

Effects of Garlic on weight and lipid profile in male albino rats

ABDULLAH MASHORI¹, SYEDA ASYA PARVEEN², SYED MANZOOR IQBAL³, *KHEMOMAL A KARIRA*⁴,
*NUDRAT ANWER ZUBERI*⁵

ABSTRACT

Background: Atherosclerosis is one of the main risk factors for coronary artery disease which leads to myocardial infarction. Lipids are main risk factors to induce atherosclerosis. Certain foods like fruits, vegetables and herbal remedies in association with exercise may protect cardiovascular diseases.

Aim: To observe the effect of garlic as a lipid lowering agent and evaluate the effectiveness of this agent.

Place of study: Department of Biochemistry, Basic Medical Sciences Institute Karachi.

Methods: A total of 36 healthy adult albino rats were included. Their average daily dietary intake was tabulated. Two ml of blood was collected from each animal after a time period of 0, 45 and 90 days. Animals were numbered, weighed and were kept in separate cages. Their diet had been given according to the diet plan. The results were compiled by using SPSS version 10.

Results: The blood samples were collected on day before the study starts referred as 0 samples were served as baseline, moreover 2nd samples on the 45th day and last on the 90th day. Two ml of blood sample was collected from the tail of each albino rats by giving small incision. After all necessary antiseptic measures, blood was allowed to clot at 37°C and serum was separated after centrifuging at 3000 rpm for 10 minutes. Following lipid parameters; total cholesterol, LDL-c, triglycerides and HDL-c had been analyzed by auto analyzer. Weight was also noted up to 90 days.

Conclusion: In diet group: garlic used for 0, 45 and 90 days we observed significant decrease in TG, TC, LDL-c, increase in HDL-c concluded that garlic protects from cardiovascular diseases. The results of weight showed significant decrease in weight in the light of present study, it is recommended that garlic can be added in the diet of hyperlipidemic and obese patients and also in certain diseases in which lipid level is increased, so to decrease the mortality as lipids are silent killers.

Keywords: Atherosclerosis, coronary artery disease, myocardial infarction, lipid

INTRODUCTION

Atherosclerosis is one of the main risk factors for coronary artery disease which leads to angina pectoris and myocardial infarction. Dietary intake of fats and lack of exercise are primary main risk factors for the development of atherosclerosis. However certain food, like fruits, vegetables in association with exercise may be protective of coronary heart diseases (Mahmoodi, 2006).

Coronary heart disease (CHD) has been a global problem since long. It prevails in high class society to low class society and affects all ages specially the middle age group. It is the cause of 25-30% of deaths in most industrialized countries (Park, 2004).

High plasma cholesterol is positively related to the risk of CHD. Elevation of plasma cholesterol is usually due to an increase in the level of low-density lipoprotein (LDL) cholesterol. Diets containing polyunsaturated fats decrease the plasma cholesterol, triglyceride (TG), very low density lipoprotein (VLDL) cholesterol and LDL cholesterol (Mata et al., 1992).

Elevated LDL cholesterol and decreased high-density lipoprotein (HDL) cholesterol in the plasma have been independently associated with increased risk for CHD. Excessive intake of fatty foods and lack of exercise lead to obesity. Obese people tend to have relatively high triglyceride which is itself a risk factor for CHD in addition to low HDL-cholesterol and raised LDL cholesterol levels. Cardiovascular disease is the leading cause of mortality and morbidity worldwide. Oxidation of cholesterol fractions, in particular of low-density lipoprotein cholesterol (LDL), has been accepted as playing an important role in atherosclerosis (Durak et al., 2004). Garlic and its preparations have been widely recognized as agents for prevention and treatment of cardiovascular diseases, cancer and prevent

¹Assistant Professor, Dept. of Biochemistry, Islam Medical & Dental College, Sialkot, Affiliated with UHS Lahore.

²Assistant Professor, Dept. of Biochemistry, Karachi Medical & Dental College, Karachi

³Assistant Professor, Dept of Pathology, Poonch Medical College, Rawalakot, AJ&K.

⁴Professor, Dept. of Biochemistry, Sir Syed Medical College for women, Karachi.

⁵Associate Professor, Dept. of Biochemistry, BMSI, JPMC, Karachi

Correspondence to Dr. Abdullah Mashori, Email: abdullahmashori@gmail.com

metabolic diseases like atherosclerosis, hyperlipidemia, thrombosis, hypertension and diabetes mellitus (Sanjay *et al.*, 2002).

