Effect of magnesium and garlic extract on the lipid profile of male rats

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Abstract:
The study was conducted in the animal house at the College of Pharmacy, University of Karbala, for a period of one month. The study included 25 adult male rats, randomly distributed into 5 groups, each group 5 animals. The first healthy group was fed a regular diet throughout the duration of the experiment, while the second group, high-fat animals, were fed a diet. Containing 1% of pure cholesterol, the third group was fed a diet containing 1% of cholesterol and dosed with alcoholic garlic extract at a concentration of 300 mg/kg, and the fourth group was fed a diet containing 1% of cholesterol and with magnesium sulfate given orally in drinking water at a concentration 10 liters/g. As for the fifth group, they were fed a diet containing 1% of cholesterol and were dosed at the same time with alcoholic garlic extract at a concentration of 300 mg/kg and magnesium sulfate was given orally in drinking water at a concentration of 10 liters/g. The study was designed to know the protective role of garlic and magnesium extract in reducing and improving risk factors for the cardiac system in white male rats. The results showed a significant increase in biochemical variables (in fats, which includes high total cholesterol, cholesterol Total and triglycerides Triglycerides, high and low density lipoprotein, Low Density lipoprotein, The lipoprotein is very low density, Very Low Density lipoprotein, In the serum of the cholesterol-treated group only, compared to the control group, it also showed a significant decrease) (in high-density lipoprotein concentration, High Density lipoprotein, As for the groups treated with garlic extract and magnesium, their role was observed in the ability to reduce lipids in the blood serum and thus reduce the risk of atherosclerosis.

Key words: cholesterol, lipid profile, garlic extract, magnesium.

Introduction

The term hyperlipidemia refers to Hyperlipidemia. This rise is due to a defect in lipid metabolism and function, which results in malnutrition, obesity and genetic diseases such as familial hypercholesterolemia. Familial hypercholesterolemia or other diseases such as diabetes Diabetes (Sudhakaran et al., 2018; Yao et al., 2020). Cardiovascular diseases may be affected in patients with high blood lipids, so hyperlipidemia or what is known as hyperlipidemia is very important for predicting coronary atherosclerosis. Coronary artery diseases and cerebrovascular disease Cerebral vascular diseases (Elhissi et al., 2014);( Zhang et al., 2018). Medicinal plants have been used since ancient time, where plants contain active substances that have a positive effect and often have a harmful effect, and unlike medicinal drugs they have harmful secondary effects, so researchers and scientists turned to studying medicinal plants and knowing their active substances and their curative and preventive benefits due to their importance in industrial, commercial, medical and other terms (Qubea, 2011).
Among the most important medicinal plants known for many benefits is the garlic plant known by its scientific name *Allium sativum*. As for the local name, it is from the family of garlic *Alliaceae*. The important part is usually used, which is the lobes (cloves) and characterized by extracts of garlic and water being alcoholic with an important effect on the body of the organism, making this plant a well-known medical importance (Ried *et al.*, 2013).

Diet therapy is the first step in the treatment of atherosclerosis, and it includes eating garlic, as it reduces the concentration of fat and thus reduces the accumulation of fat without the need to use medications. (Bitzur *et al.*, 2005). Garlic is the most important food used in traditional and herbal medicine in many cultures to treat cardiovascular diseases and other disorders. (Srinivasan and Srinivasan, 1995), magnesium. MgIt is an essential component of human health and its deficiency has been linked to the development of lipid abnormalities and related disorders, such as metabolic syndrome. The metabolic syndrome or type 2 diabetes Type 2 diabetes mellitus, or cardiovascular disease (Găman *et al.*, 2021). Magnesium is a natural element and has an important role in the prevention of atherosclerosis and hyperlipidemia (Maier, 2003).

**Materials and methods**

1-plant collection

In this experiment, garlic was used *Allium sativum* (available in the local markets of Karbala governorate. It was collected in the eleventh month of 2020, and was washed with distilled water to obtain a pure sample before the drying phase. Pure garlic cloves were obtained, then the drying process was carried out at room temperature, then these cloves were taken and placed in airtight containers until the extraction process is performed.

2-extraction process

The garlic cloves were extracted after the drying process, where they were crushed using an electric grinder. Then garlic powder was obtained, weighing about 300 g. The powder was homogenized with the addition of 1000 ml of absolute ethanol in a device. Soxhlet For 72 hours, the mixture was filtered through filter paper. Whatman No 1. To ensure that the crude extract is free from any plant fibers and impurities are removed, then the extract was evaporated through a water bath at a temperature of 40 degrees Celsius to avoid the chemical change of the mixture until it reaches a semi-solid consistency. Semisolid And then transferred to the vibrating incubator Shaker incubator ((until it is completely dry, and to obtain the alcoholic garlic extract, which was kept in dark bottles at a temperature of 20- until it is used in the study). Alnumair.2009),

3-Determining the doses

-1% - 1 of pure cholesterol was used) Cholesterol pure) With the diet to induce hyperlipidemia in male rats, according to what was reported (Hulborn, 1982),

-2Magnesium sulfate was used MgSo 4Dissolved in drinking water at a concentration of 10 g, according to what was mentioned about (Soltani *et al.*, 2007))

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The appropriate dose of the alcoholic extract of garlic cloves, which is 300 mg/kg of animal weight, which affects significantly according to what was reported on, was determined. Hassan (2012.)

