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Effect of purslane (Portulaca oleracea) nano-extract compared to glimepiride on biochemical parameters in albino rat with type 2 diabetes

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Abstract

Diabetes mellitus is a disease characterized by abnormally high blood glucose levels, hyperlipidemia, and low blood insulin levels. This study aimed to compare the effects of a purine nano-extract and the drug glimepiride on certain biochemical parameters in rats induced with type 2 diabetes. Twenty male albino rats were used and divided into four groups (n=4): a negative control group, a positive control group with streptozotocin-induced diabetes (STZ) a group of diabetic rats treated with glimepiride (3 mg/kg body weight), and a group of diabetic rats treated with a purine nano-extract at a concentration of 10 mg/kg body weight. All four groups were treated for 30 consecutive days. At the end of the experiment, the animals were sacrificed, and blood samples were collected to measure insulin concentration, antioxidant levels, and cardiac enzymes. The results showed an increase in insulin concentration. Insulin in the negative control group and the (T2,T3) group compared to the positive control group and a significant increase in (MDA) concentrations, the negative control group and the (T2,T3) group compared to the positive control group and an increase in the level of cardiac enzymes (Troponin, CK-MB) in the negative control group and the (T2,T3) group compared to the positive control group. The current study demonstrated that the nano-extract of Portulaca oleracea has a hypoglycemic effect in addition to improving antioxidant and cardiac enzyme levels

Keywords: Portulaca oleracea plant, insulin, cardiac enzymes, antioxidant index

Introduction:

Diabetes mellitus is a chronic and progressive metabolic disorder characterized by persistently high blood glucose levels, It arises from impaired insulin secretion, insulin effectiveness, or both. Diabetes mellitus affects millions of people worldwide and is considered a major public health challenge, contributing to high rates of morbidity and mortality (Yameny, 2024). The complications of diabetes mellitus manifest as chronically elevated blood glucose levels affecting

multiple body systems through damage to micro- and macro-vascular blood vessels, The selective vulnerability of certain cell types to damage caused by high blood glucose levels explains the pattern of complications affecting the nerves kidneys cardiovascular system and eyes (Yameny, 2024). Early diagnosis helps.

Diabetes can have serious consequences, as neglecting its treatment can lead to serious complications The main symptoms of diabetes include a persistently high blood glucose level increased urination excessive thirst, and increased appetite. Diabetes is classified into several types, including the main ones: Type 1, Type 2, and gestational diabetes (Gupta, *et al*., 2024). Type 1 diabetes (T1DM) is an endocrine disorder in which the beta cells (β) in the pancreas stop producing insulin This is due to an autoimmune destruction, resulting in high blood sugar and ketoacidosis Therefore insulin replacement is essential to control diabetes The incidence peaks in puberty and early adulthood but it can begin at any age The prevalence is higher among adults because those with type 1 diabetes live for many years Symptoms include excessive thirst frequent urination and weight loss Acute complications include diabetic ketoacidosis which requires prompt treatment Long-term complications include microvascular and macrovascular diseases (Syed, 2022).

Type 2 diabetes mellitus (T2D) is a disease characterized by the progressive loss of insulin secretion from the beta cells (β) in the islets of Langerhans It typically occurs after the presence of insulin resistance and is a component of metabolic syndrome. The mechanism of type 2 diabetes is not fully understood but insulin resistance and beta cell dysfunction play a role in disease progression Dyslipidemia, hyperglycemia and other metabolic disorders contribute to insulin resistance and (β) cell dysfunction in the islets of Langerhans via several common pathways including inflammation endoplasmic reticulum (ERS) stress oxidative stress and abnormal lipid accumulation There is currently no cure for type 2 diabetes, but it can be prevented or controlled through lifestyle modifications Type 2 diabetes is often associated with other components of myelodysplastic syndrome such as obesity pre-obesity metabolic disorders associated with fatty liver disease and dyslipidemia, which usually precede its onset These conditions are considered predisposing factors for type 2 diabetes (Lu, *etal* ., 2024).

