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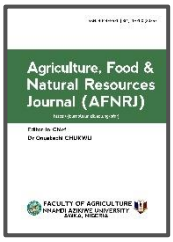

Review Article

Potential effects of garlic supplementation in older adults on a long-term cardiovascular disease risk

OPEN ACCESS

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ABSTRACT

Cardiovascular disease (CVD) is the primary cause of death among elderly people. Garlic has been used as a food and medicinal herb for millennia and is well-known for its numerous health advantages, particularly those related to cardiovascular health. This review looks at the bioactive compounds in garlic, such as allicin, and how they affect many aspects of cardiovascular health, including hypertension, heart disease, platelet aggregation, and aortic stiffness. It underlines the need to incorporate garlic into the diet as a preventative approach against CVD risk factors, particularly in older persons. Garlic and cardiovascular health are a complex and ongoing research topic. Preliminary research indicates that frequent garlic consumption may lower cholesterol and blood pressure, reduce platelet aggregation, and improve overall vascular function. In conclusion, garlic has been shown to improve cardiovascular health and may reduce CVD risk in older persons. Eating garlic regularly may enhance various health aspects and should be included in a balanced diet. However, the long-term consequences of garlic supplementation in older persons are not entirely established and warrant more research.

KEYWORDS: *Bioactive, Cardiovascular, Dietary, Garlic, Supplementation*

INTRODUCTION

Cardiovascular diseases (CVD) are a series of life-threatening ailments that afflict people of all age groups, even though adults are mostly susceptible. Cardiovascular disease consists of a number of illnesses, some of which are heart diseases, vascular diseases of the brain, kidney, and peripheral arterial disease (WHO, 2013). Common causes of cardiovascular diseases may include: Obesity, high blood pressure, high cholesterol, family history of CVD, prolonged inactivity, unrestricted smoking, etc. Adults are more prone to the diseases as result of their lifestyle choices and the bulk of what they consume. Bernard *et al*. (2010), stated that the early half of the 20th century witnessed a rapidly growing epidemic of cardiovascular diseases as a result of industrialization, urbanization, increased prosperity, and social upheaval in the higher income countries, followed by an impressive decline in mortality from cardiovascular diseases during the latter half of the 20th century. WHO puts total death rate as a result of cardiovascular diseases in 2008 at approximately 17.3 million, depicting 30% of all deaths globally. Out of these casualties, 7.3 million occurred secondary

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to coronary heart disease and 6.2 million as a consequence of stroke.

Garlic (*Allium sativum*) is a multipurpose plant belonging to the family Amarydillaceae. It is native to Central Asia and North-eastern Iran and has long been used as food seasoning worldwide, with a history of several thousand years of human consumption and use (Block, 2010). Like leeks, onions and chives, garlic belongs to the Allium genus and is characterized by bulbous appearance. It produces between 6 to 12 long leaves of about 15 cm to 60 cm, with a tall flowering scape from a single underground bulb. It divides, forming in time a cluster of plants. Even though they are perennial herbs, they are cultivated as an annual individual clove, planted in early winter or spring and the bulbs being harvested in the summer. Very many years before orthodox medicine was accessible and affordable, garlic was used for medicinal purposes in treating different epidemics, such as typhus, dysentery, cholera, and influenza (Petrovska & Cekovska, 2010), they were also widely used for food flavouring. Avicenna (1988), recommended garlic as a useful compound in treatment of arthritis, toothache, chronic cough, constipation, parasitic infestation, snake and insect bites, gynaecologic diseases, as well as in infectious diseases (as antibiotic). According to records, for many decades, garlic has been potent medicine and has been used for healing of various illnesses among the Chinese, Egyptians, Babylonians, Greeks, and Romans (Reuter, *et al.*, 1996).

In modern day, garlic has been found to possess both therapeutic and prophylactic properties and has attracted various medicinal uses in both orthodox and traditional medicine. Its constituents have been found to be potent in the treatment of high blood pressure, atherosclerosis, high level of fats and cholesterol in the body, aids respiration and digestion. Garlic is rich in sulfur-containing compounds. The thiosulfinates of garlic include allicin, which appear to be the active substances in garlic. Allicin is formed when alliin, a sulfur-containing amino acid, comes into contact with the enzyme alliinase when raw garlic is chopped, crushed, or chewed. Dried garlic preparations containing alliin and alliinase must be enteric coated to be effective because stomach acid inhibits alliinase., because alliinase also is deactivated by heat, cooked garlic is less powerful medicinally.