If the dose was given orally and on a daily basis after taking the required weight and mixing it with distilled water, where the distilled water here is a means of transporting the extract.

-4 Experience design

This study was conducted in the animal house of the College of Pharmacy, University of Karbala, where this study lasted about 30 days, in order to know the effect of alcoholic extract of garlic and magnesium sulfate on some biochemical and histological parameters of local male rats treated with cholesterol. The laboratory animals were divided into 5 groups, each group 5 rats as follows:

-1 The first group, the control group:
The animals of this group were given the usual diet with drinking water for 30 days.

-2 The second group, the group with hyperlipidemia:
The animals of this group were given a diet containing cholesterol with drinking water for 30 days.

-3 The third group, the group affected by hyperlipidemia and treated with garlic extract:
Animals of this group treated with cholesterol and garlic extract were given 300 mg/kg body weight for 30 days.

-4 The fourth group, the group with hyperlipidemia and treated with magnesium sulfate:
Animals of this group were given the cholesterol-treated diet with magnesium sulfate 10 L/g dissolved in drinking water for 30 days.

-5 The fifth group, a group with hyperlipidemia treated with garlic extract and magnesium sulfate:
Animals of this group were given cholesterol-treated diet with garlic extract 300 mg/kg of animal weight and with magnesium sulfate 10 liters/g dissolved in drinking water for 30 days.

5-sample collection

After the end of the experiment (30 days), the animals were starved for a whole day, then blood samples were drawn through cutting the jugular vein, then the blood was placed in test tubes. Test Tube Then it was placed in the incubation for 30 minutes, then a high-speed centrifuge was used at a speed of 3000 rpm for 15 minutes, then the serum was isolated. Serum About other blood components by micropipette Micropipettes And put it in the refrigerator until the biochemical tests.

6-results
Table No(1) . Measuring the level of lipid profile concentrations in the serum of laboratory rats with induced hypercholesterolemia and the effect of dosed them with magnesium at a concentration of 10 g in drinking water and garlic extract at a concentration of 300 mg/kg.

<table>
<thead>
<tr>
<th>Mean+SD VLDL mg/dl</th>
<th>Mean+SD LDL mg/dl</th>
<th>Mean+SD HDL mg/dl</th>
<th>Mean+SD Tri mg/dl</th>
<th>Mean+SD Choll mg/dl</th>
<th>Standards groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.120±2.414 A</td>
<td>73.680±20.203 A</td>
<td>10.860±2.323 D</td>
<td>165.600±12.074 A</td>
<td>131.600±19.882 A</td>
<td>induced cholesterol group</td>
</tr>
</tbody>
</table>

Results and discussion

The study showed a high level of cholesterol in the blood serum of rats treated with cholesterol only (131.6mg/dl) and the decrease in the group of rats treated with magnesium and the group of rats treated with garlic, as well as the group of rats treated with garlic and magnesium (55.72.(mg/dl and 56.18mg/dl and 55.16 mg/dl respectively compared to the negative control group .Our results showed that hyperlipidemia induced by adding 1% of cholesterol to rats led to an increase in both total cholesterol, TC and triglycerides TG and low-density lipoprotein LDL. The lipoprotein is very low density VLDL. With a decrease in the concentration of high-density lipoprotein HDL. This is consistent with the study AL-Obaidy.,(2018)which indicated the role of a high-cholesterol diet in causing a group of physiological changes in rabbits, as the results of the study led to a rise in both TC And TG And LDL And VLDL and drop in HDL. The cause of high cholesterol is due to a defect in the lipid metabolism process or a problem in the absorption of steroids or due to a decrease in the concentration of bile salts, where the low concentration of bile impedes the process of converting cholesterol into bile acids by the liver (Al-Ashlash, 2012). As for an increase in the concentration of bile TG. It is due to the action of the active oxygen species resulting from high cholesterol, which causes inhibition of an enzyme Triglyceride lipase Responsible for the breakdown of triglycerides into fatty acids and cholesterol, which leads to an increase in the concentration of TG in the blood serum (Al-Janabi, 2008). As for the reason for the increase in the concentration of LDLs that a rise in cholesterol concentration caused the inhibition of enzymes Lipoprotein lipase And Hepatic lipase. It leads to an increase in enzyme activity Acetyi CoA Carboxylase. This leads to an increase in concentration LDL And VLDL (Moghadasian et al .2001 ,.As for a decrease in concentration HDL It is due to increased oxidation LDL. And the ability of effective oxygen species to demolish
the cholesterol molecule, which leads to a decrease in its concentration HDL. Responsible for transporting cholesterol from the cells of the body to the liver Hall((2016).

