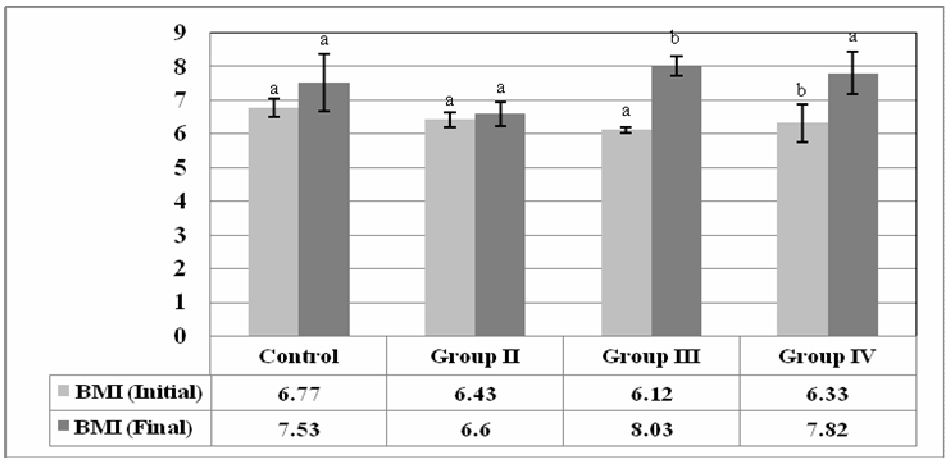
The effect of Passion fruit juice on the BMI and weight gain is controversial, results showed significantly ($p<0.05$) low final BMI in diabetics rats treated with 4 ml Passion fruit juice/day/rat (group IV) when compared to the treated with 2 ml Passion fruit juice/day/rat (group III) although the weight gain difference was Non-significant ($p>0.05$). This indicates the minor effect of fruit juice on lowering the BMI and weight gain. On the other hand, weight gain was reported as a rare side effect of

Passion fruit juice consumption **(Brownlee, 2014 ; LeBlanc and LeBlanc, 2021).**



	Control	Group II	Group III	Group IV
Feed intake (g/day)	12.2	12.5	10.2	11.1
Body weight gain (g/6 weeks)	102	98	137	132

Fig. (1): Effect of Passion fruit juice on feed intake and body weight gain in male rats, the values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at p<0.05 and vice versa.



	Control	Group II	Group III	Group IV
BMI (Initial)	6.77	6.43	6.12	6.33
BMI (Final)	7.53	6.6	8.03	7.82

Fig. (2): Effect of Passion fruit juice on BMI (g/cm2) in male rats, the values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at p<0.05 and vice versa.

The results in (Fig. 3) showed the blood glucose level in both rats treated with 2 and 4 ml Passion fruit juice/day/rat (group III and group IV) was significantly ($p<0.05$) higher than that in group (+ve) and the control group. However, the blood glucose level treated with 4 ml Passion fruit juice/day/rat (group IV) was significantly ($p<0.05$) lower than that of group III indicating the antihyperglycemic effect of the level 2 ml Passion fruit juice.

The result of other study indicated that decreasing the blood glucose concentration of diabetic rats by A. muricata treatment is due to the regeneration/proliferation in the pancreatic β-cells (**Shinpei et al., 2022**). Another study showed that the antidiabetic activity of Passion fruit can be explained by its hypolipidemic effect, antioxidant content, and protective action on pancreatic β-cells. these previous properties improve glucose metabolism. The serum insulin level was significantly ($p<0.05$) reduced only in treated with 4 ml Passion fruit juice/day/rat group IV (Fig. 4), despite the presence of high glucose level when compared to the other groups while no significant ($p>0.05$) difference in HOMA-index when compared to group +ve and the control group (Fig 5). In addition, HOMA-index was significantly ($p<0.05$) higher in group III when compared to the other groups which indicate the effect of Passion fruit juice on increasing the insulin sensitivity.

The diabetes rats for 8 weeks led to the development of hyperglycemia with a highly significant ($p<0.05$)increase in serum glucose, insulin, and HOMA-index treated with 2 ml concentrated Passion fruit juice/day/rat (group III). The obtained data showed a significant ($p<0.05$) decrease in blood glucose, serum insulin, and HOMA-index in treated with 4 ml Passion fruit juice/day/rat treated rats (group IV), when compared with the hyperglycemic rats (group III) while no hypoglycemic effect was observed In normal and positive rats groups (Group I and group II) .

