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A REVIEW ON THERAPEUTIC APPLICATION OF GARLIC (*ALLIUM SATIVUM L.*) TO HUMAN HEALTH BENEFIT IN VARIOUS DISEASES

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Abstract:
Garlic *(Allium sativum* L.) is one of the best medicinal herb. It is frequently used since time as a food and a culinary spice. Garlic also stands as the second most utilized supplement. The chemical constituent of garlic bulb contains a higher concentration of sulfur compounds called organosulfur compound (OSC). Garlic and Its products are used as sources of medicine in many ways in human beings in their day today life. The OSCs like allicin, diallyl, mono,di, tri, tetra, hexa and hepta sulfides, vinyldithiins and ajoenes which are water and lipid soluble responsible for its medicinal effects. Higher consumption of Allium products is associated with reduced risk of several types of cancers as per epidemiological studies. This paper is reviewed on the biological responses of OSCs have been largely attributed to reduction of cardiovascular disease, cancer, lowering of cholesterol by altering HDL/LDL ratios, antiparasitic, antiprotozoal, antimicrobial and antioxidant effects, inhibits platelet aggregation and enhances fibrinolytic activity reducing clots on damaged endothelium. Ajoene is another compound seems to be responsible for its anti-clotting effect.

Keywords: *Allium sativum*, allicin, anticancer, antimicrobial, anticardiovascular, antiparasitic and antiprotozoal activity.

Introduction

Garlic, *Allium sativum L.* is a member of the Liliaceae family, has been widely recognized as a valuable spice and a popular remedy for various diseases and physiological disorders. The name garlic may have originated from the Celtic word 'all' it means pungent. It is cultivated throughout the world, it appears to have originated in central Asia and then spread to China, the Near East, and the Mediterranean region before moving west to Central and Southern Europe, Northern Africa (Egypt) and Mexico [1]. According to the US Food and Drug Administration survey of 900 people, garlic stands second most utilized supplement with almost 17% of the population using garlic supplement in the preceding 12 months [2]. Most of the garlic eaten today comes from China, South Korea, India, Spain, and the United States. The peoples from Egyptians, Babylonians, Greeks, and Romans used garlic for healing purposes. The garlic bulb consists of 6 to 34 bulblets called 'cloves' which are surrounded by a common, thin, white or pinkish papery sheet. Garlic has a strong flavour and taste due to presence of sulfur compounds which are also responsible for the renowned medicinal properties such as anticancer, antidiabetic, anti-inflammatory, antimicrobial, antioxidant, cardioprotective and immunomodulatory activities [3-6]. Its widespread use around the world as a dietary as well as therapeutic supplement, and belief that it helps in maintaining good health warding off illnesses and provides more distinct properties than other bulbs. The main sulphur containing compound of bulb is allicin which provides pungent odour with antibiotic activity is but is very unstable and decomposes at room temperature within a few hours. Allicin which was first chemically isolated in the 1940's, has antimicrobial effects against many viruses, bacteria, fungi and parasites [7]. Garlic is rich in organo-sulfur compounds (OSCs) and at least 33 different types of OSCs have been identified in garlic. Biochemical conversion of garlic to OSCs may occur due to natural ageing to give rise to the water-soluble sulfur compounds S-allylcysteine (SAC) and S-allylmercaptocysteine (SAMC), or by cell decomposition to yield highly unstable oil soluble sulfur compounds such as diallyl sulfide (DAS), diallyl disulfide (DADS), diallyl trisulfide (DATS) and ajoene (4,5,9- trithiadodeca-1,6,11-triene-9-oxide) [8]. Garlic is also known to possess several therapeutic benefits mainly due to its constituents S-allylcysteine sulphoxide [SACS] and S-allyl cysteine [SAC].

