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Research Article

Efficacy Of Green Synthesis Of Silver Nanoparticles Using Allium Ampeloprasum Against Isoproterenol Induced Myocardial Infarction In Adult Albino Rats.

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Abstract

Main goal of study was to see if Allium ampeloprasum (Leek) aqueous extract and silver nanoparticles (AgNPs) biosynthesized by this extract could protect male Wistar rats from cardiototoxicity produced by isoprenaline (ISO). The contents of Leek aqueous extract were also discovered, as well as biosynthesized AgNPs. Thirty mature Wistar albino rats of (male and female) randomly assigned to six category. In group I dosed with distilled water (5 ml / kg) and then injected subcutaneously with normal saline local solution at a concentration (0.1 ml / 100 g) on days 44 and 45 from the start of the experiment. The rats in group II were given ISO subcutaneous injection 65 mg/kg for two days on days 44 and 45 after the trial began. In group III Pre-treated dosed with silver nanoparticles prepared from leek extract (AgNPS) for 43 days and on days 44 and 45 injected subcutaneously with ISO (65 milligrams / kilogram) for two consecutive days from the start of the experiment only, while in Group IV Pre-treated with aqueous extract of Leek at a concentration of 200 mg/kg every day for 43 days, and on days 44 and 45, (ISO) was injected subcutaneously (65 milligrams / kilogram) for two consecutive days from the start of the experiment only. In Group V Dosed with silver nanoparticles prepared from Leek extract at a concentration of 200 milligrams / kilogram for 45 days, while in group VI was orally dosed with aqueous extract of Leek at a concentration of 200 milligrams / kilogram for 45 days and MI was established. The cardioprotective effects of Leek extract and AgNPs/Leek extract were demonstrated by a reduction in high serum concentration of heart damage enzymes (CK-MB, ALT, AST, and LDH), as well as an increase in heart bioindicators of oxidative stress (MDA) and scavenger deficiency (GSH , SOD and CAT)AgNPs/Leek extract was more efficient than Leek extract in terms of cardiac histological alterations In summation, Leek extract and AgNPs/Leek extract, which is more effective, may protect Wistar rats against ISO-induced cardiotoxicity, and this effect may be mediated, at least in part, by antioxidant defense system augmentation.

Keywords

Isoprenaline, Leek, Silver nanoparticles AgPNS, Oxidative stress and Myocardial Infarction.

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Introduction

Despite efforts to improve clinical considerations, access to contemporary treatments, and health consciousness, Heart disease (mostly myocardium muscle infarction) is expected to remain the important source of demise, according to World Health Organization. which are a leading of death worldwide by 2020. (Orlandi et al., 2020).A typical symptom of ischemic heart disease is myocardial infarction (Freitas et al., 2020) happens when cardiovascular ischemia outperforms a clinical limit, bringing about irreversible myocardial harm (Guo et al., 2018).IHD is a life-threatening disorder that causes myocardial necrosis due to a mismatch between myocardial metabolic needs and coronary oxygen and food supply. MI causes the heart to produce free radicals, which contribute to more harmful reactions and, finally, cardiac cell death (Zhu et al., 2019).The rising occurrence of MI has resulted in astounding health and economic costs, necessitating a better understanding of the illness, as well as therapeutic research (Anderson and Morrow, 2017).4-dihydroxypheinyl)-2-isopropylameno ethanol hydrochlorid] Isoproterenol[1-(3, 4-dihydroxypheinyl)-2-isopropylameno ethanol hydrochlorid], a b-adrenergic agonist and a synthetic catecholamine (Sheta et al., 2020),causes severe free radicals on the heart, resulting in cardiac muscle damage similar to an infarct (Fajobi et al., 2020).It is familiar to produce ROS and induce MDA, which could be a role in permanent cardiac membrane injury (Sivasangari et al., 2021).

Heart-related diseases are treated with a variety of herbs (Abat et al., 2017). The use of traditional plant-based medicine has resulted from the search for an effective drug to treat cardiovascular diseases that has no adverse effects (Tasneem et al., 2019).Polyphenols, flavonoids, and tannins, for example, are plant-based chemicals that can act as antioxidants and protect versus free radical damage (Al-Snafi, 2018; Ali, 2017). Allium ampeloprasum (Leek) is a part of the Allium genus that originated in Inner Asia and northern Europe. Many regions, though, may cultivate it. Aides et al., 2019 describe A. ampeloprasum as a bulbous plant pathogen that is consumed as a vegetable. This plant is used as a generally pro, antimicrobial, diuretic, antihypertensive, and tonic in Mediterranean traditional medicine (Devi and Brar, 2018).A. ampeloprasum and its active components include antimicrobial, antioxidant, and antifungal properties, as well as the ability to protect skin from pathogenic agents, alleviate gastrointestinal illnesses, and reduce inflammation and hepatotoxicity (Van der Meer and Hanelt, 2020).