Gestational diabetes defined as high blood sugar levels first detected during pregnancy is one of the most common medical complications of pregnancy It affects approximately 15% of pregnancies worldwide equivalent to 18 million births annually Mothers with gestational diabetes are at increased risk of preeclampsia gestational hypertension and cesarean delivery Gestational diabetes also increases the risk of other complications including cardiovascular disease obesity and impaired carbohydrate metabolism potentially leading to type 2 diabetes in both the mother and the infant Furthermore, the increased blood sugar levels contribute to the development of other health problems during pregnancy

The incidence of gestational diabetes represents a significant economic burden and deserves more attention awareness and diagnostic methods as well as finding an effective treatment that can reduce perinatal and metabolic complications (Modzelewski , *et al*., 2022).

The plant known as the "vegetable of longevity" (Portulaca oleracea) is a succulent annual herb widely distributed throughout the world Numerous clinical and experimental studies have demonstrated its potential as an adjunctive and alternative treatment for diabetes as it lowers blood glucose levels and reduces fasting blood glucose in rats with streptozotocin-induced diabetes This plant contains 84 constituents including 31 organic acids and nine flavonoids (Hou , *etal*., 2021).

Materials and Methods

Plant Preparation

The herb Purslane was collected from agricultural fields in Al-Diwaniyah Governorate and washed several times, then dried in the shade for thirty days After drying it was ground in a herb grinder to obtain its fine powder and stored in plastic containers until use

Hot Alcoholic Extract of Purslane

The hot alcoholic extraction of Purslane was performed using a Soxhlet apparatus as follows:

The Purslane plant was collected and dried in the shade for thirty days The plant was then ground using an electric blender and the powder was stored in plastic containers The Soxhlet apparatus was then used according to the method of (Harborne , *et al*., 1979) This method involves placing 50 grams of Purslane powder in the middle section of the Soxhlet apparatus using a filter paper beaker and 500 ml of 70% ethyl alcohol in a flask at the bottom of the apparatus. At 70°C the alcohol evaporates, and the vapor rises to the top of the apparatus where condensation tubes pass through cold water The vapor condenses and falls onto the Purslane powder increasing the amount of condensed vapor until the section containing the Purslane powder is filled The vapor is then automatically emptied into the flask and the process is repeated Repeat until the contents of the flask become colored The extract or the part containing the powder becomes clear Then the extract is poured from the flask into heat-resistant glass dishes and placed in an incubator at 50°C to evaporate the alcohol leaving the extract to be collected and placed in glass containers at room temperature provided that the storage place is dark and dry until it is used in conducting the research.

Conversion of Hot Alcoholic Purslane Extract to Nanoparticle Size

This is done using a homogenizer following the method described by (Aldulemy and Abdul-Razak, 2021) with some modifications to convert the solutions to nanoparticle sizes (20mg) of the alcoholic purslane extract was dissolved in (100 ml) of alcohol. The solution was left for 3 hours on a magnetic homogenizer at room temperature The solution was then filtered using filter paper and the process was repeated three times The filtrate was then filtered once using a syringe filter The filtrate was then treated in a homogenizer at maximum speed for (30) minutes and the solution was filtered again once using a syringe filter to obtain a solution with nanoparticle size The filtrate was then placed Place in heat-resistant glass containers inside an incubator at a temperature of 50°C to dry and then use in the experiment.

Experimental Design

The experiment was conducted on (20) male albino rats weighing between 150 and 200 grams and aged between 10 and 12 weeks All animals were placed in safe laboratory conditions in a temperature-controlled room (22-24°C) and kept in a 12-hour light-dark cycle at the Animal House of the College of Science Al-Qadisiyah University. All rats had free access to food and water. The animals were provided by the Animal House of the College of Science University of Karbala.

