

# Medicinal Values of Garlic (*Allium sativum* L.) in Non-Communicable Diseases: A Review

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## Abstract

**Introduction:** These days many people are suffering from many non-communicable diseases like hypertension, diabetes, ethanol induced liver injury and several types of cancers. There is no absolute cure and effective modern medicine for the above mentioned non-communicable diseases. Garlic is one of the most commonly used bulb crop used in different parts of the world as a spice, traditional medicine and food additive. This plant is a species in the onion genus, *Allium*, and many studies proved that this plant could be used in the treatment of many non-communicable diseases and is safe for human use.

**Materials and methods:** Several research papers related to the medicinal values of garlic from different journals were used in order to compile this review. Search for these literatures was conducted in different electronic databases (Science Direct, MEDLINE, Research gate, Web of Science and Google Scholar) with inclusion criteria of full length published articles or experimental studies and with exclusion criteria of data from non-open access journals or partially accessed articles.

**Conclusion and recommendations:** Now days so many non-communicable diseases like hypertension, diabetes, alcohol induced liver injury and cancers are being major human problems in human life. As a widely cultivated crop Garlic has so many benefits towards these diseases and could be used as an alternative treatment for these diseases.

## Keywords

Gentamycin • Fibrinolytic • Hepatoprotective • Anti-hypertensive • Anti-diabetic • Anti-cancer

## Introduction

Garlic is a small underground bulb crop [1]. It is one of the most commonly used herbal medicines worldwide [2]. Originally from Central Asia, garlic is one of the earliest of cultivated plants [3]. Botanically it is known as *Allium sativum* and it is a member of Alliaceae or Liliaceae family. It has strong odoriferous nature and due to this it is commonly known as stinking rose [1].

Garlic has the higher concentration of sulfur compounds than any other *Allium* species [4]. Hence, there are at least thirty-three sulfur compounds, minerals like germanium, calcium, copper, iron, potassium, magnesium, selenium and zinc; vitamins A, B1 and C, fiber and water. It also contains several enzymes and seventeen amino acids. The other constituents of intact garlic include steroidal glycosides and lectins [4,5]. One of the minerals in garlic, Selenium is an essential trace element vital for the healthy body build up and maintenance. It is only obtained from food or some other source of supplementation. It contains several types of selenium proteins which are involved in reproduction, protection from oxidative damage and infection, thyroid hormone metabolism and DNA synthesis [6]. The other main biologically active ingredient present in garlic is allicin (diallyl thiosulfinate or diallyl disulphide) [5]. Allicin is formed when cloves of garlic are crushed or cut and it is responsible for the pungent smell of garlic. Allicin is the one which enables the the plant to protect itself from soil parasite and fungi [7].

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Many medicinal plants are designed to improve health but their mechanism of action remains not clear. Among these plants, garlic (*Allium sativum*) has attracted particular attention of modern medicine because of its widespread use for the prevention and treatment of some human diseases such as cardiovascular diseases, suppression of harmful cholesterol and raise level of the beneficial high-density lipoproteins in the blood [8,9]. Garlic extract has also antimicrobial activity against many genera of bacteria, fungi and viruses [10]. It is also reported to have fibrinolytic activity and inhibits anti platelet aggregation [8]. The other importance of garlic as a medicinal plant is its activity against the prevention of cancer. Garlic has the higher concentration of germanium than any other herb which is anticancer agent [9]. Many researches being conducted currently showed that many readily available foods like garlic, which make up healthy diet, have a great synergetic effect in the prevention or possibly fight against cancer [10]. Garlic also helps regulate blood sugar levels and preferred for expelling parasites like pin worms [9]. Thus, this review has emphasized to summarize the medicinal activities of *Allium sativum* from several studies conducted previously.