Nanostructure noble metals have recently attracted a lot of attention, and they're being used in a variety of technical and medicinal applications, including molecular imaging and drug delivery (Tiwari and Rohiwal, 2019), development of diagnostic and therapy materials and medical devices (Liu and Tang, 2017). To make metal nanoparticles, scientists have used a variety of techniques, including chemical reduction, ultraviolet and microwave radiation, as well as photochemical and sonoelectrochemical approaches (Jamkhande et al., 2019). The creation of an alternative eco-friendly, cheap, and reliable synthetic technique based on the reduction capability of specific compounds from natural organisms was necessary due to the severe toxicity of chemicals (Ealia and Saravanakumar, 2017).The phytochemical manufacture of silver nanoparticles (AgNPs) using plant or fruit extracts is essential in nanotechnology and nanomedicine because it provides alternative therapeutic choices that are safe, have few side effects, and are beneficial for a wide range of ailments (Chen and Liang, 2020).Several investigations have shown that AgNPs have a strong antimicrobial effect, as well as oxidative stress scavenging and anti-inflammatory effects (Khan et al., 2019).AgNPs have anticancer, antiviral, antibacterial, and anti-angiogenetic activities, according to experimental evidence. AgNPs have been demonstrated to cause apoptosis and reduce the amount of matrix metalloproteinase in wounds, as well as block angiogenesis and vascular permeability in vascular endothelial growth factor in cow retinal endothelial cells (VEGF), interleukinIL-1, and advanced glycation end products (Yetisgin et al., 2020).

Our goal was to see What is the difference between before the with Leek nanoparticles solution and normal Leek solution? affected histological and physiological alterations in rats with ISO-induced MI.The main goals were to see if Leek nanoparticles are superior than aqueous extract of Leek and to determine the appropriate doses for reducing ISO effects.

Materials And Methods

Animals

Swiss albino mice rats, adult males, ranging 220–290 g, were purchased from the Ministry of Health's Center for Drug Research in Iraq for this study. For one week, the animals were kept Change the value to 22–24 °C before conducting the study and 50% humidity. Animals were kept in an animal home under regular conditions. They had been accustomed to the confines of an animal shelter. Industrial food pieces and water were freely available to the rodents.

Drugs and Materials

A. ampeloprasum purchased from a neighborhood local shop in Ramadi- Al-anbar- Iraq , ISO (Sigma–Aldrich, USA).

MI induction

To experimentally induce MI, rats were S. C. injected with (65 mg/kg/day) ISO dissolving in pbs saline every 24 hours for two days.

Preparation of the extract of *A. ampeloprasum (Leek)*

Leaf of A. ampeloprasum were washed and cleansed for 3 repeat with PURIFIED water. After that dried for 7 days in the shade at room temperature before being grinding to become a fine powder. 5 grams of powdered placed in a 250 mL flask and heated for 30 minutes at 60 °C mixed with 100 mL distilled water to generate an aqueous extract of A. ampeloprasum. using What man No. 1 filter paper (Lu et al., 2011) .

Green synthesis of AgNPs *by A. ampeloprasum* leaf extract

1 ml of extract was combined into 50 mL of a dilute solution of AgNO3 (1 mM) at 60 °C with agitation to reduce silver salt (Ag+) to zero oxidation state and as a stabilizing agent for AgNPs. The colorless solution became light brown with time, indicating the formation of AgNPs. (Jalilian et al., 2020).

Experimental design

The animals got split into six groups of six individuals each and given the following treatments:

(1)The first group (negative control): dosed with distilled water (5 ml / kg) and injected subcutaneously with normal saline local solution at a concentration (0.1 ml / 100 g) on days 44 and 45 from the start of the experiment.
(2)The second group: Isoprenaline hydrochloride (65 milligrams/ kilogram) was injected subcutaneously for two consecutive days on days 44 and 45 from the start of the experiment only.
(3)The third group: Pre-treated dosed with silver nanoparticles prepared from leek extract (AgNPS) for days 43 and on 44 and 45 injected subcutaneously with Isoprenaline hydrochloride (65 my milligrams/ kilogram of body weight) for two consecutive days from the start of the experiment only.
(4)Fourth group: Pre-treated with aqueous extract of leek at a concentration of 200 milligrams/ kilogram every day for 43 days, and on days 44 and 45, Isoprenaline hydrochloride was injected subcutaneously (65 milligrams/ kilogram) for two consecutive days from the start of the experiment only.
(5)Fifth group: Dosed with silver nanoparticles prepared from leek extract at a concentration of 200 milligrams/ kilogram for 45 days.
(6)Sixth group: Orally dosed with aqueous extract of leek at a concentration of 200 milligrams/ kilogram for 45 days. And MI was induced.
The animals were anesthetized with Chloroform 24 hours after the previous administration of test drugs. Following that, a disposable syringe was used to inject 5 mL blood directly into the heart,

specimen centrifuged at 3000 rpm/15 min. to determine enzymes activity to AST, ALT, CK-MB, Lactic Dehydrogenase, and cardiac troponin-I. Decapitated rats were killed, and the hearts were quickly separated, cleaned in ice-cold saline, and split into two equal halves.