The first experiment involved inducing diabetes using (STZ) in male albino rats, which were divided as follows:

Group 1 (G1): This group represented the control group and consisted of (5) healthy animals that received the standard diet and distilled water throughout the experiment.

Group 2 (G2): This group consisted of (15) rats in whom glucose was induced via Streptozotocin (STZ) injection.

The second experiment included the following groups:

1-Negative control group(C) : This group received 1 ml of normal saline for 30 days.

2-Treatment group (T1): This group received glucose induction and normal saline for 30 days.
3 -Treatment group (2T): This group received glucose induction and Amaryl at a dose of 3 mg of body weight for 30 days (Eshak , *et al*., 2015).

4- Treatment group 4 (3T) in which diabetes was induced and the nano-extract of the plant Purslane was administered at a dose of 10 mg/kg/day of body weight for 30 days.

Diabetes Induction

Diabetes was induced by a single intraperitoneal injection of freshly prepared STZ at a dose of 65 mg/kg body weight dissolved in normal saline 72 hours after STZ injection and overnight fasting, a blood sample was drawn from the caudal vein of the rats. An OnCall Plus monitoring device was used to check changes in blood glucose levels. Rats with blood glucose levels above 250 mg/dL were selected for the diabetes group and tested in the first few days after STZ injection. The rats experienced hypoglycemia due to insulin release from damaged beta cells The rats were given a 10% glucose solution immediately after intraperitoneal STZ injection. To monitor the rats, blood glucose levels were measured. Tail prick.

Blood Collection and Analysis

At the end of the treatment period all mice were fasted overnight 5 milliliters of blood were collected directly from the heart while the animals were anesthetized using the heart puncture technique The blood was placed in plastic tubes and then centrifuged for 15 minutes at 3000 rpm to obtain serum. The serum was then withdrawn and collected in labeled Eppendorf tubes after separation to determine insulin levels and perform biochemical parameter tests.

Estimation of Serum Insulin Levels

Insulin concentration was measured according to the method of (Drupt ,*et al*., 1974).

Procedure: A graph of insulin levels in phosphate buffer (pH = 6) was plotted using a concentration range of L - 50 µmole / L / 250 µmole. The absorbance was measured at 214 nmUV using a spectrophotometer. The graph was a straight line with a correlation coefficient of 0.995. Figure (1) shows the graph of insulin concentration in phosphate buffer (pH = 6).

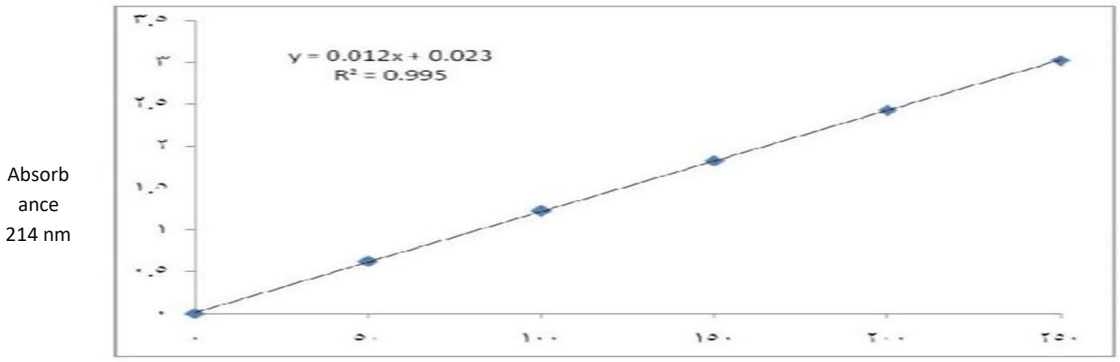

Figure (1) Standard curve of insulin in phosphate buffer solution (pH = 6)

Phosphate buffer solution, pH 6 (µL)	The model (µL)
900	**100**

The absorbance was read at a wavelength of 214 nm after incubation for one minute at a temperature of 37°C.

Determination of serum lipid peroxide ((MDA)) levels.