Allicin has exhibited biocidal activities against several types of microorganisms, including bacteria, yeast and fungi. The antimicrobial, hypolipidemic (lowering lipid-protein complexes), antioxidant and antithrombotic effects that have been attributed to garlic are thought to be related to allicin and other breakdown products. The antineoplastic or anticancer effects of garlic may be related to the sulfur compounds or to other unknown components (Koch and Lawson, 1996). Epidemiologic studies indicate that diets rich in fruits, vegetables, and spices are associated with lower risk of all-cause, cancer, and cardiovascular-disease death (Genkinger *et al*., 2004).

GARLIC INTERACTIONS

Garlic and cardiovascular diseases

Garlic has been very effective in the treatment of cardiovascular illnesses, research reveals. Cardiovascular disease is associated with multiple factors, such as raised serum total cholesterol, raised low-density lipoprotein (LDL) and an increase in LDL oxidation, increased platelet aggregation, hypertension, and smoking (Rahman & Lowe, 2006).

Garlic however, through research has been shown to inhibit enzymes involved in lipid synthesis, can reduce serum lipids in hypercholesterolemic cases and in addition, decrease platelet aggregation, prevent lipid peroxidation of oxidized erythrocytes and LDL, increase antioxidant status, and inhibit angiotensin-converting enzyme, thus, reducing factors associated with cardiovascular diseases (Rahman & Lowe, 2006). According to Chan *et al.* (2013) constant consumption of Garlic helps in lowering blood pressure, prevention of atherosclerosis, reduction of serum cholesterol and triglyceride, inhibition of platelet aggregation, and increasing fibrinolytic activity. Adults are at the most likely to come down with cardiovascular diseases due to the kind of life style the ranging from unhealthy diets, consumption of harmful quantity of tobacco and alcohol, too much fat and oily diet, high consumption of processed and preserved foods. This has continuously increased adult population suffering from various cardiovascular diseases, some of which include: high blood pressure, stroke, congestive heart failure, coronary artery disease, arrhythmia, peripheral artery disease and cardiac arrest. Consumption of garlic and its supplements have the potentials of reducing some life-threatening cardiovascular diseases as proven in many literatures.

Effect of garlic on hypertension

An increase in blood pressure is known as essential hypertension caused by an unexplained reason that raises the risk of cerebral, cardiac, and renal problems. In developed countries, the chance of getting hypertensive (blood pressure >140/90 mm Hg) over the course of a lifetime surpasses 90%. Age, obesity, insulin resistance, diabetes, and hyperlipidaemia are all common coexisting cardiovascular risk factors with essential hypertension. Early in the course of hypertensive cardiovascular disease, subtle target-organ damage such as left-ventricular hypertrophy, microalbuminuria, and cognitive impairment occurs. Although, over long periods of untreated hypertension, catastrophic events such as stroke, heart attack, renal failure, and dementia are more likely to occur (Messerli *et al.*, 2017). It was estimated that Hypertension affects more than 50 million Americans.' Patients with a systolic blood pressure (SBP) of greater than 140 mm Hg or a diastolic blood pressure (DBP) of greater than 90 mm Hg are classified as having stage I hypertension, while those with an SBP of greater than 160 mm Hg or a DBP of greater than 100 mm Hg are classified as having stage II hypertension (Reinhart *et al.*, 2009).

Through meta-analyses of randomised controlled studies, the effect of garlic on hypertension in patients with and without increased systolic blood pressure (SPS) was investigated. Researchers examined MEDLlNE, CINAHL, and the Cochrane Central Register of Controlled Trials for randomised controlled trials in humans studying garlic's influence on blood pressure. From their start until June 26, 2008, all databases were searched using the key terms garlic, Allium sativum, and allicin. A manual search of the published literature yielded other pertinent studies. Studies with a population with a mean baseline SBP of more than 140 mm Hg were analysed separately from those with lower baseline blood pressures. Garlic's effect on SBP and DBP was considered as a continuous variable, and a random-effects model was used to generate weighted mean differences. There were ten trials in total, three of which involved people with high blood pressure. Garlic reduced SBP by 16.3 mmHg (95 percent CI 6.2 to 26.5) and DSP by 9.3 mmHg (95 percent CI 5.3 to 13.3) in patients with high SBP compared to placebo. In patients with normal SBP, however, garlic had no influence on SBP or DBP. According to this meta-analysis, garlic is linked to lower blood pressure in patients with an elevated SBP but not in those without an elevated SBP (Reinhart *et al*., 2009).

Effect of garlic on heart

Garlic has been discovered as one of the most effective ways to lower elevated homocysteine levels. Lowering serum homocysteine levels, which is one of the risk factors for cardiovascular disease, can minimise the occurrence and consequences of myocardial infarction. The goal of this study was to see how garlic affected elevated homocysteine levels in patients with ischemic heart disease (IHD). This observational study involved 60 IHD patients who visited Kashan's cardiac clinic (Isfahan, Iran). For 6 weeks, two equal groups of patients (n=30) were given 800 mg garlic pills daily (equivalent to 4gr raw garlic) or placebo. Plasma homocysteine levels were measured before and after the intervention (Mousavian *et al.*, 2017).