Biochemical assays

Enzymatic kits were used to estimate CKMB, LDH, ALT, and AST to evaluate myocardial damage in MI (26–28).UV-visible spectrophotometry was used to measure absorbencies. (Shimadzu-1601, Japan).The amount of thiobarbituric acid reactive chemicals, which were assessed as malondialdehyde (MDA) in heart homogenate, was determined using a standard kit obtained from BIOLABO-France and followed the manufacturer's method to quantify lipid peroxidation in cardiac tissues (Dawn-Linsley et al., 2005) .Antioxidant enzymes, namely glutathione (GSH)(Habig et al., 1974), SOD (Ellman, 1959) and catalase were estimated in previously reported methods (Aebi, 1974).

Histopathological Examination.

The extracted cardio segment was stored with 10% natural buffered formaldehyde for 72h before dehydrated by ethanol withe fallowing concentration (50, 70, 80, 90, 95, and 100) and embedded in paraffin. To visualize histological changes in ischemia cardiac injury, samples were cutting into 5-mm slices by microtome and treated with hematoxylin and eosin inspection by a light microscope, followed by photomicrographing (Bancroft and Gamble, 2008) .

Statistical analysis

All data was analyzed by SPSS (SPSS Inc., Chicago, standard version 21.0), and the findings were expressed as mean (+ or -) standard error of the mean. (ANOVA) and the Dunnect C post hoc analysis test were used to calculate the difference in means. p0.05 significance threshold was used.

Results And Discussion

Effect Of Agnps And Leek Aqueous Extract On Cardiac Marker Enzymes

Cardiac marker enzymes are protein from cardiac tissue found in the blood. The diagnosis of disease is aided by measurement of a number of plasma enzymes‹ The amount of enzymes released depends on the cellular damage, concentration of the enzyme and mass of affected tissue(Khan et al., 2018). The enzymes released and the cause of damage showed the severity of the damage(Soumya et al., 2021). Increased serum marker enzyme activity might be attributed to increased myocardial cell membrane activity in response to ISO-mediated peroxidative damage, culminating in the release of these marker enzymes into systemic circulation (Daoud et al., 2017; Li et al., 2021).

Serum CK-MB, LDH are the most important diagnostic markers of myocardial infarction. There was a substantial rise in cardiac marker activity (AST, ALT, LDH, CK-MB) in ISO treated animal compared to normal one (Figure: 1,2,3 and 4). Pretreatment with AgNP's synthesized from Leek and Leek aqueous extract prevented the elevated activities of cardiac biomarker enzymes in serum, thereby indicating the cardioprotective activity of Allium ampeloprasum Because the Allium genus includes sulfur compounds, steroidal saponins, flavonoids, and other substances with anticancer, antioxidant, antiplatelet aggregation, antiatherosclerosis, antibacterial, lipid, and glucose biological action. S-alk(en)yl-l-cysteine sulfoxides, secondary cysteine metabolites, are prevalent in the Allium genus (Bernaert et al., 2012)

Rats suffered from myocardial infarction had higher LDH (Figure 4) AST ,ALT and CK-MB as shown in (Figure 5a,b). previous treatment of AgNPs and Leek aqueous extract significantly reduced the ISO-induced increase in serum LDH (Figure 4), AST ,ALT and CK-MB (Figure 5a,b). LDH increases after 6–12 hours of the start of myocardial ischemia, peaks at 48 hours, and stays high for 4–14 days until reverting to normal levels. Due to its non-specificity, its utility in the diagnosis of MI is restricted, and elevated levels can be detected in a variety of muscle diseases or anemia (Adedapo et al., 2019). AST enzyme elevated mostly in the liver, cardiac , and muscles, when

these organs are damaged (Toutounchi et al., 2017). amount of AST in the blood set about rising 3–8 hours after the beginning of the myocardial infarction, with a peak at one day and a full recovery in 3–6 days (Toutounchi et al., 2017). Although AST was originally believed to be a great marker of heart injury, it is now only useful in the recognition heart ischemic state due to its improper specificity (Sithuraj and Viswanadha, 2018).ALT is an enzyme found predominantly in liver cell and kidney epithelial cells, although it also has action in cardiac and skeletal muscle.Its levels rise in 6–10 hours in MI and stay high for around 4 days (Wong et al., 2017).Despite the small elevations in ALT in plasma after acute MI, even though ALT has limited in the heart, it is useful to assess the amount of ischemic tissue (Adedapo et al., 2017) .Leek has previously been shown to retain normal histological appearances of the heart and reduce increase of plasma cardiac enzyme markers, such as creatine kinase MB, during experimental MI by ISO injection because to its antioxidant and anti-inflammatory characteristics (Ardjmand et al., 2019).Curcumin has also been shown to decrease the release of LDH and boost cell viability in cardiomyocytes that have been injured (Bhushan and Kulshreshtha, 2019).By suppressing ALT and AST rise, AgNPs and Leek aqueous extract pre-treatment were found to have a hepatoprotective effect in high sugar food or diabetic animal (Jalilian et al., 2020). Swamy et al. also mention that Leek has ability to stabilize cellular membranes (Jalilian et al., 2020), since Leek pre-treatment decreased heart injury by lowering AST and ALT levels following ISO dosing AgPNS provides greater cardioprotection because to increased bioavailability of Leek nanoparticles, which increases medication delivery to infarcted cardiac tissue (Abd and Ali, 2013; Al-Zahrani and Al-Garni, 2019). Control rats and rats treated with silver nanoparticles produced from Leek showed no noticeable differences. This demonstrates Leek's non-toxic properties.

