



## Biochemical effect of garlic oil administration in heart necrosis induced experimentally in rats.

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### ABSTRACT

In the present study, the potential protective and therapeutic effect of garlic oil (G.O) administration on serum creatine kinase, (CK), creatine kinase – MB (CK-MB), lactate dehydrogenase (LDH), aspartate amino transferase (AST), total protein (T.P), albumin (Alb), electrolytes (calcium, sodium, potassium and phosphorus), glucose, RBCs glucose-6-phosphate dehydrogenase (G6PDH), heart tissue lipid peroxidation, and antioxidant enzymes in isoproterenol (ISO)-induced cardiac necrosis in rats have been evaluated. Eighty male albino rats were divided into four equal groups (20 each). Group I (Control group): received no drugs. Group II (ISO group): rats injected subcutaneously with isoproterenol at a dose of (20 mg/kg body weight in 1 ml saline) for 2 consecutive days for cardiac necrosis induction. Group III (Protective group): received G.O at a dose of (75 mg/kg B.Wt in 1 ml corn oil/day) orally for 60 days prior ISO injection and continued G.O administration for another 60 days. Group IV (Treatment group): rats administered G.O at a dose of (75 mg/kg b.wt/60 days) orally. Blood samples and heart tissues were collected from all groups (control, protective, ISO, treatment) after 30 and 60 days post isoproterenol injection. The obtained results showed that isoproterenol injection to rats significantly increased (CK, CK-MB, LDH, AST, glucose, Ca, Na) in serum, G6PDH in RBCs and L-MDA in heart tissue while significantly decreased (T.P, Alb, K, P) in serum and (SOD, CAT in heart tissue) when compared to control. Administration of garlic oil protects from increased cardiac marker enzymes and restored the biochemical and antioxidant parameters nearly to normal. These results indicated the effect of G.O against ISO-induced oxidative damage.

**Keywords:** Garlic oil, Isoproterenol, Antioxidant enzymes, Cardiac necrosis.

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## 1. INTRODUCTION

Cardiovascular diseases (CVDs) such as hypertension and myocardial infarction (MI) are the most important cause of mortality in developing countries due to changing life styles (Rajadurai and prince, 2007). MI is the acute condition of myocardial necrosis between coronary blood supply and myocardial demands (Upaganlawar and Balaraman, 2010), it increases the generation of reactive oxygen species in ischemic tissue, bringing

about oxidative damage of membrane lipid, proteins, carbohydrates and DNA and brings changes in the mechanical, electrical, structural and biochemical properties of the heart (Wang et al, 2009). Natural drugs are gaining greater acceptance from the public and medical profession due to greater advances in understanding the mechanism of action by which herbs can positively influence health (Nivethetha et al, 2009). Although modern drugs are effective in

preventing the cardiovascular disorders, their use often limited because of their side effects and adverse reactions (Thippeswamy *et al.*, 2009). ISO is a synthetic adrenergic agonist that causes severe stress in the myocardium resulting in infarct like necrosis of the heart muscle. The rat model of ISO induced myocardial necrosis serves as accepted standardized model to evaluate several cardiac dysfunction and to study the efficacy of various natural and synthetic cardioprotective agents (Upaganlawar *et al.*, 2011). Epidemiologic studies show an inverse correlation between herbal therapies such as Garlic (Liliaceae) and progression of cardiovascular diseases. Garlic has acquired a special position in the folklore of many cultures prophylactic and therapeutic medicinal agent (Rahman and Lowe, 2006). The preparations of garlic have been widely recognized as agents for prevention and treatment of cardiovascular and other metabolic diseases such as atherosclerosis, arrhythmia, hyperlipidemia (Khan *et al.*, 2008), thrombosis, hypertension and diabetes (Banerjee and Maulik, 2002). Further, dietary garlic preparations were reported for wound healing (Jalali *et al.*, 2008) and immunomodulatory activities (Jafari *et al.*, 2009). Garlic was also reported to possess cardioprotective, antioxidant, antineoplastic and antimicrobial properties (Rahman and Lowe, 2006) and it has significant antiarrhythmic effect in both ventricular and supraventricular arrhythmias (Rietz *et al.*, 1993). Moreover, garlic also exerts antioxidant effect during isoprenaline induced myocardial infarction in rat (Asdoq and Inamdar, 2010; Anoush *et al.*, 2009). One of the varieties of garlic is medicinal garlic (MG), usually found in Himalayas and china. It has milder and slightly perfumed flavor when compared to regular garlic. In spite of its traditional medicinal claims like prophylactic for bird flu, rarely explored for their role as cardioprotective agent.

