Supplementation of garlic and coriander seed powder: Impact on body mass index, lipid profile and blood pressure of hyperlipidemic patients

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Abstract: Garlic and coriander play an obligatory role in the metabolism of lipids leading to the reduction of CVD development. We hypothesized that garlic, coriander and their mixture improves the lipid profile, BMI and blood pressure of CVD patients. Eighty patients were partitioned into 4 groups, each group consisting of twenty patients. The groups were randomly assigned to three supplements i.e. garlic powder (GP), coriander seed powder (CSP) and mixture (1:1 dry weight basis) of GP and CSP at a dose rate of 2 g/day. The fourth group was kept as placebo. The patients were examined for serum lipid profile, BMI and blood pressure at the start (0 day), 20, 40 and 60th day of supplementation. The initial 40 days were the intervention period whereas the last 20 days were the follow up period. The results indicated that all the supplements significantly (p<0.05) influenced the BMI, HDL, total cholesterol, triglycerides, LDL and systolic blood pressure of the patients. Among the supplements, GP had the highest influenced on BMI, TC, LDL and HDL whereas the impact of GP-CSP and CSP was more pronounced on TGL and blood pressure of the patients, respectively. All the parameters decreased with supplementation except HDL, which increased with the consumption of supplements. It was concluded that consumption of garlic, coriander and their mixture at a dose rate of 2 g/day is improving the lipid parameters of the patients.

Keywords: BMI, hyperlipidemia, lipid profile, garlic, coriander.

INTRODUCTION

Hyperlipidemia is one of the major causes of cardiovascular diseases. It refers to an increased level of lipid substances including cholesterol, triglycerides and low density lipoprotein and decreased level of high density lipoprotein in the blood (Ahmed et al., 1998). It may be primary or secondary and contributes to various abnormal events, including coronary heart disease, rheumatic heart disease, atherosclerosis, heart attack, myocardial infarction and deep venous thrombosis (DVT) (WHO/FAO, 2002). The underlying mechanism of CVD comprises the deposition and retention of lipid containing compound such as LDL in the coronary arteries, resulting in decreased blood flow to heart muscles leading to the development of CVD related conditions (Rudling, 2006). Chylomicrons and chylomicron fragments are triglycerides rich particles that carry dietary derivative fats and may play a role in the early stages of developing CVD (Wilhelm and Cooper, 2003).

The consumption of high-energy diets, which are low in omega-3 and omega-6 fatty acids, and lack of physical activities have been attributed to the increased risk of CVD (Johnson et al., 2011 and Simopoulos, 2002). A number of plant based nutraceuticals has been recognized that prevents and reduces the progression of cardiovascular diseases and associated risk factors (Omeish et al., 2011). For example, spices offer a cheap and easily accessible source of micronutrients and other phytochemicals having antioxidant and hypocholesterolemic properties to help prevent the advancement of CVD (Mahmood et al., 2010; Tasawar et al., 2011).

Garlic and coriander have been reported to have several medicinal and nutritional implications such as they are used to lower the blood lipids and improves CVD symptoms (Dhanapakiam et al., 2007). The daily consumption of a garlic clove can lower the LDL cholesterol and triglycerides by 15 and 17%, respectively (Kojuri et al., 2007). Garlic indirectly improves CVD by reducing extra weight, hyperlipidemia, hypertension and prevent thrombus formation. The beneficial effect of garlic powder is due to the presence of organosulphur compounds that lower lipid materials in arterial wall (El-Sabban and Abouazra, 2008). The sulphur containing compound “alliin” is converted to its active form “allicin” by the enzyme allicinase when the garlic clove is crushed. Allicin blocks the HMG-CoA reductase enzyme involved in biosynthesis of cholesterol in the liver (Choudhary, 2008). In a study conducted by Liu and Yeh, it was observed that garlic extract decreased cholesterol production by up to 75% without causing any cellular toxicity.

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The consumption of coriander seeds powder has intense influence on the metabolism of lipid substances in animals fed on high cholesterol containing diet (Dhanapakiam et al., 2007). A considerable antioxidant action is exhibited by aqueous extract of coriander containing phenolic and carotenoids (De-Almeida et al., 2003). The coriander causes a significant increase in BMG-CoA reductase and plasma lecithin cholesterol acyl transferase (LCAT) enzymes activity. This mechanism has been shown to decrease the level of LDL and VLDL cholesterol while increasing HDL cholesterol (Dhanapakiam et al., 2007; Fawzy et al., 2008).

