The Effect of Fresh Crushed Garlic Bulbs (Allium sativum) on Plasma Lipids in Hypercholesterolemic Rats

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Abstract: The aim of this study was to investigate the effect of feeding fresh crushed garlic bulbs on plasma total cholesterol (TC), low and high density lipoprotein-cholesterol (LDL-c, HDL-c) and triglycerides (TG) levels in an induced hypercholesterolemic Wistar albino rats. Twenty rats were allotted to four groups A, B, C and D. Group A (control group) received a basal diet, group B received a basal diet with 2% cholesterol, group C received a basal diet with 2% cholesterol and 4% crushed garlic bulbs and group D received a basal diet with 2% cholesterol and 8% crushed garlic bulbs. The results showed that, plasma TC, LDL-c and TG levels were increased significantly (P < 0.05) in group B compared to the control group, while HDL-c level was decreased significantly (P<0.05). In group C, the plasma levels of TC and LDL-c were decreased significantly (P < 0.05), however, HDL-cholesterol was significantly increased compared to group B, but no significant difference in the level of TG was observed compared to group B. However, group C showed significantly (P < 0.05) higher levels of TC and TG and non-significant difference in LDL-c and HDL-c levels compared to the control group. The plasma levels of TC, LDL-c and TG in group D were decreased significantly (P < 0.05) compared to group B, while HDL-c was significantly (P<0.05) increased. The levels of TC, LDL-c, HDL-c and TG in group D were non-significantly different compared to the control group.

Keywords: Allium sativum, total cholesterol, hypocholesterolemia

INTRODUCTION

Elevated plasma level of cholesterol is linked to the development of atherosclerosis. This disease results when LDL-c deposited in the wall of blood vessels[11]. Many studies indicated that lowering plasma cholesterol might prevent, control, and even reverse atherosclerosis and coronary heart disease[12]. The drugs used for lowering blood cholesterol generally have undesirable side effects; hence, a harmless lipid-controlling medication would be a welcome development. Medicinal and aromatic plants are the important renewable source of drugs. In addition, WHO encourages the inclusion of medicinal plants in programmes of developing countries because of the great potential these plants represent in combating various diseases. Recently, the Sudan has produced certain drugs locally using imported or native raw materials[13].

Garlic has been employed in folk medicine since ancient time for prophylaxis as well as cure of a variety of diseases[14,15]. Extensive clinical and scientific studies support the use of garlic for treatment of hypercholesterolemia; however, the potency of garlic product can vary substantially due to mode of preparation[9]. These studies include garlic tablets[20], garlic powder[18,30], enteric coated garlic preparations i.e., Garlinase, Garlicin and Garrique, essential oil and oil macerate[21], extract of frozen and raw garlic[23], water extractable fraction (WEF), petroleum extractable fraction (PEF), methanol extractable fraction (MEF), aged garlic extract (AGE)[22], swallowing and chewing garlic[11]. The hypercholesterolemic effect of the different preparations used was attributed to water soluble sulfur compounds, especially, S-allyl cysteine (SAC) and ajoene. However, fresh crushed garlic bulbs have been reported to contain high amount of allicin (3.7 mg/dl)[21,13].

Allicin has been proposed as the active compound produced by garlic, which is responsible for its hypocholesterolemic effect. There is no garlic product in the market containing a detectable amount of allicin (<1ppm)[13], and also some of the bioactive compounds of garlic are affected by heat[12,19]. Hence the objective of this study was to investigate the effect of fresh crushed garlic bulbs, the form which most people consume it, on the level of plasma total cholesterol and its fractions and triglycerides in an induced hypercholesterolemic Wistar albino rats.

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MATERIALS AND METHODS

Experimental Animals: Twenty male Wistar albino rats weighing between 85 – 100 g, obtained from Medicinal and Aromatic Plants Research Institute, Khartoum, Sudan were used. The rats were housed in stainless steel cages in an air room under a 12-h light: dark cycle. All of the rats were initially fed a standard laboratory diet for 7 days to acclimatize to our laboratory. Tap water was freely available.

Cholesterol Supplementation in The Rat Basal Diet: Cholesterol powder (2%) was supplemented to the basal diet of all groups of rats except the control so as to induce hypercholesterolemia according to Ali et al.[13].

Preparation of The Plant Material: Garlic cloves were obtained from the local market. They were cleared of any adhering dried material. The edible parts were crushed then weighed in different concentrations of, 4% and 8% of the basal diet.

Experimental Procedure: The animals were divided into four groups, A, B, C and D. Group B, C and D received a diet containing 2% cholesterol so as to induce hypercholesterolemia. The crushed fresh garlic bulbs were added to the diet at a concentration of 4% and 8% to groups C and D, respectively. Group A served as a control and was given a standard diet. The duration of the experiment was four weeks.