Serum Malondialdehyde (MDA) levels were determined using a method modified by(Guidet and Shah 1989) This method, which measures the amount of (MDA) a major product of lipid peroxidation, relies on the reaction between lipid peroxides, primarily (MDA) and thiobarbituric acid (TBA). This reaction occurs in an acidic medium, producing a colored product that allows for the measurement of lipid peroxide. The absorption intensity was measured at 532 nanometers.

Blood Determination of Glutathione Concentration

Basic Principle: Glutathione in blood serum was determined using the method developed by(Sedlak and Lindsay, 1968). This method relied on the use of Ellman's reagent containing 5,5-dithiobis nitrobenzoic acid (DTNB), which reacts rapidly with glutathione and is reduced by the sulfhydral (SH) group of glutathione. The resulting product is a yellow compound, and the

absorption of the compound is read at 412 nanometers. The concentration of the resulting compound depends on the concentration of glutathione present in the blood serum.

Determination of Serum Catalase (CAT) Concentration: Basic Principles

Catalyse (CAT) catalyzes the decomposition of hydrogen peroxide (H2O2) into water (H2O) and oxygen (O2). Therefore, its activity is determined by the decrease in absorption due to hydrogen peroxide consumption (Mueller *et al*., 1997).

Catalyse activity is determined by the decrease in absorption due to hydrogen peroxide consumption (Mueller, *et al*., 1997). Detectors

•Potassium hydrogen phosphate (KH_2PO_4) was prepared at 5 mM by dissolving 6.81 g of it (molecular weight 136.09 g/mol) in 1 liter of distilled water.

•Sodium hydrogen phosphate (Na_2HPO_4) was prepared at 38.772 mM by dissolving 6.9 g of Na_2HPO_4 (molecular weight 141.96 g/mol) in 1 liter of distilled water. 390 mL of the KH_2PO_4 solution was mixed with 610 mL of the Na_2HPO_4 solution, and the pH was adjusted to 7.

2 - Hydrogen peroxide (H2O2)
A hydrogen peroxide solution was prepared by diluting (0.34) ml of 30% H2O2 to a phosphate buffer solution up to (100) ml. This solution was prepared immediately before the test.

Heart Function Measurements:

Cardiac Troponin Enzyme Level Assessment

The cTnI ELISA assay kit is based on competitive enzyme analysis using multiple antibodies to cTnI and an HRP-cTnI ligand. The analyte sample and solution with the HRP-cTnI ligand are prepared in a pre-loaded plate for one hour. After the preparation period, the wells are decontaminated and washed five times. The wells are then prepared with an enzyme catalyst (HRP) The reaction product of the enzyme and catalyst together forms a blue color Finally a stop solution is added to halt the reaction resulting in a yellow color The intensity of the color is measured using a The optical spectrum at (450 nm) in a small plate reader shows that the color intensity is inversely proportional to the cTnI concentration as cTnI from the samples and the HRP-cTnI ligand compete for cTnI binding sites Since the number of sites is limited as the cTnI from the sample occupies sites fewer sites remain for the cTnI-HRP ligand to bind A calibrated curve relating the color intensity (D.O.) to the concentration of the parameters is plotted The cTnI concentration in each sample is estimated by overlapping this calibrated curve.

Test Procedure

1-Fix the desired number of samples to be tested in the holder then add 100 µL of standards Gently shake each standard bottle by hand using the regulator up and down several times before adding the samples to the appropriate absorbent Add 100 µL of PBS (pH 0.7-2.7) to the control absorbent.

2-Dispense 10 µL of the equilibrium solution into 100 µL of the samples only and stir well **Note:** This step is required when the sample is a cell culture body fluid or tissue analysis If the sample consists of serum or plasma this step should be skipped.

3 -Add 50 µL of the solidified molecule to each absorbent (except the control absorbent). Stir well. Thorough stirring at this step is crucial. Cover the plate and allow to stand for 1 hour at 37°C.