Many attempts have been made to assess the individual effect of garlic (Rilvin 2001; Steiner and Li, 2001; Qidwai and Ashfaq, 2013) and coriander seed powder (Dhanapakiam et al., 2007; Aissaoui et al., 2011; Parsaeyan, 2012) on cardiovascular diseases and its associated risk factors. However, there is lack of knowledge on the combined influence of garlic and coriander seed powder on the body mass index, lipid profile and blood pressure of hyperlipidemic human individuals. Since garlic is a rich source of sulphur containing compounds and coriander provides an abundant supply of antioxidants, their combine application may synergistically enhance their potentials against cardiovascular diseases. Therefore, this study aimed to investigate the individual as well as the combined effect of garlic and coriander seed powder on lipid profile, body mass index and blood pressure of hyperlipidemic patients. We hypothesized that supplementation of garlic and coriander seed powder would prove a useful therapeutic intervention to combat cardiovascular diseases in hyperlipidemic people.

MATERIALS AND METHODS

Recruitment and study design

A single-blind, randomized, placebo-controlled intervention clinical trial was conducted at Cardiac Rehabilitation Center of Hayatabad Medical Complex Hospital Peshawar, Khyber Pakhtunkhwa-Pakistan. Eighty human individuals of both sexes and aged 40-80 years were enrolled in the study on the basis of consecutive sampling basis. The inclusion criteria was based on the presence of hyperlipidemia with CVDs, total cholesterol > 200mg/dl and serum triglycerides >150 mg/dl whereas the subjects suffering from gastrointestinal problems and pregnant and lactating women were excluded from the study. The patients were partitioned randomly into 4 groups, each group consisting of 20 patients. The 1st group was given garlic powder (GP), the 2nd group coriander seed powder (CSP) and the 3rd group GP and CSP mixture (1:1) at a dose rate of 2 g per subject per day. The control or Placebo group was not fed any supplement. The total study duration was 60 days with 40 days of dose duration followed by 20 days follow-up period.

First hydrolyzed to cholesterol and fatty acids by cholesterol esterase enzyme and then to hydrogen peroxide by cholesterol oxidase. Peroxidase enzyme converted hydrogen peroxide to red quinine. The intensity of the color was checked at 505nm and correlated with the concentration of cholesterol in the sample.

Triglycerides

The triglycerides concentration in serum was measured by enzymatic and colorimetric method using DIALAB kits. The method was based upon the principle that triglyceride incubated with lipoprotein lipidase liberated glycerol and free fatty acids. Glycerol was converted to glycerol-3-phosphate and adenosine-5-diphosphate by glycerol kinase and adenosine triphosphate. Glycerol-3-phosphate was then converted by glycerol phosphate dehydrogenase to dihydroxyacetone phosphate and hydrogen peroxide. The hydrogen peroxide reacted with 4-aminophenazone and p-chlorophenol in the presence of peroxidase to give red color; the intensity of the color was measured at 505 nm.

HDL cholesterol

In the DIALAB HDL cholesterol-AUTO reagent, separation of the lipoprotein fractions was achieved by adding antibodies, which was absorb into the surface of chyomicrons, VLDL and LDL. In a second step, the added detergent broke up the HDL lipoproteins and therefore made HDL cholesterol available for quantitation by an enzymatic system.

LDL cholesterol

LDL cholesterol was calculated by the Friedewald formula (Friedewald et al., 1972). LDL cholesterol (mg/dl) = (Total cholesterol – HDL cholesterol) - (TGL/5)

Body mass index

Clients’ weights and heights were measured by using standard procedure. Standard digital scale was used for weight determination and height was measured by using an elastic height tap. BMI was calculated from weight and height values using the following formula (WHO, 2004). 

BMI= weight in kg/ height in m$^2$ Blood pressure Blood pressure was measured byusing sphygmomanometer.

STATISTICAL ANALYSIS

The data were subjected to analysis of variance (ANOVA) using statistical software package Minitab 16. Significance was declared at p<0.05. When significant results were obtained, post-hoc analyses were carried out to compare the differences among the means using Least Significant Difference (LSD) test. Each mean was calculated from triplicate values.

RESULTS

Baseline characteristics of individuals

Baseline information regarding the study participants

showed male to female ratios of 2:5, 4:3, 5:2, 5:2 for GP, CSP, GP-CSP and control groups, respectively (table 1). The average age of the individuals across the groups ranged from 46.42 to 65.28 years. Average BMI of the individuals ranged from 26.21 to 30.39 kg/m² whereas the concentrations of TC, TGL, HDL and LDL ranged from 217 to 241, 194.28 to 292.14, 41 to 43.57, 123.17 to 148.85 mg/dl, respectively. The systolic blood pressure of subject individuals varied from 137.14 to 140 mmHg whereas the diastolic blood pressure from 83.57 to 88.57 mmHg. Similarly, the blood glucose levels of the four groups ranged from 126 to 240 mg/dl.