It has been shown that antiatherogenic effect of garlic derived organosulphur compounds can be attributed to the reactions that inhibit β -hydroxy beta methyl glutaryl CoA reductase (HMG – CoA reductase) which is the rate limiting enzyme in the cholesterol biosynthesis, and other lipogenic enzymes (Banerjee and Maulik., 2002).

The major component of garlic is water (65%) and the bulk of the dry weight is composed of fructose-containing carbohydrates, followed by sulfur compounds, protein, fiber, and free amino acids (Lawson, 1996).

It also contains high levels of saponins, phosphorus, potassium, sulfur, zinc, moderate levels of selenium and Vitamins A and C, and low levels of calcium, magnesium, sodium, iron, manganese, and B-complex vitamins; garlic also has a high phenolic content (Vinson *et al.*, 2001). Garlic and its preparations have been widely recognized as agents for prevention and treatment of cardiovascular diseases, cancer and prevent metabolic diseases like atherosclerosis, hyperlipidemia, thrombosis, hypertension and diabetes mellitus (Sanjay *et al.*, 2002). It also stimulates immune function, enhances detoxification of foreign compounds and hepatoprotection, and also is antimicrobial and antioxidant as well (Pelage *et al.*, 2003). Garlic is the most commonly used herbal remedies and is considered to have hypocholesterolemic as well as other cardio protective properties (Mahmoodi *et al.*, 2006).

With this back ground of introduction the purpose of our study was planned to evaluate the serum level of total cholesterol, triglycerides, LDL-cholesterol and HDL-cholesterol after feeding of garlic as lipid lowering effect in male albino rats, in addition to compare and correlate the effectiveness of this agent. Nutritional effect of garlic on body weight was also studied. Finally this hypothesis may be used as diet therapy and may favor in lowering the cardiovascular events.

METHOD

In present study, 36 healthy adult albino rats with age range 90-120 days, weighing around 240-280gms, were included in the study which was obtained from animal house of Basic Medical Sciences Institute JPMC, Karachi. Rats were kept under observation for one week, prior to commencement of study for the assessment of their health status on the basis of weight gain and loss. Their average daily dietary menu according to the amount of macromolecules for

the normal and special diets was given as shown in the table. However unhealthy albino rats below the age of 3 months were excluded from the study.

Animals were numbered, weighed and were kept in separate cages. Their diet was given according to the diet plan, while water was given ad libidum. Moreover their general appearance, activity, behavior and food intake were observed daily. Blood samples were collected from all albino rats on a day before the study started referred as 0 samples which serves as base line. Later specific diet containing garlic was feed to albino rats and samples were drawn on the 45th day and on the 90th day of the garlic feed date.

After all antiseptic measures, 2ml of blood sample was collected by giving a small incision on the tail of each albino rat. Blood samples were clotted at 37°C and serum was separated after centrifuging at 3000 rpm for 10 minutes and was stored at -70°C till analyzed. The serum level of lipid and lipoprotein particularly total cholesterol, triglycerides, LDL-cholesterol, and HDL-cholesterol were carried out. Finally results were compiled through computer by using SPSS version 10.

Source of remedy: Garlic: Local crop of Sindh cultivated in Malir area of Karachi.

Wheat flour(G)	12(G)
Nido milk(G)	5(G)
Water	AD LIBITUM
Garlic	(0.96g/kg body wt.)

Biochemical parameters

Total- cholesterol (mg/dl)	Enzymatic method.
HDL-cholesterol (mg/dl)	Enzymatic method.
Triglycerides (mg/dl)	Enzymatic method.
LDL-cholesterol (mg/dl)	Enzymatic method

RESULTS

This experimental study was carried out in the department of Biochemistry, BMSI, JPMC, Karachi on the male albino rats to see the effect of the garlic, as a lipid lowering agent. Thirty six albino rats were taken from the animal house of JPMC Karachi. The results of the study are presented in table number 1 to 2 and figure 1.