So, the aim of this study is to evaluate the garlic oil administration on as a

therapeutic and a protective agent against cardiac necrosis.

## 2. MATERIAL AND METHODS

### 2.1. Experimental animals:

Eighty white male albino rats of 12-16 weeks old weighing 180-220 g were used in this study. The rats were obtained from the laboratory animals research center, Faculty of Veterinary Medicine, Benha University. Rats were housed in separated wire mesh cages and kept at constant environmental and nutritional conditions throughout the period of the experiment. The animals were fed on constant ration and fresh, clean drinking water was supplied *ad libitum*. The animals were left 14 days for acclimatization before the beginning of the experiment.

### 2.2. Drugs and Chemicals:

1) Isoproterenol and garlic oil were obtained from Sigma chemical company. ISO was injected to rats at dose of 20mg /kg B.Wt dissolved in 1 ml saline solution, *s.c* for 2 consecutive days to induce cardiac necrosis (Senthilkumar *et al.*, 2010).

2) Garlic oil was administrated daily to rats at dose of (75 ml/kg B.Wt/orally) according to senthilkumaretal, 2010 in 1ml corn oil according to (Gulnaz *et al.*, 2010).

### 2.3. Experimental design:

Rats were randomly divided in to four main equal groups, 20 rats per each, placed in individual cages and classified as follows : Group I: normal control group : received no drugs. Group II: ISO group: Injected with ISO at a dose of 20 mg /kg b.wt, *s.c* for 2 consecutive days. Group III: Protective group: Rats were received G.O at a dose of (75 mg /kg B.Wt in 1 ml corn oil/daily) orally for 60 days started from the 1<sup>st</sup> day of the experiment prior to ISO administration (in the 60<sup>th</sup> day of the experiment) followed by administration of

G.O for another 60 days (from the day 62 to the end of the experiment). Group IV: Treatment group: Cardiac necrosis was induced in rats at the 60<sup>th</sup> day in the experiment, after 72 hours (62<sup>th</sup> day) G.O treatment (75 mg /kg B.Wt in 1 ml corn oil / day) orally for 60 days (from the day 62) to the end of the experiment.

#### 2.4. Sampling :

Blood samples were collected 72 hours after ISO injection from control, ISO and protective groups to be sure that heart necrosis occurred. Other blood samples and heart tissues were collected from all groups (control, protective, ISO, treatment) after 30 and 60 days post isoproterenol injection.

-Blood samples were divided in to 2 parts:

##### 2.4.1. Serum samples:

First part blood samples for serum separation were collected by ocular vein puncture at the end of each experimental period in dry clean and screw capped tubes .Serum were separated by centrifugation at 2500 r.p.m for 15 mins . The clean , clear serum was separated by automatic pipette and received in dry sterile samples tube and kept in deep freeze at -20° C until used for subsequent biochemical analysis . All sera were analysed for (CK, CK-MB, LDH and AST, T.P, Alb, glucose, Ca, Na, K and P) determination.

##### 2.4.2. RBCs samples:

The second part of blood was collected on heparinized tubes and used for determination of G-6-PDH.

##### 2.4.3. Tissue samples (Heart tissue):

Rats were sacrificed by cervical decapitation .Heart tissues were obtained ,cleaned by rinsing with ice- cold isotonic saline to remove any blood cells , clots , then blotted between 2 filter papers and quickly stored in a deep freezer at (-20°C)for subsequent

biochemical analysis. Briefly heart tissues were divided into appropriate portions , homogenized with a glass homogenizer in 9 volume of ice – cold 0.05 mM potassium phosphate buffer (PH 7.4) to make 10% homogenates .The homogenates were centrifuged at 6000 r.p.m for 15 minutes at 4°C then the resultant supernatant were used for the determination of the following parameters: SOD ,CAT and L-MDA.