Effect of GP and CSP supplementation on lipid profile

The BMI of subject individuals was significantly (p<0.05) affected by both supplement types and supplementation time (table 2). The highest average BMI (30.64 kg/m²) was recorded for control group at day 60 whereas the lowest (26.11 kg/m²) for individuals provided with GP-CSP mixture at day 40 of the experimental period. The average BMI showed a decreasing trend in treatment groups with the length of supplementation time, however, at follow-up period i.e. after day 40, a non-significant increase in BMI was observed.
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Total cholesterol significantly reduced with the supplementation of garlic and coriander (table 2). The highest decrease was noted in GP group (45.72mg/dl) followed by GP-CSP group (40.29mg/dl) during the intervention period of 40 days. In contrast, TC increased from 227 to 278.42mg/dl in control group during the 60 days of experimental period. However, the mean values of TC in intervention groups again increased during follow up period. The increase was significant for GP and non-significant for CSP and GP-CSP groups.

Triglycerides showed a decreasing trend with supplementation process. The maximum reduction was noted for GP-CSP group, where the TGL decreased from 251.28 to 136.28mg/dl during the intervention period. The lowest decrease (43mg/dl) was recorded for CSP group. The level of TGL slight increased during the follow up period in all intervention groups but the increase was non-significant (p<0.05). The control group also exhibited a progressive reduction in the mean values of TGL.

HDL level of intervention groups significantly (p<0.05) improved with supplementation. The highest impact was noted for garlic powder, which increased the HDL level of subject individuals from 42.44 to 55.14 mg/dl during the intervention period. The lowest increase (4.15mg/dl) was noted for individuals provided with coriander seed powder. During the follow-up period a reversal of the increasing trend was examined for HDL. In control group the HDL decreased from 41 to 40.28mg/dl during the entire period of the experiment.

The LDL levels reduced significantly after 40 days of intervention but the mean values again started increase during the follow up period in treatment groups, while in control group there was a steady increase in the mean values of LDL during the 60 days of experimental period. Among the supplements, GP was found most effective in decreasing the level of LDL in hyperlipidemic people.

Effect of GP and CSP on blood pressure

The present study demonstrated that a regimented garlic and coriander seed powder supplementation program significantly improved the BMI and lipid profile of hyperlipidemic individuals. Among the supplement treatments, garlic powder (alone) showed highest efficacy against BMI, total cholesterol, HDL and LDL whereas the garlic and coriander seed mixture was found more effective in reducing the triglyceride level of subject individuals. The present results are consistent with those reported in previous literature. Superko and Ronald (2000) and Bashiri (2014) reported a non-significant decrease in BMI by providing 900 and 1000mg garlic powder per day, respectively to subjects with sedentary physical activity. Similarly, Kim et al. (2011) reported a significant decrease in body weight by providing garlic extract for 5 weeks to obese and hypercholesterolemic rats. The consumption of 2g each of garlic, coriander seed powder and their mixture for 40 days, in our case, significantly reduced the BMI of hyperlipidemic individuals. The higher efficacy of garlic in reducing the BMI of hyperlipidemic people may be attributed to sulfur containing compounds that plays a key role in reducing the body weight. In addition, coriander is a rich source of dietary fiber that plays a key role in reducing the body weight.

DISCUSSION

Effect of GP and CSP on BMI and lipid profile

The present study demonstrated that a regimented garlic and coriander seed powder supplementation program significantly improved the BMI and lipid profile of hyperlipidemic individuals. Among the supplement treatments, garlic powder (alone) showed highest efficacy against BMI, total cholesterol, HDL and LDL whereas the garlic and coriander seed mixture was found more effective in reducing the triglyceride level of subject individuals. The present results are consistent with those reported in previous literature. Superko and Ronald (2000) and Bashiri (2014) reported a non-significant decrease in BMI by providing 900 and 1000mg garlic powder per day, respectively to subjects with sedentary physical activity. Similarly, Kim et al. (2011) reported a significant decrease in body weight by providing garlic extract for 5 weeks to obese and hypercholesterolemic rats. The consumption of 2g each of garlic, coriander seed powder and their mixture for 40 days, in our case, significantly reduced the BMI of hyperlipidemic individuals. The higher efficacy of garlic in reducing the BMI of hyperlipidemic people may be attributed to sulfur containing compounds that reduced the production of fatty substances. In addition, coriander is a rich source of dietary fiber that plays a key role in reducing the body weight.
cholesterol level of the participants. The present results are in line with the findings of Rajeshwari et al. (2011), Parsaeyan (2012) and Afenan (2014) who reported a significant decrease in total cholesterol with consumption of garlic and coriander seed powder. The hypocholesterolemic action of garlic and coriander was attributed to the presence of allicin, flavonoids and phenolic compounds in them that enhanced lipid metabolism Wangensteen et al., (2004). In addition to allicin, garlic contains diallyl disulfide and dipropyl disulfides that are known for their hypocholesterolemic action (Al-Numair et al., 2009). Garlic powder also contains appreciable quantity of non-digestible carbohydrates that has been reported to be associated with lowering the cholesterol (Simons et al., 1995).