Table 1 shows the comparison of the weight, lipid and lipoprotein values among Day- 0, Day- 45 and Day-90 of the garlic group. Weight of baseline, Day- 45 and Day- 90 were 259±3.59, 234±3.03 and 233.7±2.59 respectively. When these values were compared with each other at Day- 45 and Day- 90 showed statistically significant (P <0.01) difference with Day-0 (Baseline). However, it was observed that weight decreased gradually with garlic diet. Moreover the values of total cholesterol at Day-0, Day-45 and

Day-90 were 177±3.54, 169.8±6.10 and 159.4±4.82 respectively when compared with Day-0 showed statistically significant decrease in the total cholesterol of day-45 and Day-90 to Day-0 with $P<0.05$. Similarly the mean values of HDL at day-0, Day-45 and Day-90 were 40±1.03, 45.7±1.20 and 48.8±1.05 respectively when these values were compared with each other show statistically significant increase at Day-45 and Day-90 to Day-0 (Base line). The values of LDL were decreased at Day- 45 and Day- 90 were 100.3±2.42, 94.8±3.99 and 93±3.88 respectively but show no statistically significant difference. Figure-1 represents the table-2. The use of garlic for 90 days showed significantly decreased weight, TC, TG and LDL-c. While increased HDL-c level.

Weight were significantly decreased ($p<0.01$) on day-45 and day 90 as compared to baseline (day-0). Total cholesterol were significantly decreased ($p<0.05$) on day 90 as compared to baseline (day-0). HDL-c were increases ($p<0.05$) on day-45 and were also increased ($p<0.01$) on day-90 as compared to baseline (day-0)

Table 2 shows the correlation of coefficient (r) between weight and lipid profile in garlic group versus parameters total cholesterol, and HDL-c showed somewhat weak negative correlation on day-0 compared with day-45 and day-90, while triglyceride and LDL-c shows somewhat weak positive correlation on day-0 compared with day-45 and day-90. In whole only good inverse correlation ($r = - 0.69$ $p<0.05$) of HDL at day-90 which rises as the weight reduces with garlic diet was observed.

Table 1: Comparison of weight, lipid and lipoproteins values of day- 0 (baseline) with day-45 and day-90 in albino rats feed on garlic diet (n=36 rats)

	day – 0	day - 45	day – 90
	Mean±SEM	Mean±SEM	Mean±SEM
Weight (gram)	259.8 ± 3.59	234.8±3.03**	233.7±2.59●●
Total cholesterol (mg/dl)	177.8 ±3.54	169.8±6.10*	159.4± 4.8 ●●
Triglyceride (mg/dl)	142.0 ± 5.16	133.2± 8.60	129.6 ± 6.82
LDL (mg/dl)	100.3 ±2.42	94.8 ±3.97	93.0 ±3.88
HDL (mg/dl)	40.0 ±1.03	45.7±1.20 *	48.8 ±85●●

** $p<0.01$, * $p<0.05$ Statistically significant difference from day-45 to day-0

●● $p<0.01$, ● $p<0.05$ Statistically significant difference from day-90 to day-0

Fig. 1: Comparison of Weight (gm) and Lipid profile (gm/dl) On Baseline (Day 0), Day-45 and Day-90 in Garlic feed albino rats