4 - Wash the test plate using one of the methods specified below:

a. Manual Washing : Dispose of the prepared mixture by vacuuming the plate contents into a suitable basin or waste container Fill each hole completely with a (1x) concentration wash solution then dispose of the plate contents into a suitable basin or waste container Repeat this procedure five times for five washes Take care not to scratch the hole surface.

b. Automatic Washing : Wash the plate five times using a diluted wash solution (350-400 µL/hole/wash) with an automatic washer. It is recommended to set the washer for a 10-second immersion time and a 5-second vibration time between washes.

5- After washing, turn the plate over and wipe it on absorbent paper or tissue paper until no moisture is visible Complete removal of the liquid at each step is essential for good performance.

6 - Add 50 µL of catalyst A and 50 µL of catalyst B to each well, including the blank control well. Cover and allow to react for 15–20 minutes at 37°C. Avoid sunlight If the color is not dark, extend the reaction time. However, the maximum reaction time is 30 minutes.

7- Add 50 µL of stop solution to each well, including the control well. Mix thoroughly.

8 - Immediately determine the optical density (D.O.) at 450 nm using a microtometer plate reader.

Calculations

1 .A standard curve is used to determine the sample quantity.

2 . First, calculate the average of the repeated readings for each standard and sample. All(D.O.) values are subtracted from the average of the blank control before interpreting the result.

3 .Construct a standard curve by plotting the concentration on the horizontal X-axis against the average(D.O.) for each standard on the vertical Y-axis.

4. Calculate the sample concentrations that correspond to the average absorbance from the standard curve.

Creatine Kinase-MB (CK-MB) Level Assessment:

Basic Principle:

The activity of creatine kinase (CK) in serum or plasma is considered to be the activity of the CK-MB and CKMM enzymes. The involvement of the CK-BB enzyme is usually not detectable because the CK-MB reagent contains antibodies directed against the CK-M subunit, which gives complete inhibition of CKMM and partial inhibition of CK-MB, or partial inhibition of CK-M without affecting CK-B.

Statistical Analysis.

The results of the statistical analysis were subjected to determine the significant differences between the control group and the treatments. These significant differences were determined at a probability level of $p < 0.05$ using the SPSS 2010 statistical software. The statistical analysis also included obtaining the mean and standard error. The significant differences were determined using one-way analysis of variance (ANOVA) (Ab Rahman, 2015).

Results and Discussion:

Measurement of Insulin Concentration

The statistical results in Table (1) for the insulin concentration index showed a significant decrease ($P < 0.05$) in insulin concentration in group (T2), the induced diabetes group (positive

control) compared to group (C) the negative control group (no induced diabetes) No significant change (P > 0.05) was observed in insulin concentration in group (T2) the induced diabetes group which received glimepiride at a concentration of 3 mg/kg and group (T3) the induced diabetes group which received : Portulaca oleracea nano-extract at a concentration of 10 mg/kg compared to the negative control group (C).

The results of the statistical analysis showed no significant change (P>0.05) in the concentration of insulin hormone in the (T2) group in which diabetes was induced and the drug Glimepiride was administered at a concentration of 3 mg/kg and in the (T3) group in which diabetes was induced and the nano-extract of the plant Purpurea was administered at a concentration of 10 mg/kg compared to the negative control group (C).

A similar study was conducted by(Tandi , *eta l*., 2025) where it was found that oral administration of diabetic male rats with a nano-extract of Coleus Scutellarioides led to a reduction in blood glucose levels and an increase in insulin They attributed this reduction to the stimulation of the remaining pancreatic β cells to secrete insulin by the flavonoid compounds found in (C) scutellarioides The biologically active compounds may activate the PI3K/Akt signaling pathway promoting GLUT4 translocation in peripheral tissues.