#### 2.5. Biochemical analysis:

Serum was used for estimation of CK according to Young, (2001), CK-MB according to Urdal and Landaa,(1979), LDH according to Scientific Committee, (1982), AST according to Reitman and Frankel, (1957), T.P. according to Kaplan and Szalbo, (1983), Alb according to Doumas et al, (1997), Glucose according to Trinder, (1969), G-6-PDH in RBCs using the method of Glock and McLean, (1953), Ca according to McLean and Hastings, (1935), Na according to Trinder, (1951), K according to Berry et al, (1989), P by the method of Gamst and Try, (1980), cardiac tissue used for determination of SOD according to Nishikimi et al, (1972) .CAT by the method of Sinha (1972), and MDA measured according to Ohkawa et al,(1979).

#### 2.6. Statistical analysis:

The obtained data were statistically analyzed by one-way analysis of variance (ANOVA) followed by the Duncan, s multiple test. All analyses were performed using the statistical package for social science (SPSS, 13.0 software). Values at 0.05 were considered to be significant.

### 3. RESULTS

#### 3.1. Effect of isoproterenol injection on serum cardiac markers 72 hours after induction of cardiac necrosis:

The obtained results in table (1) revealed ,

significant increase in serum CK, CK-MB , and LDH in ISO group when compared to control group .Pretreatment with G.O (60 days ) in ISO induced MN in rats (72 hours) resulted in significant decrease in LDH accompanied with anon significant decrease in CK,CK-MB when compared with ISO group.

*3.2. Effect of administration of G.O in control, ISO, treatment and protective groups after ISO injection on serum, RBCs and tissue parameters.*

The obtained results in table (2 ) revealed that , significant increase in CK ,CK-MB , LDH , AST ,Glucose, Ca , Na in serum ,G-6-PDH in RBCs , and L-MDA in heart tissue were observed in ISO induced MN in rats when compared to control .On the other hand , significant decrease in T.P , Alb, K,P in serum and (SOD, CAT) in heart tissue were observed in MN induced rats when compared to control. Pretreatment with G.O in ISO induced MN in rats resulted in significant decrease in CK, CK-MB, LDH, AST, Glucose, Ca, Na in serum, G-6-PDH in RBCs and L-MDA in tissue. Meanwhile, significant increase in T.P, Alb, K,P. in serum and (SOD, CAT) in heart tissue when compared with MN non treated group .

Treatment with G.O in ISO induced

myocardial necrosis in rats resulted in significant decrease in CK, CK-MB, LDH, AST, Glucose, Ca, Na in serum, G-6-PDH in RBCs and L-MDA in heart tissue. Meanwhile, the value of T.P., Alb, K, P in serum, and SOD, CAT in heart tissue were significantly increased as compared with MN non treated group.

#### 4. DISCUSSION

ISO Induces morphological and functional alterations In the heart leading to myocardial necrosis. It also produces excessive free radicals resulting from oxidative metabolism of catecholamine. There are increasing evidences that Cardio toxicity of ISO occurs through oxidative mechanism (Remiao et al, 2001).

ISO , the cardiotoxic agent , damages the myocardial cells resulting in the loss of membrane integrity and as a result , the cytosolic enzymes creatine phosphokinase (CK), lactate dehydrogenase,(LDH) and aspartate aminotransferase(AST) are released into the blood stream and serve as diagnostic markers of the myocardial membrane damage (Sabeena et al, 2004 ;and Gurgun et al, 2008),

Table (1): Effect of isoproterenol injection (72 hours) on serum cardiac Biomarkers (CK (U/L), CK-MB (U/L), LDH (U/L)) in control, ISO and protective groups.

