Garlic as food, spice and medicine: A perspective
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ABSTRACT
From ancient time garlic has been used as food, spice and household medicine for several common problems such as high cholesterol, high blood pressure, skin problems and fungal infections while its biological function is to repel herbivorous animals. The word garlic derived from the Germanic word being composed of two elements. One is gar means spear and refers to the pointed leaves and second element lic which generally mean either leek or onion. The therapeutic effect of garlic is due to organic sulfur compound such as alliin which metabolize to other sulphur compounds such as allicone, ajoene, allyl sulfides and vinyl thiadines. This review covers the study of pharmacognosy, phytochemistry, pharmacological, its valuable effects, different herbal formulas for various diseases, garlic preparations, marketed formulations along with its major side effects and contraindication.

Key words: Garlic, Allin, allicin, Pharmacognosy, Phytochemistry, Pharmacology

INTRODUCTION
Garlic, probably nature’s most potent food, is a vegetable belongs to the Liliaceae.[1] It is an important condiment crop in the country. It is not only a herb used as spice and food but also possess medicinal properties.

PHARMACOGNOSY

Vernacular names [2,3]:
Sansk. : Rasona, Yavanesta
Assam : Maharu
Beng. : Lasuna
Eng. : Garlic
Guj. : Lasan, Lassun
Hindi. : Lahsun
Kan. : Billuci
Mal.: Vellulli, Nelluthulli
Mar. : Lasun
Tam. : Vellaipoondu
Tel. : Vellulli, Tellapya, Tellagadda
Urd. : Lahsan, Seer

Description [2,3]

a) Macroscopic character:
Drug occurs as entire bulb or isolated cloves (bulblets); bulb sub-globular, 4-6 cm in diameter, consisting of 8-20 cloves, surrounded by 3-5 whitish papery membranous scales attached to a short, disc-like woody stem having numerous, wiry rootlets on the under side; each clove is irregularly ovoid, tapering at upper end with dorsal convex surface, 2-3 cm long, 0.5-0.8 cm wide, each surrounded by two very thin Papery whitish and brittle scales having 2-3 yellowish green folded leaves contained within two white fleshy, modified leaf bases or scales; odour is pungent and disagreeable. Taste is acid.

b) Microscopic character:
A clove of bulb shows tri to tetrangular appearance in outline; outer scale consists of an outer epidermis, followed by hypodermal crystal layers, mesophyll consists of sub rectangular cells; hypodermis consists of compressed, irregular, tangentially elongated cells, each cell having large prismatic crystals of calcium oxalate, while many cells contain small prismatic crystals also, mesophyll several layers of parenchymatous cells having a few vascular tissues with spiral vessels; inner epidermis similar to outer one; inner scale similar to outer scale but outer epidermis composed of sclerenchymatous cells; prismatic crystals in hydropers slightly smaller. In surface view cells of outer epidermis elongated, narrow with thin porous wall while those of inner epidermis similar to outer one but non-porous; cells of hypodermal crystals of calcium oxalate, many cells also contain small prismatic crystals of calcium oxalate; inner scale shows markedly sclerencymatous cells with greatly thickened walls and very narrow lumen; cells of hypodermal crystal layer somewhat smaller with walls more frequently pitted, size of crystals also smaller.

Identity, Purity and Strength
Foreign matter : not more than 2 Percent
Total ash : not more than 4 Percent
Acid-insoluble ash : not more than 1 Percent
Alcohol-soluble extractive : not less than 2.5 Percent
Loss on drying : not less than 60 Percent
Volatile Oil Not : less than 0.1 Percent

Dose as per WHO
For adults daily dose is 2 to 5 g of fresh garlic (approximately one clove), 0.4 to 1.2 g of dried garlic powder, 2 to 5 mg of garlic oil, 300 to 1,000 mg of garlic extract, or other formulations that are equal to 2 to 5 mg of allicin.

PHYTOCHEMISTRY
Garlic contains a number of organic sulfur compounds e.g. allin, allicin (allyl 2-propenethiosulfinate or diallyl thiosulfinate), ajoene, diallyl trisulfide, S-allylcysteine, vinylthiadines, S-allylmercaptoctystein, and others which are responsible both for garlic’s pungent odor and its therapeutic effects.