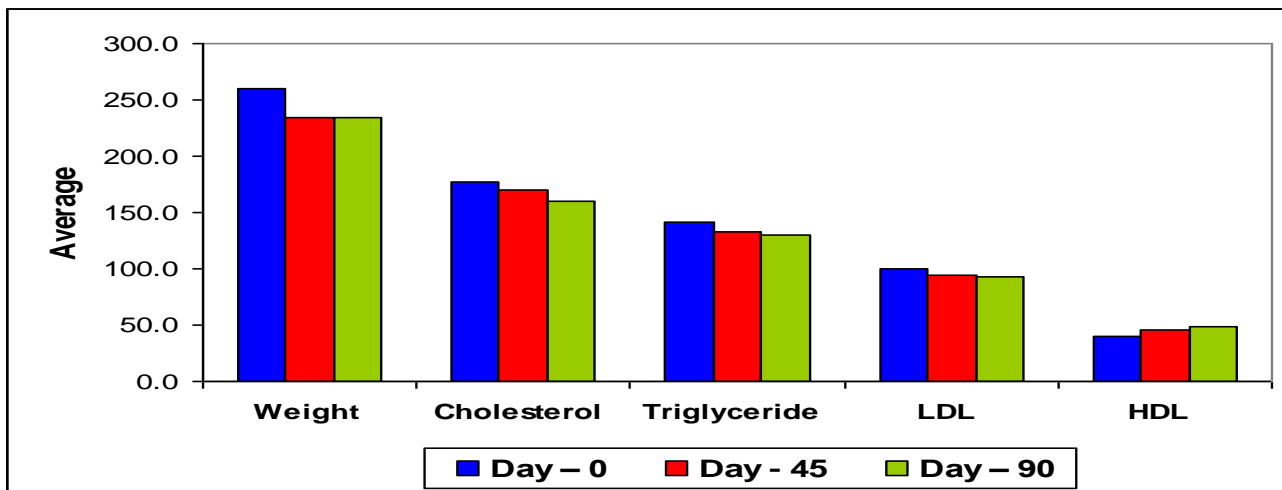


Table 2: Correlation of coefficient (r) between weight and lipid profile in garlic feed albino rats

Garlic group	Day – 0	Day 45	Day 90
Correlation - Weight (gm) with Lipid profile (mg/dl)			
Total cholesterol (mg/dl)	r = 0.18	r = 0.32	r = 0.12
Triglyceride (mg/dl)	r = 0.06	r = 0.15	r = 0.34
LDL (mg/dl)	r = 0.30	r = 0.56	r = 0.57
HDL (mg/dl)	r = -0.24	r = -0.41	r = -0.69*

$p<0.05$ Significant correlation i.e. inversely correlated weight decreases and HDL increases.

DISCUSSION

The observation of present study on the behavior of animals and body weight was noted. Significant decrease in the weight was observed when compared with day-0 (baseline). The effect of garlic on weight shows that it is due to decrease in the level of cholesterol, triglyceride and LDL-cholesterol in addition to increase in the HDL-cholesterol levels which were statistically significant when compared with day- 0 (baseline). The raised HDL-cholesterol concentration relative to baseline is beneficial in decreasing cardiovascular diseases, which is a well established predictor for coronary heart diseases. Our results are in agreement with the result of Kanner et al., (2001) who reported that reduction in total cholesterol (4.2%) and LDL-cholesterol (6.6%) and increase in the levels of HDL-cholesterol following the use of garlic powder for a period of 12 weeks in 22 individuals.

The animals feed on garlic in our study were active and healthy during the study period with brisk reflexes as compared to baseline and they showed moderate decrease in their weight. This was probably due to a fact that garlic inhibits synthesis of fat in the body by inhibiting related enzymes of cholesterol synthesis which is in agreement with the study done by Badar EL-Din (1960).

Our study correlates with the study of Xiao-Hua et al., (2001) in which there is decrease in the weight from 71±16 to 63±10 when garlic powder was used for 11 weeks.

Another study by El-Sayyad et al., (2010) concluded the cardio protective effects of garlic, they stated in their study that the use of garlic reduces LDL-c, TG, TC and increases HDL-c which is in strong favor of our study. Al-Numair KS (2009) in his study revealed the lipid lowering effects of garlic, in which he found that the use of garlic reduces the TC, TG, LDL-c and increases the HDL-c levels which is in strong correlation of our study.

Oral administration of garlic extracts in rats has caused a significant reduction in plasma TC, TG, LDL-cholesterol and significantly increased plasma HDL-cholesterol. These effects have been more pronounced with the high dose of garlic extract. The results of this study confirm the earlier hypolipidemic effects reported for garlic (Banerjee et al., 2002; Ou et al., 2003; Thomson et al., 2006).

Another study conducted by Jastrzebski Z et al (2007) concluded, the decrease in the TC and LDL-C levels in rats of the non processed garlic and cooked garlic for 20 minutes diet groups. The decrease in the levels of the TC and LDL-C was significant ($P < 0.05$). Therefore, diets supplemented with raw and cooked for 20 min garlic are bioactive and are

decreasing the levels of TC and LDL-C. Opposite, the diets supplemented with garlic cooked for 40 and 60 min are losing part of their bioactivity and therefore did not decrease the TC and LDL-C. The HDL-C and TG levels remained the same. With the help of this study we can understand that we do use garlic normally in our diet but it is cooked for more than 40 minutes which destroy its active ingredient (organosulphur compound). In manner to get the beneficial lipid lowering effect of garlic it must be used in its raw form.