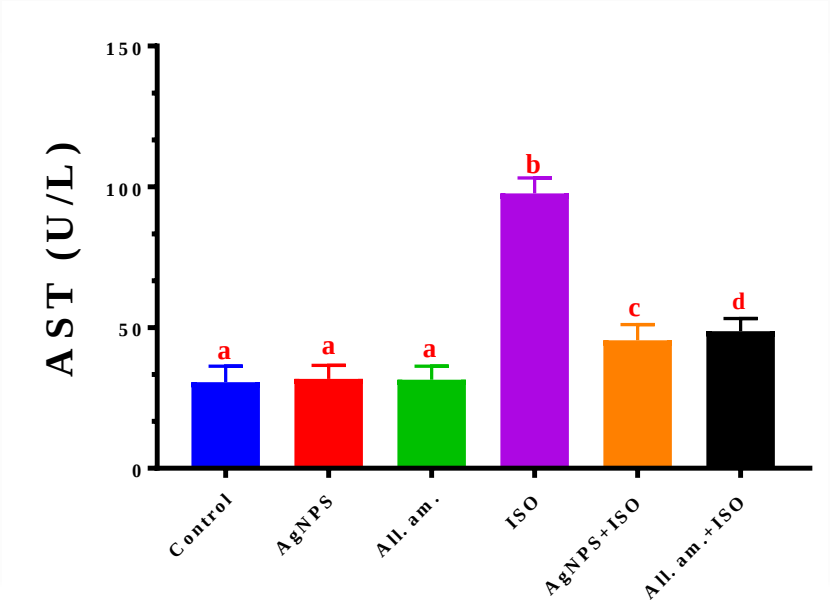

Figure (1): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on AST enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

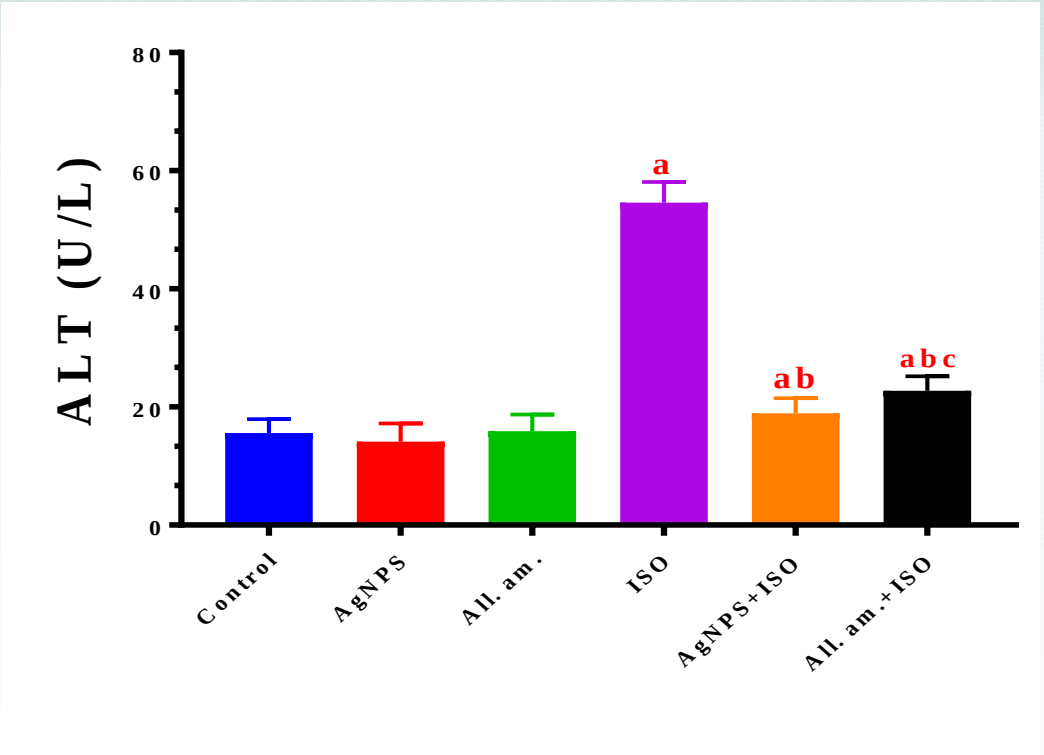

Figure (2): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on ALT enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