It is clear from the current study that there are significant differences and an increase in cholesterol in the cholesterol-treated group of rats and its decrease in the other groups under study compared to the negative control group. The reason may be that garlic has a strong and clear activity against fats that cause an increase in cholesterol in the blood serum (Kritchevsky, 1975) Or the reason may be attributed to the ability of garlic to prevent the increase in the formation of cholesterol and triglycerides. Through its ability to reduce the activity of enzymes or inhibit the action of the thiol enzymatic group (thiol) as an enzyme (HMG-CoA) (Qureshi et al., 1983) and enzyme CoASH ((in the liver) Sodimu et al., 1984), or that garlic contains the compound Diallyl sulfides Which has the ability to inhibit the activity of an enzyme Cyclooxygenase In the body, this enzyme is responsible for raising the concentration of cholesterol in the body (Miner And Schaffer, 1997). The results of this study were in agreement with the results of a study conducted by El-Hosseiny And his group ,(2000) who observed when feeding 60 mg of garlic, significantly reduced the values of total fat and total cholesterol, and also came in agreement with the results of a study conducted by Chaves et al (2008) on female sheep, who indicated that feeding 200 mg of garlic oil/kg of feed to female sheep significantly reduced cholesterol and triglyceride values (chaves and others, 2008). The results of this study also agreed with the results of a study conducted by Adegbola et al., 2021 (who noticed that giving garlic extract to rats with induced hyperlipidemia at a concentration of 500 mg/kg and 1000 mg/kg led to a decrease in the concentration of total cholesterol, triglycerides and low-density lipoprotein, but they noticed no significant differences for high-density lipoproteins and this contradicts our study.

The results also showed significant differences in the high level of triglycerides (Triglycerides) in the group of rats treated with cholesterol only compared to the negative control group (.165.6) mg/dl , 112.119 mg/dl (straight). The study also showed a decrease in the level of triglyceride concentration in the group of rats treated with magnesium (.816) mg/dl (58and the group of rats treated with garlic and magnesium (81,082(. mg/dl (and the group of rats treated with garlic only (100.42mg/dl (compared to the negative control group (112.119. ).mg/dl)). The results of this study showed agreement with other studies conducted in different regions. Including a study conducted by Slowing et al. To evaluate a low-cholesterol diet on rats, it was found that garlic consumption leads to a decrease in cholesterol LDL, triglycerides, (Slowing and others, 2001.)

Also, another study was conducted by Morcos, showed that the use of garlic and fish oils as nutritional supplements for a month leads to a decrease in cholesterol and triglycerides Triglycerides, LDL-C And increase the level HDL-C (Morcos, 1997). The results of this study also showed agreement with the study of Lee et al. Where he conducted experiments on 20 male mice for 5 weeks, during which garlic was used on a daily basis in addition to a high-fat diet, and the results showed a significant decrease in triglyceride levels, TG And LDL-C In the experimental group compared to the controls and an increase in the level HDL-C (Lee et al., 2012. (In addition, in a study
conducted on patients with cardiovascular diseases, it was noted that taking 400 mg of garlic for four weeks led to a significant decrease in cholesterol levels. TC and triglycerides TG and LDL. It leads to increased levels HDL-C. Significantly and proportion HDL-C/LDL-C (Shabani et al., 2018).

The results showed the level of high-density lipoprotein concentration HDL in rat blood serum. The results showed a significant decrease (P > 0.05) in all study groups when compared to the negative control group, where the lowest concentration level of high-density protein lipids HDL in the cholesterol-treated group (10.86 mg/dl) (followed by the group treated with garlic and magnesium (16.62 mg/dl) while the concentration level of high-density lipoprotein HDL in the garlic-treated group (17.84 mg/dl) and the magnesium-treated group (20.74 mg/dl). The current study showed a decrease in high-density lipoprotein lipids HDL in rat blood serum compared with the negative control, and these results are in agreement with some previous studies, which were conducted by Berthold et al. 1998, who indicated that there was no effect on protein lipids as a result of using garlic or its extracts (Berthold and others, 1998).

Also, the results of other studies showed that consumption of garlic and its products did not have a significant effect on lipid-protein changes (Koseoglu et al., 2010). In a separate study, 42 patients with total serum cholesterol less than ≤220 mg/dl were tested. After 12 weeks of treatment with garlic, the total cholesterol level in the blood decreased by 5.7% and the serum level LDL-C increased by 11% while there was no significant change in serum HDL-C and triglycerides TG (Jain et al., 1993).