Botanical classification

Kingdom : Plantae
Division : Magnoliophyta
Class : Liliopsida
Order : Liliales
Family : Liliaceae
Genus : Allium
Species : sativum
Scientific name: *Allium sativum L.*

Vernacular names (SYNONYMS)/ Local names: Garlic (Eng.), Lasun (Marathi), Rasonam & Lahsuna (Sankrit), Knoblauch (Ger.), Knoblauchzweibel (Ger.),Dasuan (Chin), Taisan (Japan), Taesan (Korea), Tafanuwa (Hausa), Ayo-ishi (Igbol), Kitunguusumu (Swahili), Ayu (Yoruba), Lobha [Nepalese] [9].

Figure Galic (*Allium sativum L.*) bulb

GEOGRAPHICAL SOURCE: Central Asia, Southern Europe, USA, India [10].

BIOCHEMICAL CONSTITUENTS: In garlic bulb there are more than two hundred chemical compounds. It contains

Sulfur compounds : Allicin, alliin [1], water-soluble sulfur compounds S-allylcysteine (SAC) and S-allylmercaptocysteine (SAMC), oilsoluble sulfur compounds such as diallyl sulfide (DAS), diallyl disulfide (DADS), diallyl trisulfide (DATS) and ajoene (4,5,9trithiadodeca-1,6,11-triene-9-oxide) [10].

Enzymes: Allinase, peroxidase and miracynase [11].

Carbohydrates: Sucrose and glucose [12].

Minerals: Selenium [13], germanium, calcium, copper, iron, potassium, magnesium and zinc [14].

Amino acids: Lysine, histidine, arginine, aspartic acid threonine, swine, glutamine, proline, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tryptophan and phenylalanine [14-15].

Flavonoid compounds: Apigenin, quercetin, nobiletin, tangeretin, rutin, allixin, myricetin, bergamottin [16] and cyanidin, allistatin I and allistatin II [17]

Sapogenins and saponins: Sapogenins and saponins (proto-eruboside B, eruboside B, proto-iso-eruboside B , isoeruboside B, sativoside B1-5, R1, R2, β-chlorogenin and others) have been recently identified and having cholesterol-lowering effects in animals and in vitro antifungal, antitumor and cytotoxic activities have been confirmed [16].

Vitamins: Vitamins C, E, A, niacin, B1, B2 and beta carotene [17].

Other constituents : 65% water, 28% carbohydrate, 2.3% organosulphur compound, 2% proteins, 1.2% Free amino acid (mainly arginine), 1.5% fiber, 0.15% lipids, 0.08% phytic acid, 0.07%, [9, 18] Free radicals and volatile oils [19].

Biosynthesis of organo-sulphur compound: Allicin

Odourless alliin has been said to be the precursor of the allicin, the main odourous principal of garlic and its conversion takes place under the influence of vacuolar enzyme, allinase in contact with alliin only when garlic bulb are cut or crushed. Allinase is a pyridoxal phosphate – dependent enzyme which is responsible for conversion of alliin [20] to allicin [21]. Allinase break down alliin to 2-propenesulphenic acid [22], ammonia and pyruvic acid. Two molecules of sulphenic acid react together to gives allicin by loss of water molecule. Allicin, an alkyl alkanethiosulfinate responsible for the characteristic odour and taste of garlic which is unstable and rapidly decomposes to form the oil-soluble OSCs including diallyl, methyl allyl, and diethyl mono-, di-, tri-, tetra-, penta-, and hexasulfides, the vinyldithiins, and (E)- and (Z)-ajoene (Figure 1).

History of Garlic Utilization: Garlic is consumed in cooking allium vegetables, by several civilizations and cultures around the world, with most usage in the Middle East, Orient and the Mediterranean cuisine. It is considered to be one of the most basically cultivated plants along with other growing crops thought to be have cultivated in the Middle east around 5,000 years ago. More over garlic has been used for many years in past and now [23].