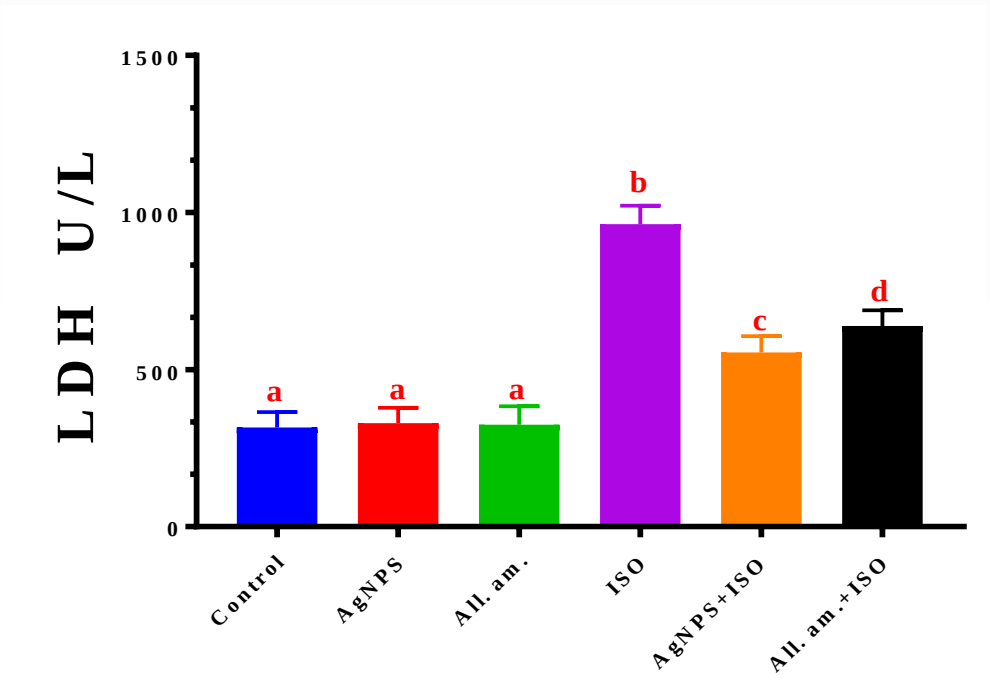

Figure (3): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on LDH enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

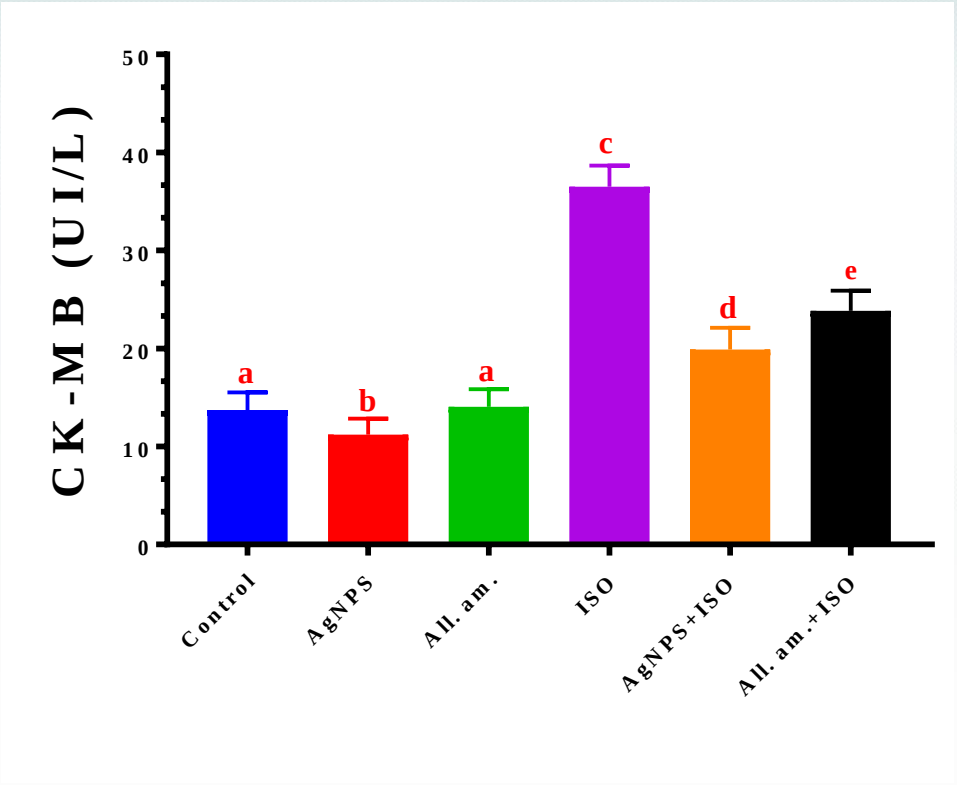

Figure (4): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on CK-MB enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

Assessment of AgNPs and *Leek aqueous extract* On oxidative stress parameters and antioxidant enzymes

An increase in oxidative stress indicators was seen when MI was induced.Higher dosages of AgNPs and Leek aqueous extract were more effective in avoiding a rise in MDA and a depletion in GSH, SOD, and CAT levels (Figure 5, 6, 7 and 8). At dosages of 200 mg/kg BW, the Leek aqueous extract avoided MDA rise and enhanced GSH, SOD, and CAT levels, compared to AgNPs and Leek aqueous extract. According to studies, one of the processes of ISO-induced cardiotoxicity is oxidative stress, and oxidative stress controlled by ROS plays a key role in ISO cardiotoxicity (Khan et al., 2018) .Once ISO penetrates the cell, it produces extremely cytotoxic free radicals and abundant ROS, causing cardiac membrane function and integrity to be lost (Fajobi et al., 2020). ISO may interact with the antioxidant system, causing oxidative damage to cardiac tissues through affecting the antioxidant system and antioxidant enzymes.The degree of oxidative stress and the degree of tissue damage have a clear positive relationship (Meeran et al., 2018) . In the same dosages, pretreatment with AgNPs had a better impact than pretreatment with Leek aqueous extract.At 200 milligrams per kilogram , the efficacy of leek aqueous extract was non-significant (Nallal et al., 2021).
CAT, SOD, and GSH are playing as RO scavenging enzymes and first-line cellular defense. enzymes eliminate (O2) and (H2O2) and stopover formation hydroxyl radical (%OH). Pretreatment group with Leek nanoparticle solution GSH, CAT, SOD, and GST activities were all enhanced in ISO-exposed rats (Adão et al., 2011).
Pretreatment of rats with Leek aqueous extract decreased lipid peroxidation as measured by MDA and increased anti-oxidation enzymes such as GSH, SOD, and catalase deficient quantities, perhaps indicating a reduction in oxidative stress. Because they include polyphenols and flavonoids, Leek nanoparticles and aqueous extract have antioxidant capabilities and can