Groups	CK-MB	CK-total	LDH
Control	301.23±10.77 <sup>b</sup>	157.30±3.41 <sup>b</sup>	768.4±53.22 <sup>b</sup>
ISO	484.30±53.19 <sup>a</sup>	973.13±165.29 <sup>a</sup>	1874.00±71.10 <sup>a</sup>
Protective	404.08±42.48 <sup>a</sup>	787.20±1.77 <sup>a</sup>	840.05±38.50 <sup>c</sup>

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Table (2): Effect of garlic oil administration after induction of cardiac necrosis in all groups on (CK (U/L) ,CK-MB (U/L), LDH (U/L), AST (U/L), Glucose (mg/dl), G6PDH (U/10(12)<sup>10</sup> RBC), T.P. (g/dl), Alb (g/dl), Ca (mmol/g. tissue), SOD (U/g. tissue), L-MDA (mmol/g. tissue), Ca (mmol/L), Na (mEq/L), K (mEq/L), P (mmol/L) ) for 30 days.

parameters	CK	CK-MB	LDH	AST	Glucose	G-6-PDH	T.P	Alb	CAT	SOD	L-MDA	Ca	Na	K	P
Groups	U/L	U/L	U/L	U/L	mg/dl	U/10(12) <sup>10</sup> RBC	g/dl	g/dl	m mol/ g.tissue	U/g.tissue	m mol / g .tissue	m mol/L	m Eq/L	m Eq/L	m mol/L
control	177.80± 16.43 <sup>a</sup>	281.65±2 2.43 <sup>c</sup>	619.63± 67.36 <sup>a</sup>	147.65± 3.54 <sup>c</sup>	79.75± 11.35 <sup>ab</sup>	65.4 ±1.15 <sup>b</sup>	6.95± 0.17 <sup>c</sup>	4.10± 0.61 <sup>c</sup>	63.35± 6.62 <sup>c</sup>	54.84± 8.69 <sup>c</sup>	0.85± 0.01 <sup>a</sup>	10.45± 0.15 <sup>b</sup>	160.35± 1.89 <sup>b</sup>	6.80± 0.10 <sup>c</sup>	6.88± 0.13 <sup>bc</sup>
ISO	752.41± 506.18 <sup>c</sup>	482.75±8 1.04 <sup>c</sup>	1553.75± 406.57 <sup>b</sup>	281.20± 11.40 <sup>d</sup>	142.53± 3.89 <sup>c</sup>	86.97± 1.37 <sup>d</sup>	7.48± 0.31 <sup>d</sup>	5.70± 0.52 <sup>d</sup>	37.26± 1.23 <sup>a</sup>	36.44± 0.42 <sup>a</sup>	2.60± 0.10 <sup>c</sup>	14.90± 0.22 <sup>a</sup>	184.78± 7.47 <sup>c</sup>	4.70± 0.26 <sup>a</sup>	3.05± 0.13 <sup>a</sup>
Treatment	552.35± 385.1 <sup>b</sup>	268.75±2 1.88 <sup>b</sup>	746.43± 433.83 <sup>a</sup>	133.48± 68.23 <sup>b</sup>	84.25± 29.18 <sup>b</sup>	73.1± 10.28 <sup>c</sup>	4.70± 1.47 <sup>b</sup>	3.73± 1.26 <sup>b</sup>	45.84± 10.19 <sup>b</sup>	49.45± 8.40 <sup>b</sup>	1.40± 0.75 <sup>b</sup>	9.70± 2.93 <sup>b</sup>	161.98± 14.92 <sup>b</sup>	5.70± 1.20 <sup>b</sup>	6.21± 2.07 <sup>b</sup>