DESCRIPTION: Garlic (*Allium sativum L.*) is a bulbous plant. It grows about 60 cm in height. Bulb is rounded, composed of up to about 15 smaller bulblets known as cloves. Cloves and bulbs are covered by a whitish or pinkish tunic (thin papery coat) coat. **Leaves are** four to twelve in number, long, sword-shaped leaves attached to an underground stem. **Inflorescence** spike up to 25 cm long, flower stalked arise from a common point. Flowers are greenish white or pinkish with six perianth segments (sepals and petals) about 3 mm long. Flowers usually abort before developing to a stage at which fertilization to form fruit. Seeds are approximately half in size with a black coat like onion seed [24].

USEFUL PARTS OF GARLIC PLANT FOR TREATMENT OF VARIOUS DISEASES

Parts of garlic	Preparation/aliment	Treatment	Ref.
Leaves	Hot concoction	Common cold	25
Leaves	Tea	Reduce serum, cholesterol and triglyceride levels	
Leaves	Oil	Blood thinning	
Bulbs green	Crushed paste	Reduce platelet aggregation, hyperlipidemia	
Bulb Crushed bulbs and dry stem	Luke warm paste Folk medicine	Antiseptic to prevent gangrene Relieving pain, defense against malaria, flu, cold and sneezing	
Cherokee	Hot syrup	Expectorant for coughs and croup	
Garlic+ cinnamon	Bulb and bark mixture	Fish and meat preservative and antimicrobial	
Whole plant	Spiritualand religious	Both good and evil	

Renewed Biological Function of the Most Abundant Bioactive Compound of Garlic

Sr No.	Name of compound	Biological Activity	Ref.
1	Alliin	Antioxidant , Antimicrobial	[26]
2	Ajoenes	Anticancer, Antimicrobial Antioxidant, Cardioprotective	[7,8, 27,]
3	Allyl sulfides	Anticancer , Antimicrobial Antioxidant, Antithrombotic	[10, 27]
4	1,2-Vinyldithiin	Antimicrobial, Antioxidant, Antithrombotic	[9]

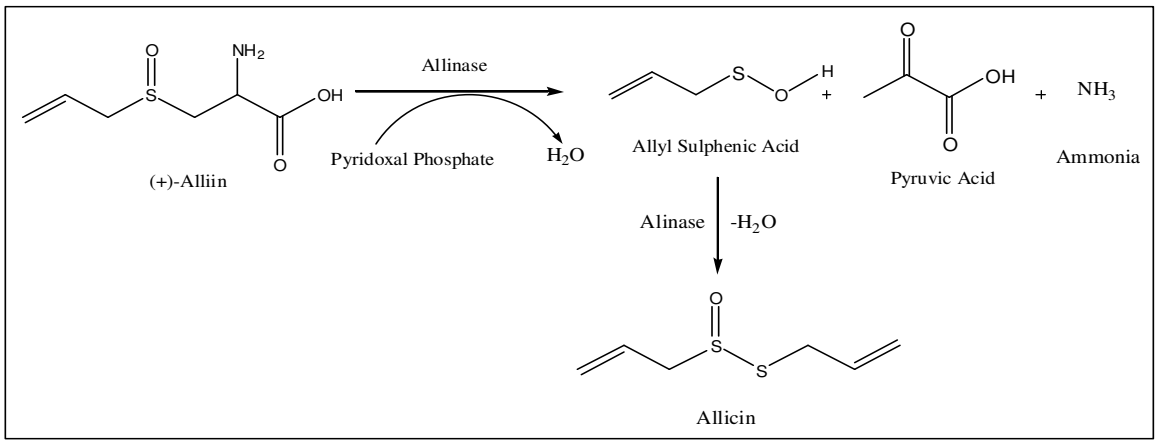

Figure 1. Synthesis of allicin from alliin precussor.

DISEASE PREVENTIVE EFFECT OF GARLIC

Antibreastcancerogenic effect: The crude extract *Allium sativum* inhibited human breast cancer cell lines by enhancement of CD8 [+] T-cell at the tumor site [28-29]. DATS is reactive oxygen species effective on growth cell lines MCF-7 and MCF-12a. DATS also promotes apoptosis by Bax protein induction and p53 protein expression [30, 34].

