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 ‘cavels’ which are surrounded by a common, thin, white or pinkish papery sheet.

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 (Sanskrit), Knoblauch (Ger.), Knoblauchzwiebel (Ger.), Dasuan (Chin), Taesan (Korea), Tafanuwa (Hausa), Ayishi (Igbo), Kitungusumu (Swahili), Ayu (Yoruba), Lobha (Nepalese) [9].

Figure Garlic (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 Sulphur compounds: Allicin, alliin [1], watersoluble sulfur compounds S-allylcysteine (SAC) and S-alllymercaptocteine (SAMC), oilsoluble sulfur compounds such as diallyl sulhide (DAS), diallyl disulfide (DADS), diallyl trisulfide (DATS) and ajoene (4,5,9trithiadodeca-1,6,11-triene-9-oxide) [10].


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, isoleuicine, leucine, trytophan and phenylalanine [14-15].

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

Sapogenins and saponins: Sapogenins and saponins (proto-eruboside B, eruboside B, protoiso-eruboside 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 odorous 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 alkanethiosulate 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 vinylthiinins, 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 round, 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

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

Renewed Biological Function of the Most Abundant Bioactive Compound of Garlic

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Name of compound</th>
<th>Biological Activity</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alliin</td>
<td>Antioxidant, Antimicrobial</td>
<td>[26]</td>
</tr>
<tr>
<td>2</td>
<td>Ajoenes</td>
<td>Anticancer, Antimicrobial</td>
<td>[7, 8, 27]</td>
</tr>
<tr>
<td>3</td>
<td>Allyl sulfides</td>
<td>Anticancer, Cardioprotective, Antimicrobial</td>
<td>[10, 27]</td>
</tr>
<tr>
<td>4</td>
<td>1,2-Vinylthiin</td>
<td>Antimicrobial, Antioxidant, Antithrombotic</td>
<td>[9]</td>
</tr>
</tbody>
</table>

Figure 1. Synthesis of allicin from alliin precursor.

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, Pseudomonas aeniginosa, Escheria 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 solani, A. tuneissima, A. tritiana, Alternaria species, Colletotrichum species, Curvularia species, Fusarium lini, Fusarium oxysporum, F. semitectum, F. udum has been observed in vitro. Virucidal activity was found in ajoene > allicin > allyl methyl thiosulfonate > methyl allyl thiosulfonate 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].

**Antioxidant effect:** Garlic extract showed 1, 1-

**Anti-parasitic and anti-protozoal effect:** Allicin exhibits wide antiparasitic and anti-protozoal activity against major human in testinal 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 ex vivo and 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 de-toxification 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 throughout 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, antinflammatory, antimicrobial, apoptotic and anti protozoal, antialzheimer, anti-platelet, antioxidant and hepatoprotective effect.

**REFERENCE:**