The possible mechanism of Passion fruit antihyperglycemic action may be through variety of mechanisms such as acting like insulin, modifying glucose utilization and enhancing blood glucose transport to the

peripheral tissues **(Jia et al., 2018)**. This fruit is low in calories, sodium, and fat but high in fiber content, carbohydrates, and natural sugars. 100 grams provides only 97 calories. These nutrients are effective in lowering cholesterol levels in the body. The positive effect of antioxidant supplementation on the HOMA index has shown in healthy individuals (Kahlile et al., 2020).

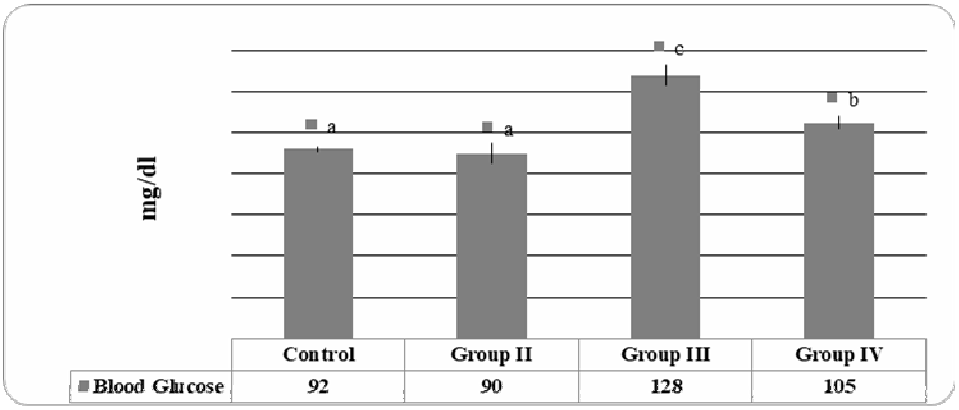


Fig. (3): Effect of Passion fruit juice on blood glucose in male rats, the values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at p<0.05 and vice versa.

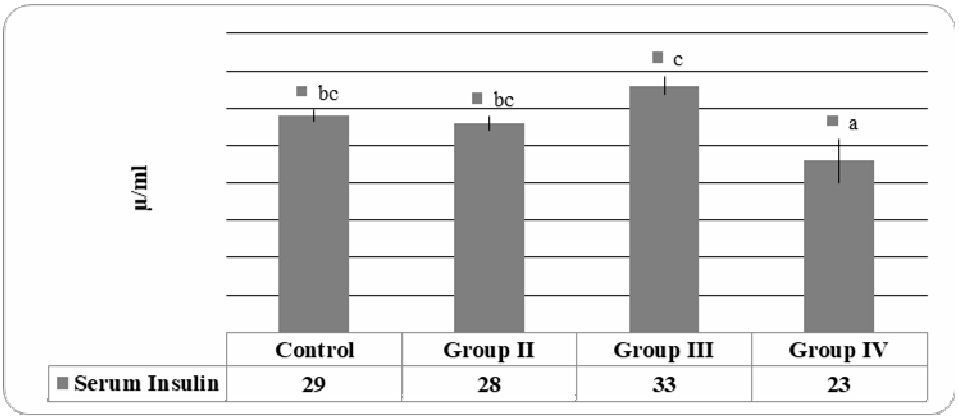


Fig. (4): Effect of Passion fruit juice on serum insulin in male rats, the values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at p<0.05 and vice versa.