Antimicrobial effect: Garlic and organosulphur containing compound have been shown wide range spectrum against antibacterial, antifungal and antiviral activity. Both garlic juice and allicin inhibited the growth of gram- negative and gram-positive bacteria including *Shigella dysenteriae, Staphylococcus aureus, Pseudomnonas aeruginosa, Eshceria coli, Streptococcus spp, Salmonella spp, and Proteus mirabilis, Klebsiella, Bacillus, Clostridium* and even acid-fast bacteria such as *Mycobacterium tuberculosis* [35]. Ajoene inhibited spore germination of some pathogenic fungi like *Alternaria sonali, A. tuneissima, A. tritiana, Alternaria species, Colletotricum species, Curvularia species, Fusarium lini, Fusarium oxysporum, F. semictum, F. udum* has been observed in vitro. Virucidal activity was found in ajoene > allicin > allyl methyl thiosulfanate > methyl allyl thiosulfanate against coxsackievirus species, herpes simplex virus types 1 and 2, influenza B, para-influenza virus type 3, vaccinia virus, vesicular stomatitis virus, human

immunodeficiency virus type 1 and human rhinovirus type 2 [36].

Anti-cardiovascular disease: Garlic based supplement used by about 30% cardiovascular patient. It enhance scavenge oxidants, increase superoxide dismutase, catalase, glutathione peroxidase, and glutathione levels, as well as inhibit lipid peroxidation and inflammatory prostaglandins and reduces cholesterol synthesis by inhibiting 3-hydroxy-3-methylglutaryl-CoA as well as to inhibit LDL oxidation [37].

Anti-parasitic and anti-protozoal effect: Allicin exhibits wide antiparasitic and anti-protozoal activity against major human intestinal parasites such as *Entamoeba histolytica, Ascaris lumbricoides* and *Giardia lamblia* and of protozoa such as *Opalina ranarum, Opalina dimidicita*, *Balantidium entozoon*, *Entamoeba histolytica, Trypanosoma, Leishmania, Leptomonas* and *Crithidia* [38].

Anti-Alzheimer's effect: Age garlic have been shown greater neuroprotective effect as "natural NSAID" "natural anti-oxidant", "natural anti apoptotic agent" and "memory enhancer" having single combination of pharmaceutical drug currently used for Alzheimer's therapy [39].

Anti-platelet effect: Platelet aggregation mediated by Platelets attached to the exposed collagen, laminin and von Willebrand factor in the injured vessel wall this is induced by garlic oil 0.5 mg/day consumption [40].

Antioxidant effect: Garlic extract showed 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity [41] and superoxide dismutase (SOD) activity *in vitro* and ezetimibe groups compared with hypercholesterole mice there was significantly reduced (TC, TG, LDL-C, VLDL-C, liver triglyceride, MDA in treated rat [42, 43]

Hepatoprotective effect: Garlic prevented liver damage in alcoholic this is mediated by glutathione act as drug for liver detoxification.Serum albumin protein act as biomarker for monitoring liver function[44].

CONCLUSION

A single clove of garlic has the potential of curing a man from various diseases by inhibiting the growth of different strains of bacteria fungi, parasites and protozoa. Garlic ranges from crushed to capsule forms is consumed through-out the world. Allicin in garlic has been found to be a powerful antibacterial and antifungal. Regular consumption of garlic can lower our blood pressure. It is demonstrated that the benefits of garlic for its potential uses in preventing and curing different diseases, and acting as antioxidant for many radicals. Several studies on garlic have been also showed many health benefits and traditional uses worldwide over the centuries. This review paper is also useful to increase advanced knowledge on garlic therapeutic effects and improve our future experimental and clinical research plans. Garlic synthesizes different sulfur containing compounds which shows multiple biological activities at nutrition and therapeutic uses against anticancer, anticardiovascular, antimicrobial, antiparasitic and anti protozoal, antialzeimer, anti-platelet, antioxidant and hepatoprotective effect.

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