ORIGINAL ARTICLE

STUDY OF THE EFFECTS OF RAW GARLIC CONSUMPTION ON THE LEVEL OF LIPIDS AND OTHER BLOOD BIOCHEMICAL FACTORS IN HYPERLIPIDEMIC INDIVIDUALS

MAHMOODI M[*], ISLAMI MR[**], ASADI KARAM GR[*], KHAKSARI M[***], SAHEBGHADAM LOTFI A[‡], HAJIZADEH MR[‡‡] AND MIRZAEE MR[‡‡]

[*]Department of Biochemistry, Biophysic and Genetic, Faculty of Medicine, Rafsanjan, Iran
[**]Faculty of Medicine, Rafsanjan, Iran
[***]Department of Physiology and Pharmacology, Faculty of Medicine, Kerman, Iran
[‡]Department of Clinical Biochemistry, Tarbiat Modares University, Tehran, Iran
[‡‡]Department of Biochemistry, Biophysic and Genetic, Faculty of Medicine, Rafsanjan, Iran

ABSTRACT

Hyperlipidemia is one of the famous disorders that can lead to atherosclerosis. Garlic has been considered as one of the blood lipids lowering agents for ages, and various studies have been carried out, some of them confirmed this effect of garlic and some did not. The aim of this study was to evaluate the effect of raw garlic consumption on human blood biochemical factors in hyperlipidemic individuals.

This clinical trial was conducted on 30 volunteer individuals with blood cholesterol higher than 245 mg/dl. Fasting blood samples were collected for biochemical tests. The volunteers consumed 5 g raw garlic twice a day for 42 days. Second fasting blood samples were collected and the individuals did not use any kind of garlic for next 42 days. After that, the third fasting blood samples were collected and the biochemical factors were measured.

After 42 days of garlic consumption the mean of blood total cholesterol ($p<0.001$) triglycerides ($p<0.01$) and FBS ($p<0.01$) were reduced significantly, but HDL-C was increased ($p<0.001$) significantly. Following 42 days of no garlic consumption total cholesterol ($p<0.001$), triglycerides and FBS ($p<0.05$) were significantly increased and HDL-C ($p<0.01$) decreased.

Garlic consumption alone can decrease serum lipids, but it cannot be used as the main therapeutic agent for hyperlipidemia. Garlic can be used in mild hyperlipidemia or when the patients cannot tolerate the chemical drugs.

Keywords: Atherosclerosis, lipoproteins, lipids, hyperlipidemia, garlic.

INTRODUCTION

Atherosclerosis is one of the main morbidity and mortality factor in developed countries. Coronary arterial atherosclerosis leads to angina pectoris and myocardial infarction (Report of WHO, 1994). Atherosclerosis remains the major cause of death and premature disability in developed societies. Moreover, current predictions estimate that by the year 2020 cardiovascular diseases, notably atherosclerosis, will become the leading global cause of total disease burden, defined as the years subtracted from healthy life by disability or premature death. Substantial success has been achieved in reducing morbidity and mortality due to acute coronary events. However, the treatment of the underlying disease process, atherosclerosis, and preventing its acute complications presents an enormous challenge and opportunity simultaneously (Kasper *et al.*, 2005).

Correspondent author: e-mail: mahmoodies@yahoo.com

Hyperlipidemia constitutes a major etiopathological factor for atherosclerosis. The medicinal value of garlic is best known for its lipid lowering effects and antiatherogenic effects. It has been shown that antiatherogenic effects of garlic derived organosulphur compounds can be attributed to the reactions that inhibit beta-hydroxy-beta-methylglutaryl-CoA (HMG-CoA) reductase (the rate limiting enzyme in cholesterol biosynthesis), and other lipogenic enzymes (Mathew *et al.*, 2004). The beneficial effect of HMG-CoA reductase inhibitors on cardiovascular risk reduction has been clearly established. Garlic is the most commonly used herbal remedies and is considered to have hypocholesterolemic as well as other cardioprotective properties. Short-term garlic (in the form of alliin) therapy in adults with mild to moderate hypercholesterolemia did not affect either lipid levels or various psychopathologic parameters (Peleg *et al.*, 2003).

Garlic and its preparations have been widely recognized as agents for prevention and treatment of cardiovascular and

other metabolic diseases, atherosclerosis, hyperlipidemia, thrombosis, hypertension and diabetes. Many clinical trials showed a positive effect of garlic on cardio-vascular diseases, however a number of negative studies have recently cast doubt on the efficacy of garlic specially its cholesterol lowering effect (Banerjee and Maulik, 2002).