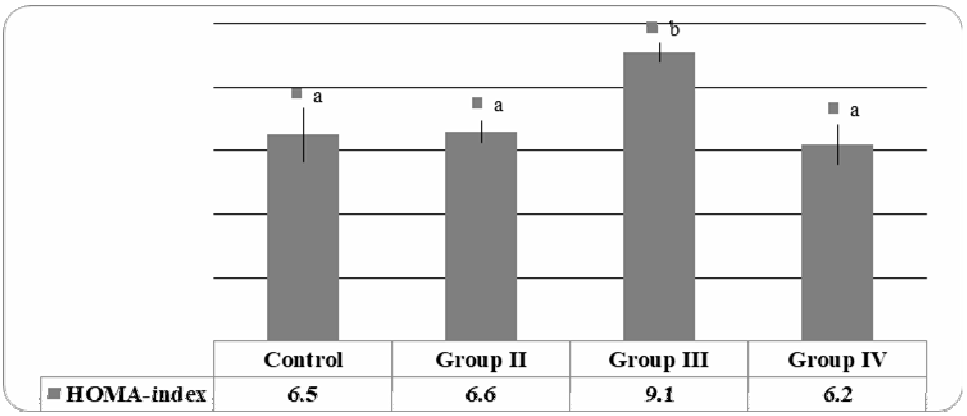
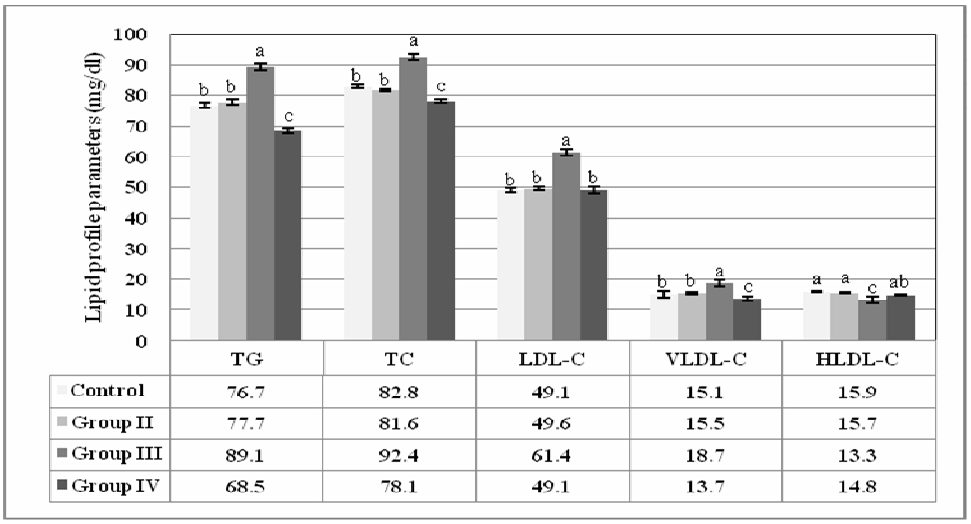


Fig. (5): Effect of Passion fruit juice on HOMA-index in male rats, the values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at p<0.05 and vice versa.



	TG	TC	LDL-C	VLDL-C	HLDL-C
Control	76.7	82.8	49.1	15.1	15.9
Group II	77.7	81.6	49.6	15.5	15.7
Group III	89.1	92.4	61.4	18.7	13.3
Group IV	68.5	78.1	49.1	13.7	14.8

Fig. (6): Effect of Passion fruit juice on serum lipid profile in male rats, the values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at p<0.05 and vice versa, TG: Triglycerides, TC: Total cholesterol, HDL-c: High density lipoprotein cholesterol, LDL-c: Low density lipoprotein cholesterol, VLDL-c: Very Low density lipoprotein .

Lipid profile analysis (Fig. 6) revealed that treated with 2 ml concentrated Passion fruit juice/day/rat (group III) has significantly ($p<0.05$) the highest levels of Triglycerides , total cholesterol, LDL-C, and VLDL-C while having the lowest level of HDL-C, This means the negative effect of 2 ml concentrated Passion fruit juice/day/rat (group III) on the lipid profile in diabetic rats. On the other hand, group IV has significantly ($p<0.05$) the lowest levels of Triglycerides, total cholesterol, and VLDL-C while having the highest level of HDL-C although the LDL-C level was similar to that in group (+ve) and the control group (-ve) (non-significant difference). The results indicate the great effect of Passion fruit juice in the control of lipidemia. These results are in agreement with **Juliana et al.** (**2018)** who reported that could reverse the hyperlipidemia in experimental diabetic rats, and thus may lead to a decrease in the risk of micro- and macrovascular disease and related complications. Passion fruit treatment could significantly decrease the serum triglyceride, total cholesterol and LDL cholesterol levels compared to diabetic control groups. Passion fruit treatment was able to improve serum lipid metabolites of diabetic rats, including decreasing the levels of triglyceride, total cholesterol, LDL cholesterol, and increasing the level of HDL cholesterol. Passion fruit contains dietary fiber that provides the body with several health benefits. It may help lower blood cholesterol levels, reduce elevated insulin levels, and reduce the risk of metabolic syndrome (**Milena et al., 2020**).

The results indicate that injected alloxan induces a significant increase in the levels of nitric oxide (NO) and lipid peroxidation in blood and lens and the concentration of lens Fas-L, while the level of reduced glutathione (GSH) and the activity of the antioxidant enzyme superoxide dismutase (SOD) decreased significantly in positive group (+ve) when compared to control group (- ve) (Tables 1 and 2).