Triglycerides levels of the subjects were also significantly influenced by the supplements. The highest impact was examined for garlic and coriander seed powder mixture. Similar results were previously reported by Parsaeyan, (2012) and Afenan et al. (2014). However, contradictory results exist that do not allow a conclusion on the beneficial role of garlic and coriander in the improvement of CVD risk via normalization of blood lipids (Ziaei et al., 2001; Parastouei et al., 2006). These discrepancies may be explained by the interference of several factors, such as lack of consistency among studies, variation in dosages, standardization of garlic and coriander preparations and duration of treatment. The TGL lowering effect in the current study may be due to inhibited fatty acids synthesis (Bopanna et al., 1997), increased lipolytic activity by tissue lipases, suppression of lipogenic enzymes (Pari and Venkateswaran, 2003) and activation of LCAT (Aissaoui et al., 2011). Flavonoids and polyphenols in coriander and allicin and sulfur-containing compounds in garlic are responsible for the hypolipidemic effect (Jia et al., 2009; Udayakumar et al., 2009).

The supplementation of garlic powder, coriander seed powder and their mixture to hyperlipidemic subjects significantly improved their HDL level. Among the supplements, garlic exerted the strongest influence on the enhancement of HDL level of the participants. The present results are consistent with those reported by Kojuri et al., (2007) who reported that a dose of 800 mg/day enteric-coated garlic powder significantly increased the HDL level of hyperlipidemic patients. Similar results were also reported by Qinna et al., (2012) and Hussien et al., (2013). The effectiveness of garlic in enhancing the HDL level might be due to inhibited absorption of intestinal cholesterol and enhanced cholesterol turnover to bile acids by allicin. Allicin inhibits HMG-CoA reductase and thus reduces hepatic cholesterol biosynthesis (Ashraf et al., 2005; McRae, 2005).

Patients with garlic and coriander seed powder supplementation. Although all the supplements showed significant results, the reducing power of garlic powder was more pronounced. The present results complimented the findings of Sebonin et al., (2008) who reported 13.8% reduction in the LDL level of 42 hypercholesterolemic human subjects by providing them with 600 mg/day garlic powder. Hussein et al., (2013) reported a marked decrease in LDL level of hyperlipidemic patients by feeding them with 1000 mg garlic per day for a period of 12 weeks. Similarly, Rajeshwari et al., (2011) observed a significant

**Effect of GP and CSP on blood pressure**

The supplementation of GP and CSP significantly affected the SBP whereas no influence was recorded on DBP was non-significantly noticed. These results are consistent with Bashiri (2014) who reported significant reduction in systolic blood pressure by feeding the patients with 1000mg garlic powder per day along with regular exercise for 4 weeks. Similarly, Ashraf et al., (2013) showed significant reduction in systolic and diastolic blood pressure in both dose and duration dependent manner in patients with essential hypertension.

The possible mechanism by which garlic might induced its hypotensive effect could be through the production of nitric oxide, which promotes vasodilation (Al-Qattan et al., 2001). Similarly, the functions of both endothelium-derived relaxing factor and constricting factors like endothelin-1 is found to be altered with garlic consumption (Tripathi, 2009), that ultimately affect the blood pressure. The gamma glutarylcysteines, present in garlic, may also be involved in lowering blood pressure, as these compounds inhibit angiotensin-converting enzyme (Omar et al., 2007). In an in vitro study Benavides et al., (2007) demonstrated that garlic-derived compounds could be converted to hydrogen sulfide by red blood cells that act as vasodilator and thus may have cardio protective properties (Lefer, 2008). Likewise, the use of coriander as a traditional hypotensive agent has been reported in many cultures (Eddouks et al., 2002). The antihypertensive property of coriander may be attributed to its ability to increase urine output, excretion of electrolytes and glomerular filtration rate (Aissaoui et al., 2008). In addition, coriander is reported to exhibit gut stimulatory, inhibitory and hypotensive effects by mediating the cholinergic, Ca²⁺ antagonist and the combination of these mechanisms.

**CONCLUSION**

Garlic powder caused a statistically significant reduction in BMI, TC and LDL, however a significant increase in HDL, while a non-significant reduction in TGL and VLDL. Coriander powder decreased TC and LDL significantly while TGL, VLDL and BMI non-significantly, however HDL increased but it was non-significant. Mixture of both reduced TC, TGL, LDL and VLDL significantly while HDL increased significantly but BMI reduced non-significantly.
REFERENCES