scavenge free radicals. Flavonoids playing a big role in antioxidant so Cardio protection (Bernaert et al., 2012).

To our information, it's the first research to assess the effects of Leek nanoparticles against traditional leek pre-treatment on cardiac oxidative damage in rats with ISO-cause heart ischemia the observed oxidative damage and antioxidant capacity measures followed a similar trend (Añides et al., 2019) Following homogenization, as in cardiac tissue, with greater expression in the myocardial tissue, as predicted. We detected an increase in myocardial MDA levels following MI production when we looked at oxidative stress indicators in heart muscle (Shaikh et al., 2019), In generally, intracellular anti free radicals enzymes like SOD and CAT eliminate the free radicals generated, ensuring a regulated production and elimination of free radicals (Alkadi, 2020). When free radicals build disproportionately in vivo and are not eliminated by antioxidant enzymes in a timely manner, the equilibrium among free radicals and the body's defense mechanisms is disrupted, promoting peroxidation and cell injury (Ruan et al., 2019). Because MDA is the primary result of the lipid peroxidation process, its concentration in tissues might reflect the degree of lipid peroxidation and, consequently, the equilibrium of the free radical and antioxidant countermeasures (Żukowski et al., 2018).

Rats of group in pre-treated with AgNPS with Leek show decreased levels (Figure).MDA is a persistent lipid peroxidation end-product that is commonly employed as a measure of (ROS) generation (Jalilian et al., 2020). MDA levels in cardiac tissue of rats given ISO were higher, indicating enhanced lipid peroxidation.MDA in cardiac tissue of rats pre-treated with AgNPS and Leek were reduced (Figure 7a) indicates that the Leek has anti lipid peroxidation activities (Bernaert et al., 2012). Leek has already been shown to reduce the rate of peroxidation while help in antioxidant capacity following a myocardial hypo perfusion. (Khoshnamvand et al., 2019) and also AgPNS can better increase the antioxidant capacity.

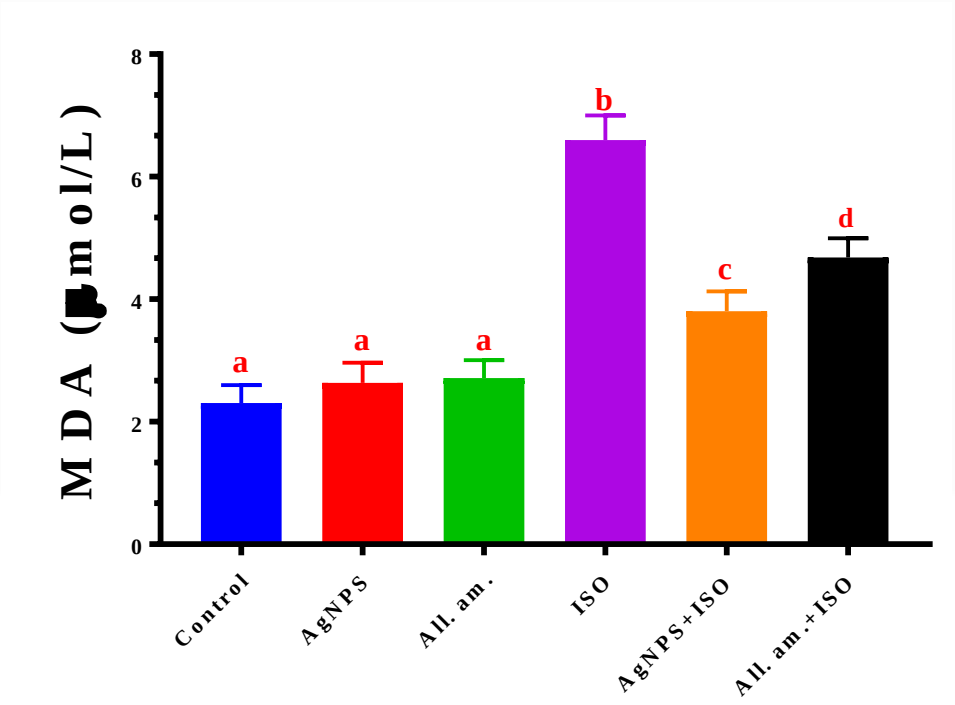

Figure (5): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on MDA enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

