

THERAPEUTIC ACTIVITIES OF GARLIC CONSTITUENT PHYTOCHEMICALS



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Abstract: *Garlic (Allium sativum L.) has medicinal value but also an important dietary component for centuries. It belongs to the family of Liliaceae, which is mostly grown and found in Ethiopia and Africa. Ethiopian garlic has been mostly used in traditional medicines. Inhibitory activity of garlic extract has been reported by various researchers for Lactobacillus acidophilus, Staphylococcus aureus, Nocardia asteroides, pseudomonas aeruginosa, actinomyces viscosus, veillonella alcaligenes bacterial strains. The garlic paste and lime was used for mouth sore, sore throat and also can be used in toothpaste to prevent dental caries. The present review describes the potential of garlic phytochemicals for the improvement of the immune system against diseases in humans.*

Keywords: garlic, *Allium sativum*, antibacterial, antifungal, herbal medicine

Introduction

It is the one of the first crop in early 5000 years ago which was domesticated by human. During 1970's garlic was tested on 10 different species and shows inhibitory activities against *Salmonella*, *S. Aureus*, *Mycobacterium* and *proteus* species. Garlic is an antibacterial as well as anti-fungal agent (Block, 2010; Rivlin, 2001). As allicin is present in garlic which has its own molecular properties and several therapeutic effects and it is also basically a defence molecule. Allicin (allyl thiosulfinate) is a thiol-containing protein which is a fluid like compound present in garlic. Allicin produce smell of garlic (Agarwal, 1996; Amagase *et al.*, 2001). Garlic is the most basic spice used in Indian & Pakistani foods. Basically due to the presence of allicin in garlic it became effective against gram positive and gram negative bacteria. Garlic has also the ability to kill *streptococci*. It has a pungent odor, also contain sulphur compounds. Fresh crushed garlic is used as an effective medicinal extract against common pathogenic (Corzo-Martínez *et al.*, 2007; Flora, 2009). During 1940's the main purpose of using herb plants was to used for herbal medicines which are more effective against several infections and diseases. Garlic is also good for heart and stomach disease, also for wound and sexually transmitted diseases (Banerjee and Maulik, 2002). It is also good against the anthrax disease. Garlic also helps to lower down the cholesterol level. The use of garlic increases the shelf life of food. Garlic is also used in the form of capsule and powder form. Louis Pasteur first described the antibacterial activities of garlic

juice. Garlic has antibiotic resistance against several bacteria such as *E. coli*, *Salmonella*, *Shigella Senterae*, *Pseudomonas*, etc. The alliinase enzyme turns into allicin (Kim and Kyung, 2003; Urs *et al.*, 1994). These are responsible for the smell of garlic and garlic has also several antioxidant properties due to antioxidant properties. Antioxidants good for cancer, it protect cells from free radical and prevent the damage of cells due to oxidation. Garlic is not only antibacterial but also has antifungal & antiprotozoal properties (Jansen *et al.*, 1989; Kim and Kyung, 2003). When garlic is cooked the allicine of garlic destroys but in case we use raw garlic which is more effective then cooked garlic. It has anti-inflammatory, hypoglycaemia, also consist of hormone like effects. Garlic is oldest medicinal plant used in foods and as a medicine in different ways (Shimon *et al.*, 2007; Wang *et al.*, 2011).

Chemical properties

Allicin is not present in fresh garlic clove. It is odourless amino acid, not stable at room temperature, contains sulphur, is anti-hypertensive, antioxidant, and also has lipid lowering properties. Diallyl disulfide is organosulfur compound with light yellowish color. Due to this compound, most bacteria are sensitive to extracts from plants such as clove, garlic, mustard, onion, organo, turmeric etc. Garlic can also cause adverse reaction on our health such as allergy, cardiovascular problem dermatitis and bleeding under controlled manner (Shimon *et al.*, 2007; Zhou and Wang, 2009). Adverse reactions are due to the improper use of garlic and poor remedies. Garlic allergy has been manifested as rhinitis,

asthma, anaphylaxis contact dermatitis and pemphigus. Diallyl disulfide (C₆H₁₀S₂) and allylpropyle disulfide (C₆H₁₂S₂) are the basic components of garlic which are causative of allergies. Allylpropyl is the strongest sensitizer. Garlic consisted of anti-mitotic potential against colon neoplastic lesions in vivo and colon tumour cell growth in vitro. It inhibits colon cancer. It also has anti obesity properties which directly mean it helps to increase the metabolic rate and in this way it lower downs the cholesterol level (Banerjee and Maulik, 2002; Shimon *et al.*, 2007). Further study is needed to ascertain its toxicity against mammalian cells *in vivo* method may be used to confirm its potential side effects and efficacy. According to a survey 77% of the garlic is produced in India, South Korea, Egypt, Russia, , Myanmar, Ethiopia , USA , Bangladesh, & Ukraine (1856 MMT).