A similar study conducted by (Darwich, *etal*.,2026) on male rats induced with (STZ) showed that when the nano-extract of Pine Leaf was administered there was a decrease in blood sugar levels and an increase in insulin levels in the diabetic animals They attributed this improvement to the presence of polyphenols and flavonoids in this extract which have antioxidant properties and improve insulin sensitivity thus facilitating glucose metabolism and reducing oxidative stress in diabetic rats.

On the other hand a study conducted by (Rusminingsih, *et al*., 2023) on male ahbino rats with diabetes and by dousing these animals with the nano-extract of the Moringa oleifera plant led to a significant increase in insulin levels compared to the diabetic control group The consumption of MoNP nanoparticles contributed to reducing the fasting blood sugar level to the normal range Therefore the consumption of MoNP nanoparticles can contribute to reducing inflammatory cytokines and insulin resistance in diabetic animals.

Measurement of antioxidants and oxidants

On the other hand no significant change (P>0.05) was observed in the concentration of the oxidant marker Malondialdehyde (MDA) in the (T2) group in which diabetes was induced and glimepiride was administered at a concentration of 3 mg/kg and in the (T3) group in which diabetes was induced and propionate nano-extract was administered at a concentration of 10 mg/kg compared to the negative control group (C).

The results of a study conducted by (Wahjuni , *et al*., 2022) were consistent with this finding When male albino rats induced with STP were orally administered a Coriandrum sativum nano-extract a decrease in (MDA) levels was observed This reduction in the blood of the hyperglycemic rats is attributed to the ability of phenolic compounds such as flavonoids, saponins, alkaloids, and terpenoids to lower (MDA) levels in rat blood through the oxidation of long-chain lipids into unsaturated fatty acids This suggests that the Coriandrum sativum nano-extract compound possesses superior anti-hyperglycemic activity.

Similarly another study conducted by (Wahjuni , *et al* ., 2024) administered the nano-extract of the plant (Etlingera elatior) to diabetic rats using (STZ) A decrease in the level of (MDA) was found in the group that was given the nano-extract of the plant (Etlingera elatior) compared to the

positive control The decrease in the levels of (MDA) which is a key indicator of lipid peroxidation and oxidative stress is attributed to the strong antioxidant ability of the nano-extract of the plant (Etlingera elatior) The extract is rich in phenolic compounds and flavonoids that play a crucial role in neutralizing free radicals and reactive oxygen species The nano-extract of the plant (Etlingera elatior) helps protect cellular lipids from oxidative damage, which in turn leads to a decrease in ((MDA)) production.

On the other hand, a study conducted by (Naibaho *,et al* ., 2019) found a decrease in (MDA) levels in diabetic male rats treated with STP when administered orally with a nano-extract of Orthosiphon aristatus. This decrease in (MDA) levels was attributed to the inhibitory effects of lipid peroxidation through the neutralization of free radicals, given their ability to damage cells and DNA, and the extract's ability to reduce oxidative stress.

On the other hand no significant change (P>0.05) was observed in the concentration of the antioxidant markers Catalase (CAT) in the (T2) group in which diabetes was induced and glimepiride was administered at a concentration of 3 mg/kg and in the (T3) group, in which diabetes was induced and propionate nano-extract was administered at a concentration of 10 mg/kg, compared to the negative control group (T1).

A similar study conducted by (El-Saied *et al* ., 2021) on male rats induced hepatotoxicity and oxidative stress using the compound Methomyl and an orally administered nano-extract of the plant Balanites aegyptiaca at a concentration of 10 mg/kg of body weight showed no change in the index The concentration of (CAT) enzymes was improved and the reason for the improvement in the liver enzyme concentration index (CAT) was attributed to the fact that the Balanites aegyptiaca plant controls toxicity and oxidative stress due to its high content of flavonoids and tannins, which are considered stimulants of internal antioxidants.

Another study conducted by (Mohammed , *et al*., 2022) found that when male rats with diabetes were orally administered a nano-extract of Malva parviflora using the compound (STZ) there was no change in the concentration indices of the enzymes (CAT) The improvement in pancreatic function was attributed to Malva parviflora, or possibly to quercetin and kaempferol which may be responsible for the protective effects of Malva parviflora, vitamin A and ascorbic acid.