On the contrary, the results of a study conducted by showed Bordia et al. on 62 patients with disease cipher and those with high cholesterol levels who ate garlic for 10 months had lower triglycerides, total cholesterol and low-density lipoprotein cholesterol. LDL Mean while, it showed an increase in the concentration of high-density lipoprotein (HDL) lipids HDL. Significantly (Bordia et al., 1998).

The results showed a decrease in the concentration of low-density protein lipids LDL in the garlic-treated group, followed by the garlic and magnesium-treated group (16.566 mg/dl, 18.574 mg/dl) respectively when compared to the negative control group. The results of this study also showed a significant increase in the level of low-density protein lipids in the cholesterol-treated group and relatively in the magnesium-treated group (73.68 mg/dl, 33.016 mg/dl) respectively when compared to the negative control group.

The results of the current study are in agreement with previous studies conducted in different regions. The results of a study conducted by Mansell A significant decrease in the level of cholesterol, triglycerides, and low-density protein lipids and an increase in the proportion of high-density lipoprotein cholesterol in individuals who took garlic by 900 mg per day for 6 weeks (Mansell et al., 1996).

In another study conducted by Rahmani It indicated a low level of cholesterol and low-density protein lipids LDL-C The result of the effect of eating garlic powder for 12 weeks (Rahmani, 1999).

In various other studies, the active ingredients of different forms of garlic have been mentioned. The main components of garlic include Alpyne and enzyme alinazGarlic. 
powder also contains three active substances from Alin and alkaline and Allicin. Old garlic contains an abundance of antioxidant compounds, including allicinalixinselenium (Padiya & Banerjee, 2013).

The effect of garlic on the level of fat concentration in the blood is due to Allicin. It is the main component of A. sativum where it is believed that Allicin has the ability and effectiveness to reduce the level of cholesterol and protein lipids in the blood (Agarwal, 1996).

A study by Farshidi et al. (2020), where this study examined the effect of MgSO4 oral to improve the level LDL Oxidative stress in the blood of patients with atherosclerosis, where he gave 300 mg of MgSO4 daily for six months and compare the results with the control group. Notice an improvement of the percentage LDL Significantly, where magnesium improved the main risk factors for atherosclerosis, and this is consistent with the results reported in our study.

The results of the current study showed a significant increase in the concentration of very low-density protein in the serum of cholesterol-treated rats (33.12) mg\dl (compared to the negative control group (21.95). mg\dl. The results also showed a significant decrease in the concentration of very low density protein lipids VLDL In a group of rats treated with magnesium (11.844mg\dl followed by the group treated with garlic and magnesium (18.6). mg \dl, while the results showed a relative decrease in the garlic-treated group (19,967. (mg \dl compared to the negative control group.

The results of the current study show changes in the level of low-density protein lipids, which are in agreement with the results of the study Abdulla et al, which reported changes in cholesterol, triglyceride, and protein levels in rats who were given magnesium as dietary supplements for 8 weeks) Abdulla and others, 2020.

pointed out Arpaci And others in their study that there is no correlation between the level of magnesium and the level of cholesterol, triglycerides and protein fats, which does not agree with the results of our study) Arpaci et al., 2015.

On the other hand, the results of the current study are in agreement with the results of a study conducted by Mohammadi And Oshaghi She indicated that eating garlic reduces total cholesterol (16.7%), and low-density protein lipids LDL-C ,(%30) triglycerides (14.3%), and very low-density lipoprotein VLDL-C ,(%15.5) compared with the control group) Mohammadi And Oshaghi, 2014.

MahaAndKhalil. In a report, they reported that adding 8% of raw garlic, along with 2% of cholesterol to the diet of mice, leads to a decrease in total cholesterol and low-density protein. LDL-C Increased high-density lipoprotein HDL-C (MahaAndKhalil, 2008). The reduced level of lipids by garlic extract may be due to lowerhepatic 3-hydroxy-3-methylglutaryl-CoA reductase , cholesterol 7α-hydroxylase , pentose-phosphate pathway activities (Qureshi et al., 1983 .(cholesterol ester transfer protein active) Kwon et al., 2003 ,) microsomal triglyceride transfer protein ( Lin et al., 2002 , )increased bile secretion.Stephen et al., 1999 ,and inhibition of hepatic fatty acid metabolism) Chang And Johnson, 1980).

as shown AouadiIn his study ,adding fresh garlic with 10% and 2% of cholesterol to the diet of rats significantly reduced levels of LDL-C ,AndVLDL-c and increase levels HDL-C (Aouadi, 2000).
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