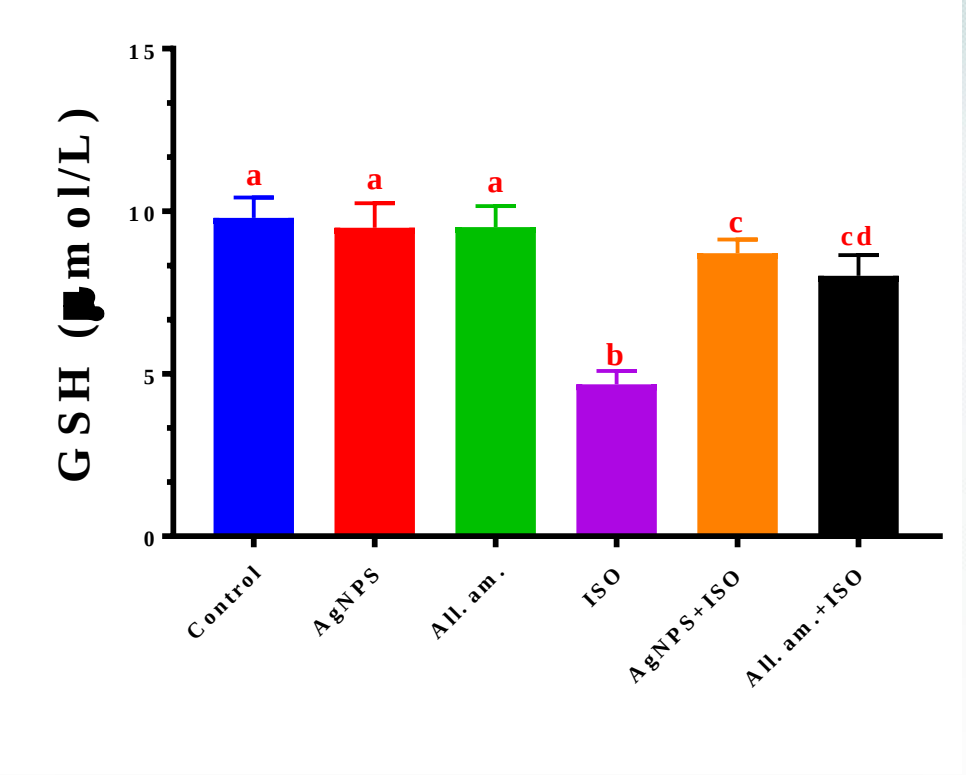

Figure (6): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on GSH enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

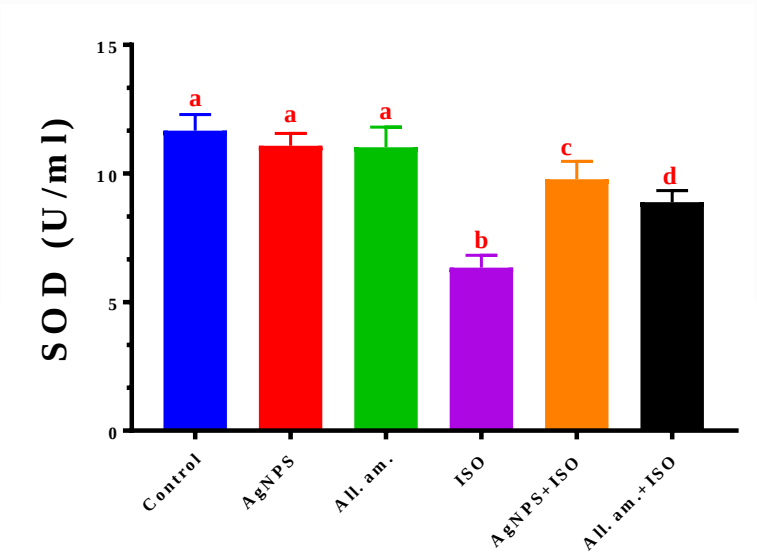

Figure (7): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on SOD enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