The results of a study conducted by(Abdu , *et al* ., 2017) corroborated this finding When male rats with colon cancer were given a nano-extract of Zingiber officinale Rosc at a concentration of 10 mg/kg of body weight no change was observed in the levels of the (CAT) enzymes The improvement in (CAT) levels was attributed to the active components of the Zingiber officinale Rosc nano-extract which possess antioxidant properties and protect against free radicals such as reactive oxygen species (ROS) and hydrogen peroxide (H2O2).

Cardiac Function Indicators

The statistical results in Table (1) for cardiac enzyme indicators showed a significant increase (P < 0.05) in both (troponin , CK-MB) enzymes in group (T1) inducible diabetes, positive control compared to group (C) negative control no diabetes No significant change (P > 0.05) was observed in the concentration of troponin and CK-MB enzymes in group (T2) inducible diabetes 3 mg/kg glimepiride and group (T3) inducible diabetes 10 mg/kg propionate nano-extract compared to the negative control group (C).

These results are consistent with a study conducted by (Al-Alfayyadh *,et al*., 2025) who observed a decrease in the concentration of the enzyme (Troponin, CK-MB) when male albino rats were orally administered nano-extracts of Opuntia ficus-indica. They attributed this decrease to the

properties of plant nano-extracts, which contain high levels of polyphenols and help combat atherosclerosis oxidative stress and cardiovascular problems.

A study conducted by (Xu , *et al*., 2024) on male ahbino rats with myocardial infarction found that administering a 10 mg/kg body weight nano-extract of Spinacia oleracea, loaded onto silver particles, led to a decrease in the levels of the enzyme (troponin, CK-MB) in the group of rats with myocardial infarction compared to the control group. This improvement was attributed to the fact that this Spinacia oleracea nano-extract reduces the levels of pro-inflammatory cytokines in the hearts of rats with myocardial infarction and effectively inhibits the levels of myocardial injury markers.

On the other hand, our study is consistent with a study conducted by (Xu , *et al*., 2024) in which male rats with isoproterenol-induced cardiotoxicity were orally administered a nano-extract of Panax japonicas loaded with silver nanoparticles. A significant decrease in the concentration of the cardiac enzyme (troponin ,CK-MB) was observed in the cardiotoxic rats compared to the unaffected control group. This decrease was attributed to the positive effects of the Panax japonica nano-extract, which acts as a cardioprotective and antioxidant agent. This nanoparticle treatment resulted in a reduction in the size of the infarct area, a decrease in cardiac marker levels, and a reduction in immune cell infiltration and myocardial necrosis.

Table No. (1)

	Mean ± SD				P-value
	Con-	T1 (Con +)	T2AMY	T310ML	
Insulin	**54.62 ± 0.25**	**10.17 ± 1.29**	**59.39 ± 4.89**	**56.96 ± 5.9**	**0.0001**
MDA	**24.65 ± 6.17**	**40.4 ± 4.04**	**31.4 ± 1.29**	**27.65 ± 0.87**	**0.0001**
Cat.	**32.36 ± 5.85**	**105.34 ± 1**	**26.16 ± 2.58**	**24.1 ± 3.34**	**0.0001**
Trop I	**2.1 ± 0.45**	**10.17 ± 1.29**	**3.27 ± 0.65**	**2.31 ± 0.31**	**0.0001**
CK-MB	**1.97 ± 0.23**	**41.34 ± 5.19**	**1.41 ± 0.04**	**1.34 ± 0.15**	**0.0001**

Conclusion:

The current study demonstrated that the nano-extract of Portulaca oleracea at a dose of 10 mg/kg of body weight has a hypoglycemic effect similar to that of the antidiabetic drug glimepiride, in addition to improving antioxidant and cardiac enzyme levels.

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