Garlic smell may be present in sweat and breathe following heavy consumption because of garlic’s strong-smelling sulfur compounds are metabolized, forming allyl methyl sulfide which cannot be digested so passed into the blood and excreted from lungs and the skin.[4, 5] Alliin, present in the undamaged cloves of garlic is odorless sulfur containing amino acid derivative (+) - S-allyl-L-allylcysteine, which generally mean either leek or onion. The therapeutic

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Table 1: Rp values of some suspected compounds with their sensitivity

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Rp value of suspected compounds</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0.58, 0.72 (both light blue)</td>
<td>UV (366 nm)</td>
</tr>
<tr>
<td>2.</td>
<td>0.18, 0.26, 0.34, 0.38, 0.46, 0.58, 0.72, 0.77 and 0.93 (all yellow)</td>
<td>Iodine vapour</td>
</tr>
<tr>
<td>3.</td>
<td>0.26, 0.38, 0.46, 0.58, 0.67, 0.72 and 0.93 (all pink)</td>
<td>Naphthyl reagent</td>
</tr>
<tr>
<td>4.</td>
<td>0.26, 0.38, 0.46, 0.58, 0.67, 0.72 and 0.93 (all grey)</td>
<td>Vanillin-Sulphuric acid reagent</td>
</tr>
</tbody>
</table>

Nutritional Constituents

Garlic holds all the best properties for which it is considered as a food. It has been used as a food for many of years. Traditionally it is used to add flavour to food. The nutritional value of garlic is described in the following table 2

Table 2: Nutritional value of garlic

<table>
<thead>
<tr>
<th>Nutritional value per 100 g (3.5 oz)</th>
<th>Energy 623KJ (149kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.N. Constituents</td>
<td>Quantity</td>
</tr>
<tr>
<td>1. Carbohydrate</td>
<td>33.06 g</td>
</tr>
<tr>
<td>2. Sugar</td>
<td>1.0 g</td>
</tr>
<tr>
<td>3. Dietary fiber</td>
<td>2.1 g</td>
</tr>
<tr>
<td>4. Fat</td>
<td>0.5 g</td>
</tr>
<tr>
<td>5. Protein</td>
<td>6.39 g</td>
</tr>
<tr>
<td>6. Beta carotene</td>
<td>5 µg (0%)</td>
</tr>
<tr>
<td>7. Thiamine (Vit. B1)</td>
<td>0.2 mg (15%)</td>
</tr>
<tr>
<td>8. Riboflavin (Vit. B2)</td>
<td>0.11 mg (7%)</td>
</tr>
<tr>
<td>9. Nicacin (Vit. B3)</td>
<td>0.7 mg (5%)</td>
</tr>
<tr>
<td>10. Pantothenic acid (B5)</td>
<td>0.596 mg (12%)</td>
</tr>
<tr>
<td>11. Vitamin B6</td>
<td>1.235 mg (95%)</td>
</tr>
</tbody>
</table>

USES

Antibacterial/Antifungal, Antimycotic/Antiviral, Hypoglycemic, Anticoagulant (antiplatelet aggregating), fibrinolytic activity enhancement, Lipid lowering, Antioxidant/Anticancer, Hypotensive, Hepatoprotective, Immunomodulatory, Aphrodisiac, Expectorant, Stimulant, Diuretic, carminative etc.

Garlic preparations

There are different garlic preparation viz. garlic oil macerate, garlic essential oil, garlic powder, garlic extract showing in Flow Chart 1

Garlic oil macerate
Encapsulated mixtures of whole garlic cloves ground into vegetable oil

Garlic powder
Obtained by steam distillation

Garlic essential oils
Obtained by crushing cloves

Garlic oil
Obtained by soaking the garlic in alcohol

Some marketed formulations and herbal formulas of garlic are described in the following table no 3 and 4 respectively.