## Recent Advances in Garlic Medicinal Use

### Hepatoprotective effect against ethanol induced liver injury

In a research conducted by Zhang, et al. to show the hepato protective effect of allicin against acrylamide induced hepatocyte damage in cultured mouse primary hepatocytes and mouse liver both *in vivo* and *in vitro*, it was demonstrated that allicin is effective against acrylamide induced liver toxicity [11]. Other study was also conducted after that to assess the hepatoprotective effect of other *Allium* species like *Allium cepa*, in ethanol induced liver damage on Wistar rats [12]. The other research carried out on hepatoprotective effect of garlic was to evaluate modulatory effect of garlic inclusion in a diet, on gentamycin induced hepatotoxicity in rats. And results from this study demonstrated that 2% or 4% garlic inclusion in diet helps to reduce the levels of gentamycin induced liver damage marker enzymes such as AST and ALT to normal levels compared to those rats taking diets alone without inclusion of garlic [13].

It is well known that alcohol is a known hepatotoxic which can cause progressively aggravated liver disease named as Alcoholic liver disease. It is also the main cause of advanced liver disease in Europe, USA and china

and globally it is responsible for 47.9% of all liver cirrhosis deaths [14]. The potential use of garlic in the treatment of ALD has been investigated in the past few decades, and much of these studies showed that garlic has a hepatoprotective effect. The hepato protective effect of garlic is associated to its antioxidant effect. Garlic may protect tissue damage in the liver by resulted from elevated oxidative stress by increasing anti-oxidant level through hunting Reactive Oxygen Species (ROS) [15] and minimizing the lipid peroxidation in the cells [16]. Ethanol metabolism activates CYP2E1 to generate ROS, leading to hepatic oxidative stress, inflammation, and fibrosis. It was found that organosulfur compounds present in garlic, like DAS, DATS, and DADS, are responsible for inhibiting CYP2E1 activity and expression. DAS has the highest inhibitory efficacy and lowest toxicity. It works by activating Constitutive Aderostane Receptor (CAR) and nuclear factor related factor 2 (Nrf2), which is responsible for synthesizing drug metabolizing enzymes [17,18]. Based on the above therapeutic effects garlic was found to be effective in the treatment of ALD and could be taken as a new protecting agent for alcoholic liver damage and further researches needs to be conducted in order to effectively use garlic for ALD.

### Anti-hypertensive effect

Animal experiments conducted *in vivo* with intravenous administration of garlic extracts showed a considerable reduction of both systolic and diastolic blood pressures [19]. The activity of garlic against blood pressure was also assessed using processed garlic on spontaneously hypertensive rats. And a significant decrease in DBP and SBP was shown on the spontaneously hypertensive rats relative to the control ones [20].

Research on human was also conducted to assess the activity of garlic on hypertension. Study conducted in different primary health care centers in Karachi, Pakistan on patients with newly diagnosed stage I essential hypertension. By this study it was tried to show the effect of garlic, placebo and atenolol on systolic and diastolic blood pressure for 24 weeks. Finally from the result it was shown that there was a significant drop off in both SBP and DBP as compared to the placebo and standard hypertensive agent. And this fall in blood pressure was better while using garlic in both dose dependent and duration dependent manner [21]. On another study there was a significant (up to 10%) reduction in systolic and diastolic blood pressure by supplementation of 25 grams of crushed garlic cloves for longer time [22]. The mechanism of action for blood pressure lowering property of garlic is attributed to several mechanisms which include mediation of intracellular Nitric Oxide (NO) and Hydrogen Sulfide (H<sub>2</sub>S) production and also blockage of angiotensin-II production, which in turn promotes vasodilation and thus reduces the BP [23].

### Anti-diabetic effect of garlic

Since there are some doubts about the effectiveness and safety of current oral hypoglycemic agents science is towards searching for more effective and safer anti-diabetic drugs [24].

In most studies it was confirmed that garlic can reduce blood glucose levels in diabetic mice, rabbits and rats [25]. On other study macerated garlic cloves with *in vivo* oral doses of 0.1 g, 0.25 g and 0.5 g/kg between reduced serum glucose TC, TG levels on diabetic rates when compared with glybenclamide for 14 days [26]. Diabetes is known to contribute for increased free radical production. Some mechanisms that contribute for the formation of free radicals in diabetes may include increased non-enzymatic and auto oxidative glycosylation, metabolic stress resulted from changes in energy metabolism, levels of inflammatory mediators and the status of anti-oxidative defense. In some study it was indicated that this metabolic stress was normalized using garlic oil in streptozotocin-induced diabetic rats [27]. In another study a garlic derived protein was used in the control of hyperglycemia in diabetic mice by stimulation of systemic NO and insulin level. And this was the first study to demonstrate the strong anti-diabetic role of manose binding lectin protin from garlic even though there were some other few studies which explained the anti-diabetic effect of garlic earlier [28].