Organosulfur is derived from organic compounds, also present between the hot acidic volcanoes and deep in sea or ocean. Organosulphure is present in all living cells as the important amino acids, in the form of cysteine, cystine, and methionine they are important compounds of proteins (Chakraborty and Hancz, 2011; Tsai *et al.*, 2012). Organosulfur consist of five cyclic compounds, isolated from the *Allium sativum*'s leaves on the basis of physiochemicals. Organosulphur is mostly present in cruciferous vegetables, cauliflower, garlic, onion etc (Bayan *et al.*, 2014; Iciek *et al.*, 2009).

Medical importance

Garlic is a naturally a good source of therapeutic agents. Garlic is an ethno pharmaceutical drug but also proved to have therapeutic effects by different scientific studies allicin an organosulfur compounds, which prevent lipids from biosynthesis it was proved from a study that it damage the *Candida albicans* cell wall and inhibition of RNA in bacteria. For batter results garlic should be fresh and chemical free. Pure allicin has been found effective against isolates of *Aspergillus* in vitro study (Kuettner *et al.*, 2002; Zhou and Wang, 2009). It is also good for hair growth, for flu and anti-febrile. Garlic also helps to get rid of intestinal tract of *Giardia limbia* which is a parasite live water stream and it causes infection (giardiasis) in small intestine (Harris *et al.*, 2001; Sallam *et al.*, 2004). Mostly homeo-pathies refers to take garlic cloves dissolved in water three times a day to get rid of Giardia. Antimicrobial activity: as the allicin consist of organosulfur compounds which are the most important for the antimicrobial property. Anti-helminthic activity: helminthic is basically infection caused by worm, the body is infected with parasitic worm. Garlic has been used to treat the parasitic infections in humans and animals as well

(Hughes and Lawson, 1991; Ross *et al.*, 2001). It has also shown antihelminthic activity against *Ascaris lumbricoides*. Diallyl trisulphide has shown activity against several protozoans *e.g.* Trypanosoma species, *Entamoeba bistolytica* and *giardia lamblia*. The natural phytochemicals are present in it which is more effective alternative to antibiotics (Avato *et al.*, 2000; Goncagul and Ayaz, 2010). It has ability to kill all natural streptococcus strains. Garlic is an immunosuppressive for down regulation of pro inflammatory responses. It is also reported that in both effects vivo and vitro the secretion pattern of cytokines from TH2 to TH1 (T helper cell type 2 and 1) interferon-gamma and nitric oxide production also under the certain conditions (Indu *et al.*, 2006; Lai and Roy, 2004).

Mechanism of action and synergistic effect of garlic

It is studied that due the complex nature of plants, posses multiple mechanisms of action some of them are: viability, number of virulence factors, effect of antibiotic as resistance modifying agent. By the disruption of structure and membrane function, interruption in synthesis of DNA/RNA take place coagulation of cytoplasmic constituents occurs. Different agents involve in the interaction between synergistic effects and they are more efficient than other. There are several phases of effect active sites of bacterial cell are modified, degradation of antibiotics, membrane permeability increases, inhibits efflux pump (Gull *et al.*, 2012; Indu *et al.*, 2006).

Antioxidant efficacy

Garlic is rich in antioxidants which help to destroy the free radicals and particles that damage cell membrane and DNA which slows down the aging process. Garlic has complex chemical properties which have apparently opposite biological effects and play role in the antioxidants properties but if it is taken in higher it may cause toxic effects to heart and liver (Sallam *et al.*, 2004; Yin and Cheng, 2003).

Antibacterial effect of garlic on dental plaque:

dental plaque is the most common cause of dental disease. Plaque is actually the stick deposit on teeth consist of number of bacteria together. Plaque is not only bad for teeth but also bad for other health issues. Plaque removal is most important for the prevention of dental health and overall health (Chakraborty and Hancz, 2011; Sallam *et al.*, 2004). *Allium sativum* is good alternatives to antibiotics it is effective against *Escherichia coli*, *lactobacilli*, *klebsiella pneumonia*, *pseudomonas aereuginosa*, *mycobacterium tuberculosis*. It responsive to minimum 4 to 32 ug/ml. Pure extracts are more efficient against cecal bacteria. It is more effective against *Candida Albicans* which

is mostly present in oral cavity. Garlic also acts synergistically with antibiotics (Lai and Roy, 2004; Ross *et al.*, 2001).

Effect of garlic on human stomach: *Helicobacter Pylori* is most common bacteria in human stomach. Garlic has contribution in the treatment of *H. pylori* infection. *H. pylori* can cause severe gastritis which affect fundus, ulcer, malt lymphoma thyroid and skin are the common diseases or infections caused by *H. pylori*. The treatment of *H. pylori* consists of a proton pump inhibitor and two antibiotics amoxicillin and clarithromycin for at least two weeks. People suffering from gastric disease have secretion of hydrochloric acid find it hard to tolerate (Flora, 2009; Londhe, 2011; Tsai *et al.*, 2012). Garlic has been used world widely for several infections garlic is the best alternative of antibiotics. Several remedies have been discovered for drug development, these are pure standardize products obtained for herbal medicines. Secondary metabolites and phytochemicals seem to be the most important for screening purpose and drug development. Natural products have many advantages over to synthetic chemical drugs (Calo *et al.*, 2015; Gyawali and Ibrahim, 2014).