In vitro experiments that were carried out on the cultures of rat hepatocytes, demonstrated an inhibitory effect on important enzymatic activities taking place in the biosynthesis of cholesterol and fatty acids. The antiatherogenic effect of garlic was markedly manifested by a reduction of lipid plaques in the arteries in hypercholesterolemic rabbits and decreased accumulation of cholesterol in vascular walls of animals (Sovova and Sova, 2004).

The biological responses of garlic largely attributed to: 1)- reduction of risk factors for cardiovascular diseases and cancer, 2)- stimulation of immune function, 3)- enhanced detoxification of foreign compound, 4)- hepatoprotection, 5)- antimicrobial effect and 6)- antioxidant effect (Banerjee and Maulik, 2002).

To our knowledge, there were only a few human studies on the effects of garlic, and none of the previous studies used raw garlic. Therefore, the aim of this study was to evaluate the effect of raw garlic consumption on blood biochemical factors in hyperlipidemic individuals.

MATERIALS AND METHODS

This clinical trial carried out in 30 volunteer individuals with blood cholesterol higher than 245mg/dl. The volunteers first screened for blood cholesterol and the individuals with blood cholesterol more than 245mg/dl, enter to the study after explaining the procedure to them and signing the informed consent.

Fasting blood samples were collected for the biochemical tests at the beginning of study.

The individuals consumed 5g of raw garlic twice a day for 42 days. The garlic was prepared, packed and handled to the individuals weekly. The volunteers were followed up continuously by telephone or visit.

Second blood samples were collected and the volunteers were asked not to consume any kinds of garlic for the next 42 days (washing out period).

The third fasting blood samples were collected after 42 days of stopping garlic consumption.

Blood biochemical factors including: FBS, total cholesterol, triglycerides, urea, creatinine, uric acid, aspartate amino-transferase (AST), alanine amino-transferase (ALT), alkaline phosphatase (ALP), high density lipoproteins cholesterol (HDL-C), low density lipoproteins cholesterol (LDL-C), and hemoglobin A1C (HbA1C) were measured.

Data were analyzed by Instat software. To compare the blood factors in 3 stages repeated measure ANOVA was used, if the differences were significant, Tukey-Kramer test was used. $P<0.05$ considered as significant difference.

RESULTS

42 days garlic consumption caused a significant decrease in blood FBS ($p<0.01$), total cholesterol ($p<0.001$), and triglycerides ($p<0.01$) compared to the beginning of study. The blood HDL-C increased significantly ($p<0.001$) in this stage (table 1).

Following 42 days of stopping garlic consumption, the blood FBS, Triglycerides ($p<0.05$) and total cholesterol ($p<0.001$), increased and HDL-C ($p<0.01$) decreased again significantly. The results are shown in table 1.

Other blood biochemical factors like HbA_1C, urea, creatinine, uric acid, ALT, AST, ALP, and LDL-C were not changed significantly during the study (table 2). The level of LDL-C was decreased by garlic consumption but it was not significant (table 2).

DISCUSSION

According to our results consumption of raw garlic leads to reduction in the FBS, total cholesterol, triglycerides and LDL-C, and elevation of HDL-C, therefore garlic supplemented diet can be useful in hyperlipidemic individuals. Most of the similar previous studies have used garlic preparations or extracts but not raw garlic that is more available and very cheap compared to the garlic products.

Kannar *et al.* reported a reduction in total cholesterol (4.2%) and LDL-C (6.6%) following using garlic powder for a period of 12 weeks in 22 individuals, but they did not find any changes in HDL-C and triglycerides (Kannar *et al*., 2001). We propose that raw garlic is more useful and more effective than the garlic powder in hyperlipidemic individuals who can tolerate garlic.

Our results are in consistent with the finding of Morcos NC (Morcos, 1997) who administered garlic and fish oil and found a reduction in serum cholesterol (11%) and triglycerides (34%). It has been reported that garlic can prevent the cholesterol biosynthesis in liver by inhibiting HMG-CoA reductase and 14-alpha methylase (Liu and Yeh,

Table 1: The levels of blood FBS, cholesterol, triglycerides and HDL-cholesterol during three stages of the study.

Blood Factors (mg/dl) (Mean ± SEM)	Stage 1	Stage 2	Stage 3
FBS	99.6±2.02	92.9±2.2**	98.5±2.4*
Cholesterol	278.5±4.7	248.4±5.2***	256.9±5.8***
Triglycerides	227.1±19.5	189.4±16.2**	212.1±16.2*
HDL-Cholesterol	44±1.2	48.2±1.3***	43.4±0.8**

Stage 1= Beginning of the study, stage 2= after 42 days garlic consumption and stage 3= after 42 days stopping garlic consumption. Data represents Mean ± SEM, n=30. - *: = p<0.05, **:= p<0.01 ***:= p<0.001

Table 2: The amount of blood urea, cretinine, Uric acid, AST, ALT, alkaline phosphatase (ALP), total bilirubin(TB), direct bilirubin(DB), LDL-cholesterol and hemoglobin A1C (Hb A1C) during three stages of the study.