protective	443.88± 73.46 <sup>b</sup>	158.75±3 0.83 <sup>a</sup>	685.25± 56.36 <sup>a</sup>	114.95± 2.54 <sup>a</sup>	74.00± 5.35 <sup>a</sup>	61.33± 0.65 <sup>a</sup>	4.20± 0.14 <sup>a</sup>	2.45± 0.24 <sup>a</sup>	48.78± 0.68 <sup>b</sup>	52.47± 1.23 <sup>bc</sup>	0.83± 0.01 <sup>a</sup>	8.52± 0.08 <sup>b</sup>	146.15± 1.72 <sup>a</sup>	7.70± 0.26 <sup>d</sup>	8.00± 1.56 <sup>c</sup>
60 days															
parameters	CK	CK-MB	LDH	AST	Glucose	G-6-PDH	T.P	Alb	CAT	SOD	L-MDA	Ca	Na	K	P
Groups	U/L	U/L	U/L	U/L	mg/dl	U/10(12) <sup>10</sup> RBC	g/dl	g/dl	m mol/ g.tissue	U/g.tissue	m mol / g .tissue	m mol/L	m Eq/L	m Eq/L	m mol/L
control	196.40± 32.36 <sup>a</sup>	291.00± 10.80 <sup>b</sup>	661.73± 27.00 <sup>c</sup>	148.33± 3.81 <sup>c</sup>	82.33± 11.67 <sup>c</sup>	65.4± 0.85 <sup>c</sup>	6.90± 0.08 <sup>c</sup>	3.95± 0.13 <sup>c</sup>	63.48 ±7.38 <sup>a</sup>	60.22± 8.15 <sup>c</sup>	0.85± 0.01 <sup>b</sup>	10.57± 0.43 <sup>c</sup>	159.03± 2.33 <sup>b</sup>	6.37± 0.35 <sup>b</sup>	6.87± 0.13 <sup>bc</sup>
ISO	1176.0± 136.99 <sup>b</sup>	486.50± 5.57 <sup>d</sup>	2673.5± 69.21 <sup>a</sup>	316.28± 15.05 <sup>d</sup>	154.33± 4.71 <sup>d</sup>	92.63± 0.73 <sup>d</sup>	8.45± 0.92 <sup>d</sup>	5.50± 0.48 <sup>d</sup>	31.16± 4.05 <sup>a</sup>	35.03± 0.47 <sup>a</sup>	3.10± 0.10 <sup>d</sup>	15.53 ±2.19 <sup>c</sup>	197.30± 23.13 <sup>c</sup>	4.00± 0.10 <sup>a</sup>	2.49± 0.07 <sup>a</sup>
Treatment	413.65± 320.53 <sup>b</sup>	141.00± 18.57 <sup>b</sup>	448.25± 991.47 <sup>b</sup>	123.20± 86.97 <sup>b</sup>	66.55± 40.37 <sup>b</sup>	55.77± 18.03 <sup>b</sup>	3.55± 2.50 <sup>b</sup>	3.35± 1.40 <sup>b</sup>	55.66± 14.47 <sup>b</sup>	52.32± 864.11 <sup>b</sup>	0.94± 1.02 <sup>c</sup>	8.73± 2.90 <sup>b</sup>	144.93± 26.00 <sup>a</sup>	6.57± 1.62 <sup>b</sup>	6.98± 4.24 <sup>b</sup>
protective	248.85± 6.72 <sup>ab</sup>	81.50± 10.85 <sup>a</sup>	322.5± 42.59 <sup>ab</sup>	105.93± 8.35 <sup>a</sup>	55.93± 7.7 <sup>a</sup>	46.57± 1.27 <sup>a</sup>	2.65± 0.37 <sup>a</sup>	1.78± 0.13 <sup>a</sup>	64.66± 6.19 <sup>c</sup>	63.16± 4.45 <sup>c</sup>	0.74± 0.01 <sup>a</sup>	7.55± 0.29 <sup>a</sup>	137.90± 3.46 <sup>a</sup>	8.30± 0.26 <sup>c</sup>	13.35± 4.05 <sup>c</sup>

(mean±SE) SE: Standard error a significant < 0.05 aa high significant < 0.01 aaa very high significant < 0.001 Mean values with different superscript letters in the same column and in the same row are significantly different at (P< 0.05).