Generally these and some more studies have found garlic useful in the treatment and management of diabetes in several animal models. So the studies should also be focused in the management of diabetes in humans. And much intensive researches and clinical trials should be carried out in human models in order to use this organic product for the treatment and management of diabetes mellitus.

### Anti-cancer effect of garlic

Even though there is advancement of technology in the field health, cancer is still one of the most disease of concern which is responsible for the death and sufferings of many people around the world [29]. Though human develops advanced therapies like chemo therapy, antibody therapy, chemotherapy and target therapy to treat cancer, this treatments have their own side effects [30]. Thus the development of effective drugs that are cost effective, non-toxic and sustainable is crucial in order to find an alternative way of cancer treatment [31]. For more than 2000 years garlic is well known and used as medicinal food for its use as immune regulatory, anti-bacterial, anti-hypertension, anti-hypercholesterolemia, anti-diabetic, anti-atherosclerosis and anti-tumor agent [32,33].

In addition to other compounds garlic also contains phenolic compounds, anti-oxidants and other bioactive ingredients which can aid expression of anti-oxidant enzymes. These enzymes are responsible for the protection of normal cells. It is well known that high intake of foods like garlic, which is reach in natural anti-oxidant or foods that stimulate the production of antioxidant enzymes reduces the risks of several types of cancers including breast, prostate, bladder and colon cancers [33]. Two major groups of compounds have been isolated from garlic and are shown to have anti-cancer activity. The first one is lipid-soluble allyl sulfur compounds like Di Allyl Disulfide (DADS) and Di Allyl Tri Sulfide (DATS), and the other one is the water-soluble compounds-γ-glutamyl S-allylcysteine group such as S-allylcysteine (SAC) and S-allylmercaptocysteine (SAMC). Some of the possible mechanisms of cancer preventive effect of garlic include; inhibition of DNA adduct formation, free radical scavenging, signal transduction modification, effects on tumor growth and cell proliferation by inducing oxidative stress and apoptosis [34-36]. In some studies it is shown that garlic extract increases the concentration of caspase-3 activity which triggers caspase-3 dependent apoptosis or cell death. This activity of garlic was seen in human cancer cell lines, such as hepatic (HepG2), colon (Caco-2), prostate (PC-3), and breast (MCF-7). It was also shown that some garlic extracts such as allicin and gallic acid undergo caspase independent cell death [33].

In some study it was found that fresh garlic extract makes Ehrlich ascites tumor cells non tumorigenic. First this tumor cells were incubated *in vitro* with fresh garlic extract and other Ehrlich ascites tumor cells were incubated with saline. Then the intra peritoneal injection of these tumor cells to experimental and controlled group of mice resulted in the death of all the mice injected with the tumor cells pre incubated with saline and those injected with the tumor cells incubated with the fresh garlic extract failed to develop the tumor [37].

## Conclusion

Garlic is a widely cultivated and commonly used underground bulb crop by human being. And this crop has so many uses as a medicinal crop in different kinds of non-communicable diseases. Among its use in the prevention and treatment of non-communicable diseases its protective effect against ethanol induced liver injury, anti-hypertensive activity (garlic is effective in lowering blood pressure, but further intensive clinical trials should be conducted and pharmacological properties and physiological effect of this naturally produced crop must be studied further), anti-diabetic activity and its anti-cancer effect are of major significance. Even though only little experiments were conducted and additional experiments needs to be done in order to prove its efficacy for the mentioned non communicable diseases, it seems a to have a promising therapeutic effect for the these

non-communicable diseases. Thus additional experiments and researches should be conducted in order to make better use of garlic as a medicinal plant for non-communicable diseases.

## Conflict of Interest

There is no conflict of interest regarding the publication of this literature review.

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