As shown in table (1), the treatment with different doses of 2 and 4 ml concentrated Passion fruit juice/day/rat (groups III and IV), significantly ($p<0.05$) decreased serum glucose levels compared with diabetic cataract (+ve) group. Treatment with different levels of Passion fruit juice increased significantly ($p<0.05$) GSH and SOD activity in both blood and lens in 3

and 4 groups which were given orally 2ml, and 4ml concentrated juice/day/rat ,respectively. On the other hand, the results of NO concentration in blood and lens show a significant decrease in all treated groups compared with the positive control group (group 2) (Tables 1 and 2). In the line with this study, **Nadeem et al. (2020**) found that phenols and flavonoids which may have a major role in reducing oxidative stress associated with diabetes. Thus the observed antidiabetic activity of Passion fruit in our study may be attributed to the antioxidant property of the plant **(Jeong et al., 2017 ; Eliza et al., 2019).**

The data in tables 1and 2 showed that in both blood and lens the treatment with different doses of Passion fruit juice significantly ($p<0.05$) decreased lipid peroxidation MDA in all treated groups compared with cataract diabetic control group. The best results were observed in groups 3 and 4 (given 2 ml and 4 ml juice /day / rat) which revealed no significant ($p>0.05$) differences between them but significant ($p<0.05$) when compared with the control group (-ve). On the other hand, Passion fruit could significantly ($p<0.05$) decrease the total oxidant capacity and increasing the total antioxidant capacity as shown in treated groups when compared to group (+ve) and their level has nearly reached that in the control group (-ve).These results confirm the antioxidant effect of Passion fruit. As mentioned previously, the free radical scavenging activity of Passion fruit may be due to certain chemical constituents such as polyphenols or terpenes which possess good oxygen radical scavenging potential **(Eliza et al., 2019)**.

Table (1): Effect of level Passion fruit juice treatment on blood reduced glutathione (GSH**), superoxide dismutase (**SOD**), nitric oxide (**NO**)and lipid peroxidation as malondialdehyde (**MDA**) in diabetic rats and cataract groups**

Parameters / Groups	**GSH mg/dl**	**SOD U/ml**	**NO µmol/L**	**MDA nmol/mL**
Control	92.05± 2.97a	1.49± 0.15 a	2.83± 0.13b	1.68± 0.27c
Group II	51.81± 2.85c	0.32± 0.04 c	4.13± 0.32a	5. 82± 0.03a
Group III	88.25± 8.83b	0.98± 0.21b	3.04± 0.21b	4.01± 0.06b
Group IV	89.45± 15.24 ab	1.12± 0.23a	2.63± 0.22b	2.34± 0.24b

The values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at $p<0.05$ and vice versa.

Table (2): Effect of level Passion fruit juice treatment on c (FAS-L**), reduced glutathione(**GSH**), superoxide dismutase (**SOD**), nitric oxide (**NO **)and lipid peroxidation as malondialdehyde (**MDA**) in diabetic rats and cataract groups**

Parameters / Groups	**FAS-L Lens Pg/ml**	**GSH Lens mg/dl**	**SOD U/mg lens protein**	**NO µmol/mg lens protein**	**MDA nmol/mg lens wt.**
Control	375± 18.9 d	89.76± 9.18 a	127.43± 8.31a	2.49± 0.01c	1.83± 0.01 c
Group II	657± 12.4a	23.98± 2.01d	78.07± 5.26 c	4.11± 0.06 a	3.58± 0.32 a
Group III	433± 22.8 b	67.42± 6.81b	100.17± 9.07b	2.88± 0.04b	1.62± 0.04b
Group IV	428± 17.0 c	71.23± 9.27b	109.83± 8.21 ab	2.78± 0.02b	1.59± 0.06 b

The values are expressed as mean ± SEM (n= 7 rats/ group). The different letters means that there is a significant difference between groups at $p<0.05$ and vice versa.

Table (2) showed that Fas-ligand in the lens which is a biomarker of apoptosis increased significantly ($p<0.05$) in diabetic cataract (+ve) control group, while there was a significant reduction in all treated groups than (+ve) control. The examination of the eyes using a slit lamp biomicroscope on the dilated pupil to investigate the lenticular opacity revealed that the Passion fruit juice treatments delay the formation of cataract.

The results of the present study show that daily treatment with concentrated Passion fruit juice especially at levels 2 and 4 ml/day reduces oxidative damage and greatly improves the antioxidant stress status in diabetic cataracts rats. The experimental evidence includes remarkable significant reductions in both serum and lens markers of oxidative damage to lipids, such as MDA, and improvement in the oxidative status of blood and lens GSH, and SOD activity. Dietary antioxidants are important in retarding cataractogenesis. **Nadeem et al. (2020**). This may reflect the spread of cell wall death. Elevated status of apoptosis and hyperglycemia is a marker associated with diabetic cataract, it was also reported that Passion fruit may inhibit apoptosis, and slit lamp examination showed that Passion fruit supplementation delayed cataract development and maturation in the treated groups compared to the positive control (+ve) (group II), which developed subcapsular cataracts.