The amounts of high density lipoproteine (HDL), triglyceride (TG), and low density lipoproteine (LDL) were determined using the (ELISA) technique, as well as TG, HDL, and enzymatic procedures, respectively. Result showed the average age of the patients was 60.6±10.1, with 39 men (65%) and 21 women (35%). The mean plasma homocysteine level reduced from 4.6 to 4.4 mol/l at the end of the research, while it climbed from 4.5 to 4.6 mol/l in the placebo group. However, when the confounding factor was used to compare the effects of two medicines on homocysteine, TG, HDL, and LDL levels, no significant differences were detected. In conclusion, for 6 weeks, taking 800 mg of garlic daily had no effect on serum homocysteine or lipid levels (Mousavian *et al.*, 2017).

Effect of garlic oil on platelet aggregation in humans

Platelet aggregation refers to platelets' capacity to stick together and form the haemostatic plug, which is an important component of primary homeostasis. Antiplatelet medication helps those who are at risk of cardiovascular events live longer (Wojcikowski *et al.*, 2007). Garlic and its components have antiplatelet action, which has largely been an established in vitro study. Garlic oil was demonstrated to reduce platelet aggregation ex vivo in healthy persons and patients with coronary artery disease (CAD). In this study, the acute and long-term impacts were looked into independently. The acute effect study included five healthy, non-smoking guys between the ages of 30 and 35. After fasting blood samples were taken, platelet aggregation in platelet-rich plasma (PRP) was generated using a predetermined concentration of each agonist (ADE, epinephrine and collagen). The same concentration was employed throughout the research. After that, garlic off tablets were administered in one dose, blood samples were taken, and aggregation was performed after 4 hours. The trial was repeated in the same subjects with different garlic dosages after a 5-day hiatus (Bordia *et al.*, 1996).

Garlic and aortic stiffness

Aortic stiffness is an important component of circulatory system performance and a prognosticator of cardiovascular risk, through interfering with cardiac function, coronary blood flow, and the mechanical integrity of the arteries. Aortic stiffness has also been found as an independent risk factor for cardiovascular disease. Caffeine is the most extensively used pharmacologic drug, yet little is known about its influence on arterial stiffness. In addition, its significance in hypertension is debatable. Caffeine has a significant, long-lasting, acute pressor effect, but its long-term impact on blood pressure (BP) has yet to be determined (Vlachopoulos *et al.*, 2003).

Garlic supplements have been found to be effective in the treatment of uncontrolled hypertension, with a biologically plausible mechanism of action. A study conducted by Ried *et al*., (2013) looked at how aged garlic extract affects central blood pressure and arterial stiffness which are the two major risk factors of cardiovascular morbidity. A total of 88 patients and community members with uncontrolled hypertension took part in a 12-week double-blind randomised placebo-controlled trial to compare whether the daily intake of aged garlic extract (1.2g containing 1.2mg S-allylcysteine) or the placebo affected cardiovascular markers such as the blood pressure, cholesterol level, homocysteine, platelet function, and inflammatory markers. Results revealed that central hemodynamic indicators such as central blood pressure, central pulse pressure, mean arterial pressure, augmentation pressure, pulse-wave velocity and arterial stiffness improved more in the garlic group than in the placebo group.

The aged garlic extract was well tolerated and acceptable, with no increased risk of bleeding in patients using blood thinners. It can therefore be implied that aged garlic extract can lower peripheral and central blood pressure in a large proportion of patients with uncontrolled hypertension, as well as reduce arterial stiffness, inflammation, and other cardiovascular indicators in individuals with high levels (Ried *et al*., 2013).

PROPERTIES OF GARLIC

Antimicrobial property

It's been proven over time that garlic has tremendous anti-microbial potentials effective against a plethora of gram-positive, gram-negative, and acid-fast bacteria (Bayan *et al*., 2014). These include Salmonella, *Escherichia coli* (Adler & Beuchat, 2002), Pseudomonas, Proteus, *Staphylococcus aureus* (Cavallito & Bailey, 1944), Escherichia coli, Salmonella (Johnson & Vaughn, 1969), Klebsiella (Jezowa *et al.,* 1966), Micrococcus, *Bacillus subtulis* (Sharma et al., 1977, Clostridium (De Witt *et al*., 1979), Mycobacterium (Delaha & Garagusi, 1985), and Helicobacter (O'Gara *et al.*, 2000). It has been documented that garlic exerts a differential inhibition between beneficial intestinal microflora and potentially harmful enterobacteria (Ress *et al*., 1993).