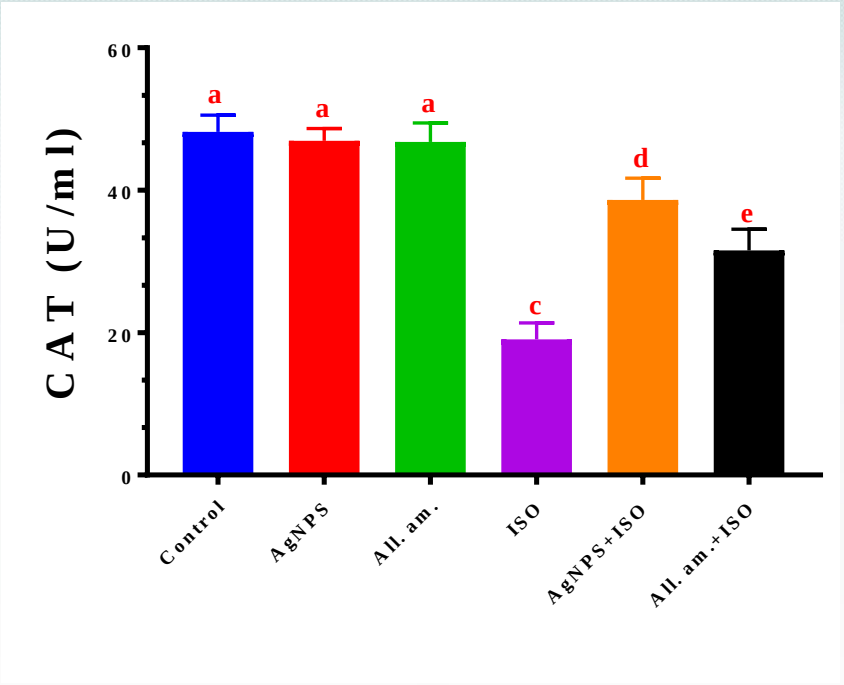

Figure (8): Effect of silver nanoparticles prepared from leeks (200 mg/kg body weight) and conventional aqueous extract of leeks (200 mg/kg body weight) on CAT enzyme concentration (unit/liter) In the serum of healthy laboratory male rats exposed to oxidative stress induced by isoprenaline (ISO) at an amount of (65 mg/kg body weight).

- Different capital letters indicate significant differences (P≤0.05) within the 45-day trial period.

Effect of **AgNPs and *Leek* aqueos extract** on histopathology of heart tissues

Histopathological analysis revealed there were significant ultrastructural alterations in the ISO-induced MI group, involving widespread leukocyte infiltration, severe diffuse edema, and protracted sub-endocardial death (figure 10) compared with control group, as previously described by our group (Wei et al., 2017). Rats given AgNPs and Leek aqueous extract showed less severe cardiac tissue alterations (figure 9), including less severe interstitial oedema, less inflammatory cell buildup, as well as less myofibrillary breakdown and death over a longer time (García-Herrera et al., 2014).

Leek's capacity to inhibit inflammatory properties of eicosanoids-induced at the site of cardiac damage prevents edema (Shahnazi et al., 2018) . Leek also helps damaged cardiomyocytes improve its mitochondrial activity, which may explain why cardiac cell degeneration and death are reduced (Nehdi et al., 2020). The greater bioavailability of Leek nanoparticles relative to Leek aqueous extract can be explained by improved immersion of Leek nanoparticles through the GIT system, lower humiliation, and decreased removal in cardiac muscle (Nallal et al., 2021).

The current study shows that pre-treatment with Leek aqueous extract and Leek nanoparticles can prevent Following a MI, the spread of injured cardiac tissue, with a higher effect evaluated by the little dissimilarity when contrast to a control group (Figures 9 and 10).When compared to the standard Leek aqueous extract, the Leek nanoparticle solution performed better, the greatest concentration (AgPNS200, Figures 9 and10) produced the best results. The enhanced potential of Leek nanoparticles to lower oxidative stress in cardiac tissue and to boost antioxidant defense is the mechanism by which they have a stronger cardioprotective impact (Jalilian et al., 2020). Leek nanoparticles should be considered as part of cardiovascular disease prevention methods, Because early initiation of this therapy can be a significant option for avert the spread of heart injuries of cardiac muscle in situations of acute MI.

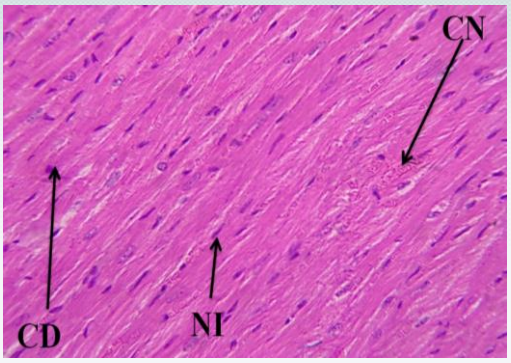

Figure (9): Cross-section of the heart of the control group showing the normal structure of cardiomyocytes (CDF), with elongated nuclei (NI) and observing the coronary veins (CNV) H&E X400

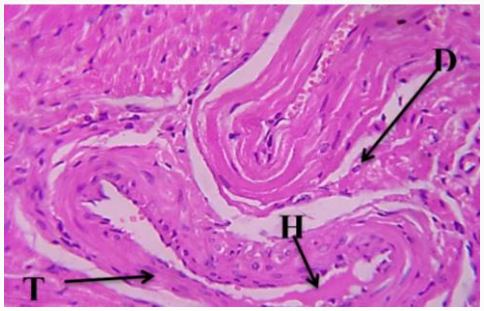

Figure (10): Cross section of the heart of the isoprenaline group showing degeneration (D) of cardiomyocytes, with thickening of the wall (TW) of the coronary veins and hemolysis (HE) H&E X400

Conclusions:

The cardioprotective effects of Leek extract and AgNPs/Leek extract were demonstrated by a reduction in high serum concentration of heart damage enzymes (CK-MB, ALT, AST, and LDH), as well as an increase in heart bioindicators of oxidative stress (MDA) and scavenger deficiency (GSH , SOD and CAT)AgNPs/Leek extract was more efficient than Leek extract in terms of cardiac histological alterations In summation, Leek extract and AgNPs/Leek extract, which is more effective, may protect Wistar rats against ISO-induced cardiotoxicity, and this effect may be mediated, at least in part, by antioxidant defense system augmentation.

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