Garlic for hairs: Garlic consists of vitamin B-6 and C which are good for hair growth. Garlic is also good for health scalp because of its antibacterial and antifungal properties and which is also good for dandruff. Garlic may cause burns on skin when applied on skin (Hajheydari *et al.*, 2007; Khan *et al.*, 2008).

For respiratory infections: in Russia garlic is also known as to be used for respiratory infection treatment by the physicians. It was also used as the inhalator for children. During World War 1 it was used for the soldier's treatment so garlic was named as Russian garlic or a natural antibiotic (Lissiman *et al.*, 2014).

People use garlic as a basic spice in their cuisine have low risk of blood vessel disease atherosclerosis and other heart diseases and also lower down the cholesterol (Bongiorno *et al.*, 2008; Rouf *et al.*, 2020).

Anti-biofilm activity: Multi drug resistance are the most common concern of the society nowadays. The anti biotic resistance have been increased the study based on nano-particles containing garlic extract. Bacterial biofilms are produced due to the drug resistant bacteria which add more resistance. *Staphylococcus aureus* biofilms are commonly used for anti-bacterial activity studies. The study suggest GE-np are promising treatment and helpful for chronic infection treatment due to the presence of biofilm resistance (Girish *et al.*, 2019; Vijayakumar *et al.*, 2019).

Antiviral activity of garlic: influenza virus is the most common virus related to respiratory diseases because of its antigenic variations, there are very complex mutations which make it difficult to make the effective vaccine. Garlic is the one of most effective herbal against influenza virus (Bilal *et al.*, 2020; Chattopadhyay and Naik, 2007).

Garlic and covid-19: Garlic fight against bronchitis infection and basically in corona virus bronchitis infection is the major symptom. As garlic is good for boosting immune system and also has several antibacterial properties to fight against bacteria (Chattopadhyay and Naik, 2007). But covid-19 is a new virus so many researches did research on garlic but didn't have any satisfied result, so garlic can be used for immunity boosting purpose to fight against covid-19 as garlic is good source for boosting immunity.

Role of garlic in wound healing: Several studies have shown that garlic extract increase the rate of wound healing also decrease the rate of infection. Fibrinogen is activated by allicin which is present in garlic and fibrinogen is most important for wound healing. Garlic containing ointment has more healing power (Alhashim and Lombardo, 2018; Ejaz *et al.*, 2009).

Food pathogens sensitivity (garlic): The inhibitory activity of garlic against *staphylococcus aureus*, *E. coli* and *listeria* was measured by the turbidity method and is used garlic for stomach chills, flatulence, colics etc. Garlic is basically an inhibitor for food pathogens. Garlic increases the shelf life and decreases the chances of food poisoning and spoilage (Kuetner *et al.*, 2002; Tsai *et al.*, 2012).

Garlic for hypertension: Garlic is widely used for the lowering of blood pressure due to hypertension number of patients die. The herbal medicine have great impact on cardiovascular, still some evidences are not clearly identified that garlic provide a satisfied therapeutic advantage against some diseases. Two trials were done on 87 patients but not satisfied results found against hypertension (Gull *et al.*, 2012; Reinhart *et al.*, 2008).

Prevention of pre-eclampsia from garlic: Pre-eclampsia is a condition of high blood pressure in which oedema (fluid retention) and proteinuria (protein in urine) are major symptoms. It affects some women during second half of the pregnancy or may be after the delivery of their baby, women kidneys, brain and liver may also be affected and obesity occurs. Low number of evidence found that garlic is helpful to reduce the pre-eclampsia risk (Meher and Duley, 2006; Thangaratinam *et al.*, 2011).

Garlic against tuberculosis: Tuberculosis is a kind of bacterial infection caused by *Mycobacterium tuberculosis*. It is globally most faced problem. According to homeopathy medicine garlic has the resistant properties against tuberculosis. As explained in various studies that garlic has anti-mycobacterium activities. *Mycobacterium tuberculosis* is the most sensitive and rapidly died (Nasiru *et al.*, 2012; Rao *et al.*, 1946).

Intestinal parasites: In several lab studies researchers suggested that raw or cooked in both forms garlic is effective against the intestinal parasites such as roundworm and *ascaris lumbricoids* (Ankri and Mirelman, 1999; Burke *et al.*, 2009).

Ear pain and garlic: most children have ear problem they feel ear pain and it's called as otitis media. Mostly pain killers are given to the patient but now according to the latest herbal research it is suggested that ear drops containing garlic extract are good for pain relief (Ismail *et al.*, 2012; Rose *et al.*, 1990; Uzun *et al.*, 2019).

How to use it effectively: mostly at high temperature the allucin is killed. So add garlic in your recipes when your cooking is almost done.

Conclusions

It was concluded from all of our discussions that garlic is an important natural herb which may be used for improving immune system. It must be used on daily basis for combating with diseases to live healthy and long life. However, still more research studies are required to evaluate the potential of garlic as natural herbal medicine.

Conflict of interest

The authors declared absence of conflict of interest.

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