the diagnostic marker enzymes CK,LDH and AST increased significantly in the isoproterenol treated rats when compared to control rats (Lalitha et al, 2012). The diagnostic marker enzymes of myocardial infarction (MI) are CK-MB and LDH, release of these biomarkers in serum indicates myocardial injury (Asdaq and Inamdar, 2010). The quantity of enzyme released from the damaged tissue is a measure of the number of necrotic cells (Manjula et al, 1992). Extent of cardio protection offered by the drug is associated with significant attenuation of plasma creatine kinase (Gao et al, 2000) and LDH levels (Hung et al, 2001).In the present study, a significant decrease in serum levels of CK, CK-MB, LDH and AST in protective and treatment groups is indicative of the fact that garlic oil has a significant cardioprotective effect and maintains myocardial membrane integrity, reducing the myocardial damage restricting the increase in these enzymes levels (Senthilkumar et al, 2010). Pretreatment with garlic decreased the ISO induced

elevation of serum CK-MB and LDH level may be by protecting the cell membrane from the destructive effect of free radicals and also by inhibiting the oxidative modification of LDL as well by balancing lipid profile (Rahman and Lowe, 2006).

The activities of antioxidant enzymes (SOD, CAT) were decreased significantly in the heart tissue of isoproterenol injected animals when compared to control animals which concurs with the previous study of (Ithayarasi et al, 1996). The decrease in the activities of these enzymes is due to the increased generation of reactive oxygen radicals, such as superoxide and hydrogen peroxide, which in turn leads to the inhibition of these enzymes (Patel et al, 2010 and Sabeena et al, 2004). Garlic oil pretreatment increases the activity of (SOD and CAT) and it scavenge superoxide

radicals and reduces myocardial damage caused by free radicals (Saravanan and Prakash, 2004). Subsequent to isoproterenol administration an increased formation of lipid peroxidation product, MDA was also observed. Lipid peroxidation is an important pathogenic event in myocardial necrosis and the accumulation of lipid hydroperoxides reflects cardiac damage (Sevenian and Hochstein, 1985). The increased lipid peroxides in isoproterenol- induced G.O administration resulted in reduction of MDA levels .The antioxidant action of G.O can be explained by scavenging or neutralizing of free radicals , inhibiting hydrogen peroxide and tumor necrosis factor – alpha (Ban et al, 2007), inhibiting xanthine oxide (Ou et al, 2003), interacting with oxidative cascade and preventing its outcome, oxygen quenching and making it less available for oxidative reaction, inhibition of cytochrome P450 (Ho et al, 2010). However , G.O improved the antioxidant mechanism due to the ability of diallyldisulfide and diallyltrisulfide present in G.O in modulating the oxidative stress and detoxifying enzyme system (Pedraza-Chaverri et al, 2007 and Hassan et al, 2009). They reduce proinflammatory cytokines through blockade of nuclear factor kappa –B (NF-KB)(Ban et al, 2007). G.O block cell mediated cytokines (Oommen et al, 2004), prevent the reactive oxygen species from acting on DNA and micronuclei formation (Zhang et al, 2012), suggesting a possible role of G.O as chain breaking antioxidant against lipid peroxidation (Pari et al, 2007).

In this study, decreased levels of serum total proteins were observed in isoproterenol induced rats .These results could be due to increased free radicals production by the administration of isoproterenol (Saranya et al, 2012), furthermore Low albumin and total protein concentrations may result from a number of oxidative processes , such as changes in vascular permeability (Shearman

etal,1988), secondary to vascular injuries , or may be a marker of increased oxidation of lipoproteins (Esterbauer et al, 1989). Administration of G.O resulted in significant increase in serum total protein by preventing protein oxidation (Metwally, 2009).In these results , serum total protein and albumin were significantly increased and that may be due to the ability of garlic oil to scavenge free radicals (Chung, 2006).