RECOMMENDATIONS

In present study it is concluded that, the use of garlic has decreased the total-cholesterol and increased HDL-cholesterol in addition to reduce weight at the Day-45 to 90. All these findings are in favor that use of garlic in diet will reduce the risk of ischemic heart diseases and obesity. It is therefore recommended that garlic should be added in our daily routine diet and in the diet of diabetic patients where lipids are silent killer. Garlic should also be added in the diet of hypertensive and hyperlipidemic individuals or those patients who do not tolerate the medicines. Garlic should be used uncooked, in its raw form.

REFERENCES

1. Al-Numair KS. Hypocholesteremic and Antioxidant Effects of Garlic (*Allium sativum*) extract in Rats Fed high cholesterol diet. *Pak J Nutr* 2009; 8 : 161-66.
2. Badar El-Din MK. Antiasthmatic activity of the active principle of *Nigella sativa* "Nigellone". *Gazette Egypt Paediatr Assoc* 1960; 8:864-7.
3. Banerjee SK and Maulik SK. Effect of garlic on cardiovascular disorders: a review. *Nutr J* 2002; 19: 1-4.
4. Banerjee SK, Maulik M, Mancahando SC, Dinda AK, Gupta SK, Maulik SK. Dose-dependent induction of endogenous antioxidants in rat heart by chronic administration of garlic. *Life Sci* 2002; 70: 1509-18.
5. Durak L, Kavutcu M, Aytac B, Avci A, Devrim E, Özbek H, Öxtürk SH. Effect of garlic extract consumption on blood lipid and oxidant/antioxidant parameters in humans with high blood cholesterol. *J Nutr Biochem* 2004; 15: 373-77.
6. El-Sayyad HI, Amoura M, Abou-El-Naga, Gadallah AA, Iman H, Bakr. Protective effects of *Allium sativum* against defects of hypercholesterolemia on pregnant rats and their offspring. *Int J Clin Exp Med* 2010; 3:152-63.
7. Jastrzebski Z, Leontowicz H, Leontowicz M, Namiesnik J, Zachwieja Z, Barton H, Pawelzik E, Arancibia-Avila p, Toledo F, Gorinstein S. The bioactivity of processed garlic (*Allium sativum* L.) as shown in vitro and in vivo studies on rats. *Food and Chemical Toxicology* 2007; 45:1626-33.
8. Kannar D, Wattanapenpaiboon N, Saviqe GS, Wahlqvist ML. Hypocholesterolemic effect of an

- entericcoated garlic supplement. *J Am Coll Nutr* 2001; 20: 225- 31.
9. Lawson LD. The composition and chemistry of garlic cloves and processed garlic, the science and therapeutic application of *Allium sativum* L and related species In: Koch HP, Lawson LD Baltimore Eds 24th Ed, Williams & Wilkins 1996; pp 37-107.
 10. Mahmoodi M. Study of the effects of raw garlic consumption on the level of lipids and other blood biochemical factors in hyperlipidemic individuals. *Pak J Pharm Sci* 2006; 19: 295-98.
 11. Mata P, Alvarez-Sala LA, Rubio MJ. Effect of longterm monounsaturated versus polyunsaturated enriched diets on lipoproteins in healthy men and women. *Am J Clin Nutr* 1992;55:846-50.
 12. Ou CC, Tsao SM, Lin MC, YinMC. Protective action on human LDL against oxidation and glycation by four organosulfur compounds derived from garlic. *Lipids* 2003; 38: 219-24.
 13. Park K. In: Parks text book of preventive and social medicine. Eds 24th Ed, Jabalpur India Banarasi Das Bhanot 2004; pp. 272 - 73.
 14. Rahman K. Historical perspective on garlic and cardiovascular disease. *J Nutr* 2001; 131:977S–9S5.
 15. Thomson M, Al-Qattan KK, Bordia T, Ali M. Including garlic in the diet may help lower blood glucose, cholesterol and triglycerides. *J Nutr* 2006; 22-26.
 16. Vinson JA, Su X, Zubik L, Bose P. Phenol antioxidant quantity and quality in foods: fruits. *J Agric Food Chem* 2001; 49:52.
 17. Xiao-Hua Z, Lowe D, Giles P, Fell S, Connock MJ, Maslin DJ. Gender May Affect the Action of Garlic Oil on Plasma Cholesterol and Glucose Levels of Normal Subjects. *J Nutr* 2001: 1471-78.