Antifungal properties

A sample of pure allicin was shown to be antifungal. Removal of the allicin from the reaction by solvent extraction decreased the antifungal activity (Hughes & Lawson, 1991). Activity has also been observed with the garlic constituents, diallyl trisulfide, against cryptococcal meningitis (Cai, 1991), ajoene, and against Aspergillus (Yoshida *et al.,* 1987). Thiol reduced the activity, suggesting the blocking of thiol oxidation by allicin. Inhibition of respiratory activity is thought to be due to inhibition of succinate dehydrogenase. Many fungi are sensitive to garlic, including Candida (Yousuf, 2011), Torulopsis, Trichophyton, Cryptococcus (Fromtling & Bulmer, 1978), Aspergillus (Hitokoto *et al.,* 1980), Trichosporon, and Rhodotorula (Tansey &Appleton, 1975). Garlic extracts have been shown to decrease the oxygen uptake (Szymona, 1952), reduce the growth of the organism, inhibit the synthesis of lipids, proteins, and nucleic acids (Adetumbi *et al.*, 1986), and damage membranes (Ghannoum, 1988).

POTENTIAL BENEFITS OF GARLIC

Garlic is an important multipurpose medicinal plant, not all its uses have been well documented in literature. Some of the uses are however stated below:

Nutritious

Garlic can be eaten cooked or raw, widely consumed, especially in southern Europe, as a flavourant in a wide range of foods, it contributes nutritious and healthy addition to the diet, however, because of its very strong aroma, it is mostly used in very small quantities as a flavouring in salads and cooked foods (Duke & Ayensu, 1985)

Natural repellent

Garlic has been found to be a natural repellent to insects and even rodents. This effectiveness may be attributed to its lingering smell due to the presence of sulfur in its extract

Medicinal

Garlic has been found to be useful in the treatment of many health-related challenges. It is commonly used in the treatment of high blood pressure, high levels of cholesterol or other fats in the blood, and hardening of the arteries. It is also used for the common cold, osteoarthritis, and many other conditions. Its expressed juice is an excellent antiseptic for treating wounds, also, Garlic's fresh bulb is effective in reducing the actions of bacteria, aids detoxification of chronic lead poisoning and can keep amoebic dysentery at bay (Sampath *et al*., 2010).

Body immunity booster

According to a study by Steinmetz *et al*. (1994) involving 41,000 women between the ages of 55 and 69, those who routinely ate garlic, fruits and vegetables had a 35% lower colon cancer risk.

Works as anti-inflammatory

Anti-inflammatory activity of sulfur-containing compounds (oil) from garlic have been found to be effective in the treatment of sore and inflamed joints or muscles (Lee *et al*., 2012).

Maintains healthy heart

Banerjee and Maulik (2002) opined that garlic can have a positive impact on your arteries and blood pressure. When sulfur in garlic reaches the red blood cell, it is turned to hydrogen sulphide gas which us capable of expanding the blood vessel, hence making regulation of blood pressure easier.

Skincare

The antibacterial and antioxidants properties of garlic is capable of ensuring a acne-free skin by destroying the bacteria causing it (Pazyar & Feily, 2011)

Reduces cancer risk

Garlic compounds generate reactive oxygen species leading to activation of stress kinases and cysteine proteases for apoptosis in human glioblastoma (Arabinda *et al*., 2007). Allicin induces apoptosis by regulating caspase independent or dependent apoptotic signalling pathway in various cancer cells (Zhang *et al*., 2006) Also, (Zhang *et al*., 2010) showed that allicin induces gastric cancer cell apoptosis by decreasing the mitochondrial membrane potential ($\delta\Psi m$) and activating caspase 3, 8, and 9

Enhances bodily performance

Garlic was used in ancient medicine to reduce fatigue and improve the productivity of hired labour. According to Morihara *et al.* (2007), it has been confirmed that garlic produces symptomatic improvement in persons with physical fatigue, systemic fatigue due to cold, or lassitude of indefinite cause, suggesting that garlic can resolve fatigue through a variety of actions, although the mechanism involved remains unclear.

Keeps the liver healthy

According to various reports, mineral present in Garlic, called selenium can cleanse the liver. It can trigger liver enzymes, and naturally flush out the toxins from your body.

CONCLUSION AND RECOMMENDATION

Literature has proven that beyond being useful as flavorants and condiment in cooking, the medicinal properties of garlic are numerous. It is therefore recommended that anybody willing to benefit from the various potential benefits mentioned in this review should include garlic more often in their diets, not only for its prophylactic potentials but because it is also therapeutic. Adults living with any form of cardiovascular infections or diseases are advised to not only lead a healthy but also include garlic supplement in their diets to stand a chance of improved health status.

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Authors' Contribution

OAA., ASA, LAA were responsible for sourcing research materials and writing of the review paper. AAG, MON did the editing, added necessary corrections and ensured it conformed with the journal's standard.

Ethical Statement

Not applicable

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