Increased level of blood glucose was observed in isoproterenol group may be due to the enhanced glycogen breakdown and less utilization (Prabhu et al, 2006). Ashour et al, (2011) stated that treatment of diabetic rats with garlic oil alleviates each of hyperglycemia .It shows an improvement in the insulin level in the diabetic rats when treated with garlic. In this regard , it has been reported that the garlic may affect the insulin secretion from B- cells , release of bound insulin or increase of insulin sensitivity (Thomson et al, 2007), therefore directly reduce blood glucose levels by stimulating glycogenesis and inhibiting gluconeogenesis and glycogenolysis in hepatic and muscle cells ; it may increase beta cells in the pancreas by activating regulation of these cells (Shanmugasundaram et al, 1990), thereby affecting blood glucose (Nelson et al, 1991). In this regard ,the previous auther and his team work has been reported that (s-allylcysteinsulfoxide) allicin of garlic is the responsible component for enhancing serum insulin activity due to its free SH group and also may be due to restoration of delayed insulin response or due to inhibition of intestinal absorption of glucose (Block, 1985). In addition, antioxidative property of allicin might be another reason of garlic beneficial effect on diabetes (Augusti, 1996). Therefore, treatment with garlic which contain compounds such as S-allylcysteine and organosulfur can gradually normalize oxidative stress and causes an increase in

serum insulin levels in diabetic rats, delaying the side effects of diabetes (liu et al, 2005).

The catecholamine, isoproterenol stimulated the activity of myocardial G6PDH in atime and dose dependent manner .The isoproterenol induced stimulation was c-AMP – dependent may be due to increased new synthesis of enzyme protein (Zimmer, 1996). Chess and Stanley, (2008) also suggested that may be due to the development of and progression of heart failure .The increased activity of glucose 6 phosphate dehydrogenase , may increase the rate of synthesis of NADPH level , thereby increases lipid biosynthesis and lipid peroxidation (Abhilash et al, 2011). G6PDH is elevated In response to external stimuli like toxic agents and oxidative stress .Garlic oil exerts its effects by modulating lipid peroxidation and enhancing antioxidant and detoxifying enzyme system (Saravanan and Prakash, 2004). Diallylsulfide (DAS, one of active ingredients of garlic oil) administration decreased G6PDH indicating that increased amounts of NADPH are required for detoxification process (Rizk and Ibrahim, 2008).

The changes in the levels of sodium and potassium in ISO group may be attributable to loss of cellular integrity, inhibition of Na<sup>+</sup> / k<sup>+</sup> ATPase function as a result of energy depletion and changes in ratio of intracellular and extra cellular volume (Constantindes et al, 2001). In the cell, ATPases are closely associated with the plasma membrane and participate in the energy dependent transport of sodium, potassium, magnesium and calcium translocation. An increase in sodium and calcium along with decrease in potassium were observed in ISO injected rats which might be due to altered ATPases activity in membrane as a result of lipid peroxidation produced by ISO. Increased concentration of sodium might be due to decrease in

Na<sup>+</sup>/K<sup>+</sup> ATPase (Alnumair *et al.*, 2012). Depletion of ATP by ISO leads to opening of K<sup>+</sup> channel leading to the decrease in K<sup>+</sup> ions in the myocardial tissue. Increased levels of intracellular Na<sup>+</sup> also operate to depress Ca<sup>2+</sup> effect and augment Ca<sup>2+</sup> influx. In the present results, ISO caused a significant increase in Ca<sup>2+</sup>, Na<sup>+</sup> and a significant decrease in K<sup>+</sup>, P while G.O caused significant decrease in Ca<sup>2+</sup>, Na<sup>+</sup> and a significant decrease in K<sup>+</sup>, P. Administration of G.O to cardiac necrotic groups showed significant decrease in serum Ca and Na levels while significant decrease in serum K and P. This may be due to the ability of G.O to regulate the electrolyte levels. Administration of G.O can prevent the altered levels of electrolyte and these effects of G.O could be due to the prevention of 'SH' group of the ATPases from oxidative damage through the inhibition of peroxidation of membrane lipids indicating the membrane stabilizing effects of G.O (Saravanan and Prakash, 2004; Chung *et al.*, 2006). In conclusion, the present study demonstrated that G.O administration provided an effective protection against myocardial necrosis and oxidative damage in heart tissue induced by isoproterenol injection in rats, since G.O was able to ameliorate serum (CK, CK-MB, LDH, AST, T.P, Alb, glucose, Ca, Na, K, P), RBCs (G6PDH) and antioxidant defense system in heart tissue (CAT, SOD and L-MDA).