Parameters: All parameters in plasma were measured by using fully automated apparatus (Hitachi 902) in Research and Laboratory Unit, Khartoum Teaching Hospital.

Statistical Analysis: The data were subjected to completely randomized design. Analysis of variance (ANOVA) and mean separation were conducted to test significant differences of groups, according to Gomez and Gomez with the aid of SAS computer programme[14].

RESULTS AND DISCUSSION

Results: The results of plasma total cholesterol, LDL-c; HDL-c and triglycerides levels of groups A, B, C and D were presented in Table (1) and Fig. (1).

There was a significant increase (P< 0.05) in plasma total cholesterol level in group B (cholesterol fed group) compared to the control group (group A). There was a significant (P< 0.05) decrease in plasma total cholesterol level in both groups treated with garlic (groups C and D) when compared to group B. However, the decrease was more in group D compared to group C. The plasma total cholesterol level in group D was non-significantly different compared to group A, while group C showed a significantly (P< 0.05) higher total cholesterol level compared to group A (Fig.1, panel A). The levels of LDL-c were significantly (P< 0.05) higher in group B (cholesterol fed group) compared to the control group (group A). There was a significant (P< 0.05) decrease in plasma LDL-c levels in the groups treated with garlic (groups C and D) compared to group B. However, there was no significant difference between the groups treated with garlic (groups C and D) and the control group (group A). Also there were no significant differences between the treated groups (C and D) (Fig.1, panel B).

The plasma HDL-c levels were significantly (P< 0.05) lower in group B (cholesterol fed untreated group) compared to the control group (group A). The levels of HDL-c in the treated groups (groups C and D) were significantly (P< 0.05) higher compared to group B. The levels of HDL-c in the treated groups (groups C and D) were non-significantly different compared to the control group (group A), also there was no significant difference between group C and D with respect to HDL-c levels (Fig.1, panel C).

Plasma triglycerides levels were significantly (P< 0.05) increased in group B (cholesterol fed untreated group) compared to the control group (group A). There was a significantly (P< 0.05) decreased level of triglycerides in group D when compared to group B, while no significant difference is found in group C compared to group B. The plasma triglycerides level in group D was nonsignificantly different compared to the control group. While group C showed significantly (P< 0.05) higher triglycerides level compared to the control (Fig.1, panel D).

Discussion: Common available garlic preparations in the form of garlic oil, garlic powder, pills and different extractions are widely used for therapeutic purposes, especially lowering blood pressure and improving lipid profile[29,2,10]. Therefore, there is a great need for evaluation of the effects of fresh crushed garlic bulbs on the level of plasma total cholesterol and its fractions beside triglycerides.

The results showed that plasma total cholesterol level was decreased significantly following administration of garlic, however, the higher concentration (8%) possessed the highest activity. These results were in line with the reports that suggested that administration of garlic to human, rats and cell culture is effective in decreasing total cholesterol and triglycerides[16,41]. Others have also
Fig. 1: The effect of fresh crushed garlic bulbs on plasma total cholesterol, LDL-c, HDL-c and TG in an induced hypercholesterolemic Wistar albino rats.

Bars with the same small letters are non-significantly different. Significant difference (P< 0.05) between a, b and c.

Group A: fed standard diet.
Group B: fed standard diet with 2% cholesterol.
Group C: fed standard diet with 2% cholesterol and 4% garlic.
Group D: fed standard diet with 2% cholesterol and 8% garlic.

 demonstrated the hypolipidemic effect of aged garlic extract when added to diets of rats fed cholesterol\(^{[6,23]}\). Reported mechanisms included direct reduction of cholesterol production by the liver by inhibition of 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase\(^{[23]}\) and increased bile acid excretion\(^{[28]}\).

In the present study garlic, supplemented diet caused significant reduction in plasma LDL-c levels in the groups treated with garlic. These results agree with Shela et al.\(^{[24]}\) who reported that, adding aqueous extract of raw garlic with 1% cholesterol to rabbits, decreased plasma total cholesterol and LDL-c
Results showed that plasma triglycerides decreased significantly in the group treated with high concentration of garlic (8%), thus this group showed control like level. These results are in line with Ali et al.\textsuperscript{[3]} who suggested that administration of garlic to rats is effective in decreasing total cholesterol and triglycerides significantly. The mechanism for triglycerides lowering effect of garlic is not well understood. However, Yeh and Yeh\textsuperscript{[31]} demonstrated that the rate of acetate incorporation into fatty acid was reduced in hepatic cell culture treated with garlic extract. Thus, the triglycerides lowering effect of garlic may some how be due to the inhibition of fatty acids synthesis.

In conclusion, fresh crushed garlic is effective in lowering cholesterol levels; hence, it can play a role in the prevention of atherosclerosis.

### REFERENCES


24. SAS., 1998. SAS institute, NC, USA.