CONCLUSION

In diabetes mellitus, various reactive oxygen species ROS can be generated in the lens through many pathways. From the obtained results, it seems that Passion fruit juice could induce inhibitory effects on inflammatory such as on blood and lens (FAS-L), GSH, SOD , NO, and lipid peroxidation level. It also can improve the BMI blood sugar level, insulin sensitivity, HOMA-index, and lipid profile hyperglycemia control, and the total antioxidant capacity with relieving oxidative stress. Therefore, the consumption of Passion fruit juice could be beneficial for the control of protective action against cataract and diabetic complications.

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التأثيرات الحيوية لفاكهة الباشن فروت في منع تكوين المياة البيضاء المستحث بالألوكسان في الفئران

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الملخص العربي:

الخلفية: تؤثر أعراض مرض السكري على الرؤية ، و المستويات المرتفعة من الجلوكوز في الدم تؤدي إلى سحب السوائل من الأنسجة ، بما في ذلك عدسات العين. الهدف من هذه الدراسة هو دراسة الخواص الكيميائية والبيولوجية لفاكه الباشن على الوقاية من الإجهاد التأكسدي ومستوى السكر في الدم وحساسية الأنسولين ومؤشر مقاومة الأنسولين ونسبة الدهون وإعتام عدسة العين في الفئران المصابة بداء السكري الناجم عن الألوكسان.

الطريقة: تم تقسيم ثمانية وعشرون من ذكور الفئران بطريقة عشوائية الى اربع مجموعات (كل مجموعة تحتوى على سبع فئران) وذلك على النحو التالى : مجموعة ضابطة سالبة، مجموعة ضابطة موجبة، ومجموعتان اخرتان . كل المجموعات تم حقنهما ١٢٠ مليجرام من الالوكسان / كجم من وزن الجسم ما عدا المجموعة الضابطة السالبة. تم تغذية المجموعتان الأولى والثانية على الوجبة القياسية، بينما تغذت المجموعتان الثالثة والرابعة على الوجبة القياسية مع إعطاء الفئران جرعة يومية عن طريق الفم تساوى ٢ و٤ مل من عصير فاكهه الباشن المركز على التوالي

النتائج: أظهرت نتائج تحليل المركبات الفينولية لفاكهة الباشن فروت أعلى نسبة من rutin, *trans*-cinammic and *p*-coumaric acids. وبعد ثمانية اسابيع من التجربة البيولوجية اوضحت النتائج البيولوجية ، ان المجموعات التي عولجت بعصير فاكهة الباشن فروت سجلت انخفاضًا ملحوظًا في مستوى الجلوكوز في الدم ، والأنسولين ، ومؤشر كتلة الجسم ، و مؤشر مقاومة الأنسولين و الجلسريدات الثلاثية ، والكوليسترول الكلي ، و LDL-C ، و VLDL-C ، وبيروكسيد الدهون في الدم وعدسة العدسة ، وأيضا انخفاض معنوي في تركيز lens Fas ligand، مقارنة بالموجبة الضابطة الموجبة (+ ve). كما أظهرت المجموعات المعالجة زيادة معنوية في مستوى HDL-C ,الجلوتاثيون ونشاط فائق الأكسيد ديسموتاز وانخفاض معنوي في مستويات تركيز أكسيد النيتريك. كما أظهر الفحص بالمصباح الشقي أن تناول المكملات بمستوى (٣ و ٤ مل) من عصير فاكهة الباشن فروت يؤخر تطور واعتام عدسة العين (المياه البيضاء) في المجموعات المعالجة مقارنة بالمجموعة الضابطة الموجبة (+).

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الخلاصة: أهمية تناول فاكهة الباشن فروت لما لها من تأثير وقائي لتقليل مضاعفات مرض السكري وتكوين اوعية دموية جديدة في شبكية العين. أوصت الدراسة الحالية بإدراج عصير فاكهة الباشن فروت في أطباقنا اليومية ومشروباتنا اليوميه وكذلك المركبات الصيدلانية.

الكلمات المفتاحية: إعتام عدسة العين - الباشن فروت - مؤشر مقاومة الأنسولين - مؤشر كتلة الجسم – بروتينات العدسة