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## التأثير الكيميائي الحيوي لزيت الثوم في احتشاء عضلة القلب المحدث تجريبيا في الفئران .

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### المخلص العربي

تم لإجراء هذه الدراسة عدد 80 من ذكور الجرزان البيضاء وقد قسمت الى أربع مجموعات متساوية (20 فأر) وتم توزيعها كالاتي: المجموعة الأولى (المجموعة الضابطة): لم تعطى أى أدوية. المجموعة الثانية: (مجموعة الأيزوبروتيرنول): تم اعطاء الأيزوبروتيرنول عن طريق الحقن تحت الجلد بتركيز 20 مليجرام لكل كيلوجرام في 1 مل محلول ملحي في يومين متتاليين لاحداث احتشاء القلب. المجموعة الثالثة (المجموعة الوقائية): تم اعطاء زيت الثوم بتركيز 75مليجرام لكل كيلو جرام في 1 مل زيت الذرة لمدة 60 يوم قبل وبعد الحقن بالأيزوبروتيرنول. المجموعة الرابعة: (المجموعة المعالجة): تم اعطاء زيت الثوم بجرعة 75 مليجرام لكل كيلو جرام في 1 مل زيت الذرة لمدة 60 يوم عن طريق الفم. تم سحب عينات الدم فقط من مجموعة الأيزوبروتيرنول والمجموعة الوقائية والمجموعة الضابطة بعد الحقن ب 72 ساعة فقط للتأكد من حدوث المرض ثم تم سحب عينات الدم والأنسجة من جميع المجموعات في اليوم 30 واليوم 60 بعد حقن الأيزوبروتيرنول. وقد أظهرت نتائج التحليل البيوكيميائي حدوث احتشاء عضلة القلب في اليوم الثالث من الحقن بالأيزوبروتيرنول في مجموعة الأيزوبروتيرنول بزيادة الكرياتين كائينز والكرياتين كائينز ام بي واللاكتيت ديهيدروجينيز مقارنة بالمجموعة الضابطة والمجموعة الوقائية. كما أظهرت النتائج زيادة ملحوظة في الكرياتين كائينز والكرياتين كائينز ام بي والاسبارتيت امينو ترانسفيريز واللاكتيت ديهيدروجينيز والجلوكوز والجلوكوز 6 فوسفات ديهيدروجينيز والكالسيوم والصوديوم في الدم والمالونداى الدهيد في نسيج القلب وانخفاض معنوى في البروتين الكلى والالبومين في الدم والسوبر اكسيد ديسميوتيز والكتاليز في نسيج القلب في مجموعة الأيزوبروتيرنول المحدث بها احتشاء عضلة القلب مقارنة بالمجموعة الضابطة كما ان المجموعة الوقائية والمجموعة العلاجية أظهرت انخفاض ملحوظ في كلا من في الكرياتين كائينز والكرياتين كائينز ام بي والاسبارتيت امينو ترانسفيريز واللاكتيت ديهيدروجينيز والجلوكوز 6 فوسفات ديهيدروجينيز والكالسيوم والصوديوم في الدم والمالونداى الدهيد في نسيج القلب وزيادة معنوية في البروتين الكلى والالبومين في الدم والسوبر اكسيد ديسميوتيز والكتاليز في نسيج القلب مقارنة بمجموعة الأيزوبروتيرنول . ومن هنا أوضحت الدراسة أن استخدام زيت الثوم كمادة واقية ومضادة للأكسدة كان لها دور فعال في حماية عضلة القلب من الاحتشاء المحدث تجريبيا في الجرذان باستخدام الأيزوبروتيرنول. لذلك توصى الدراسة بضرورة استخدام زيت الثوم كمادة وقائية وعلاجية ومضادة للأكسدة .

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