Blood Factors (Mean ± SEM)	Stage 1	Stage 2	Stage 3
Urea (mg/dl)	26.6±1.5	25.7±1.2	24.9±1.1
Creatinine (mg/dl)	0.6±0.03	0.62±0.04	0.6±0.02
Uric Acid (mg/dl)	4.3±0.17	4.4±0.14	4.5±0.16
AST (IU/L)	24.9±1.5	24.03±1.3	25.5±1.2
ALT (IU/L)	25.5±1.4	24.6±1.02	26.6±1.1
ALP (IU/L)	207.8±13.2	209.5±13.3	209.5±10.2
TB (mg/dl)	0.94±0.03	0.9±0.02	0.84±0.02
DB (mg/dl)	0.23±0.01	0.19±0.01	0.19±0.01
LDL-Cholesterol (mg/dl)	103.6±3.03	101.7±2.4	106.9±2.2
Hb A1C (% of Total Hb)	5.64±0.14	5.67±0.09	5.76±0.1

Stage 1= Beginning of the study, stage 2= after 42 days garlic consumption and stage 3= after 42 days stopping garlic consumption. Data represents Mean ± SEM, n=30.

2002). HMG-CoA reductase is the rate limiting enzyme in cholesterol biosynthesis, and other lipogenic enzyme, therefore we assume that garlic can cause reduction in blood cholesterol and triglycerides by inhibiting the lipogenic enzymes.

The results of our study showed that raw garlic consumption caused a reduction in blood sugar significantly; our results are in consistence with the results of Sheela CG and Augusti KT (Sheela and Augusti, 1992) who administered garlic oil (200 mg/kg) in rats found reduction in blood sugar, ALP and serum lipids. Ahmed and Sharma (Ahmed and Sharma, 1997) also have reported a reduction in blood sugar, ALP and ALT in rats, but in our study the level of ALT and Alp enzymes was not changed significantly by garlic.

According to a study in Kuwait University in the year 2000, garlic powder can reduce the serum level of cholesterol, and triglycerides, but not the glucose (Ali *et al*., 2000).

Ackermann RT *et al.* (Ackermann *et al*., 2001) also reported in the year 2001 that garlic has not a considerable effect on blood glucose. Thus the garlic effect on blood glucose in most of the studies is controversial yet and more studies should be carried out to confirm the hypoglycemic effect of garlic.

In Berthold HK *et al.* (Berthold HK *et al*., 1998), and Superko and Krauss (Superko and Krauss, 2000) studies, the garlic oil and garlic powder did not change the serum cholesterol, HDL-C, and LDL-C significantly, so again it confirms our hypothesis that raw garlic is more effective than other garlic preparations.

Treatment with an enteric garlic-coated Thai garlic extract and dietary advice did not produce any significant changes in lipid levels in subjects with hypercholesterolemia (Satitvipawee *et al*., 2003).

Very recently a study has examined the effect of raw and boiled aqueous extracts of garlic on the levels of blood sugar and lipids by daily administration of the extracts to normal rats both orally and intraperitoneally for 4 weeks. The results showed that, raw garlic had a profound effect in reducing the glucose, cholesterol, and triglyceride levels, whereas boiled garlic had little effect in controlling these

parameters. The investigators concluded that, because hyperlipidemia is a major etiopathological factor for atherosclerosis, garlic may play an important role in the prevention of atherosclerosis (Thomson *et al*., 2006). This study also confirms our hypothesis that raw garlic is more effective than other preparations of this magical medicinal herb.

Finally, according to the results of most of the studies that administered garlic preparations, it can be concluded that fresh raw garlic consumption is much more beneficial than the garlic preparations. We suggest that raw garlic consumption should be advised to all people specially the mild hyperlipidemic ones.

CONCLUSION

Fresh raw garlic consumption alone can decrease serum lipids, but it cannot be used as a main therapeutic agent for hyperlipidemia.

Garlic can be used in mild hyperlipidemia or when the individuals cannot tolerate the chemical drugs. We certainly believe that garlic overall is a magical medicinal herb and if consume as much as possible has got the prophylactic effect in all people that can consume and tolerate the garlic's odour.

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