Table 3: Marketed formulation of garlic

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Amount of alliin produced by the product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliinex®</td>
<td>180 milligrams of alliin powder</td>
</tr>
<tr>
<td>Kwa™/Loe™</td>
<td>18 milligrams*</td>
</tr>
<tr>
<td>Garlic™/Bay™</td>
<td>5.0 milligrams*</td>
</tr>
<tr>
<td>Pure Garlic™</td>
<td>10.0 milligrams*</td>
</tr>
<tr>
<td>Garlicmax™</td>
<td>5.5 milligrams*</td>
</tr>
<tr>
<td>Garlic Powder™</td>
<td>3.0 milligrams*</td>
</tr>
</tbody>
</table>

Table 4: Some herbal formulas involving garlic

<table>
<thead>
<tr>
<th>Formula</th>
<th>Consists of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antioxidant formula</td>
<td>Broccoli, garlic juice, onions and ginger and few drops of graviola saponin</td>
</tr>
<tr>
<td>anti-platelet formula</td>
<td>Garlic, vinegar, comfrey root, wormwood, lobelia, marshmallow, white oak, black walnut, mullein, skullcap, usa-arctis</td>
</tr>
<tr>
<td>Asthma formula</td>
<td>Extracts of Comfrey leaf, Mullein, Garlic and glycine</td>
</tr>
<tr>
<td>Respiratory Relief Syrup</td>
<td>Onion Juice, Garlic Juice, Fennel, Nuttie, Mullein and Chickenweed</td>
</tr>
<tr>
<td>Cold sore relief formula</td>
<td>Golden Seal Root, Garlic and Shallag</td>
</tr>
<tr>
<td>Breathing Aid Formula</td>
<td>Brigham Tea, Horseradish, Marshmallow, Cayenne, Garlic, Rosehips, Watercress, and Feverfew</td>
</tr>
<tr>
<td>Bowel Formula</td>
<td>Aloe, Semi, Cascara Sagada, Gentian Root, Ginger Root, Garlic, Cayenne, Turkey Rhubarb, and Flax Seed also with X-Cepctic, Oak Bark, Golden Seal Root, Myrrh, Garlic and Capsicum</td>
</tr>
</tbody>
</table>

PHARMACOLOGICAL STUDY

Alliin exhibits antibacterial and anti-fungal properties. Williams E. D. reported that specific interference with the sulphhydril enzymes may be the cause of alliin’s antimicrobial properties.

Garlic contains a compound called alliin, which is converted into allicin when the garlic bulb is crushed or cut. Allicin has been shown to possess various health benefits, including antioxidant, anti-inflammatory, and cardioprotective properties.

Uses of garlic in health

Garlic is commonly used in traditional and alternative medicine for various conditions. It is often used as a natural remedy for a range of health issues, including:

- Cardiovascular health: Garlic may help lower blood pressure and cholesterol levels, which can reduce the risk of heart disease and stroke.
- Immune system: Garlic contains compounds that may boost the immune system and help fight off infections.
- Antioxidant and anti-inflammatory: Garlic contains compounds that may help protect cells from damage caused by free radicals and reduce inflammation.
- Digestive health: Garlic may help improve digestion and bowel function, and it may also help relieve symptoms of conditions like irritable bowel syndrome (IBS).

Garlic is a versatile food that can be used in a variety of dishes to add flavor and nutrition. It is generally safe for most people, but some individuals may experience side effects like heartburn, gas, or upset stomach.

Garlic is a rich source of nutrients, including:

- Vitamin C: Helps support the immune system and promote healing.
- Vitamin K: Important for blood clotting and bone health.
- Vitamin B6: Essential for energy production and brain function.
- Fiber: Helps support healthy digestion and may lower cholesterol levels.

Garlic is also a source of other compounds that may have health benefits, such as alliin, allicin, and diallyl disulfide (DADS). These compounds may help reduce inflammation, lower blood pressure, and improve heart health.

Garlic is used in various forms, including:

- Fresh garlic
- Garlic powder
- Garlic oil
- Garlic capsules

Garlic is enjoyed as a flavoring agent and as a natural remedy. It is a versatile ingredient that can be used in many dishes.

Garlic is a natural food that has been used for centuries for its health benefits. It is a rich source of nutrients and contains compounds that may have various health benefits.

Garlic is a delicious and versatile ingredient that can be added to a variety of dishes to add flavor and nutrition. It is a natural source of beneficial compounds that may help support overall health and wellness.

Garlic is a popular food that is used in many dishes and is known for its health benefits. It is a rich source of nutrients and contains compounds that may help support heart health, digestion, and immunity.

Garlic is a natural food that has been used for centuries for its health benefits. It is a rich source of nutrients and contains compounds that may help support heart health, digestion, and immunity.

Garlic is a nutritious and flavorful food that can be used in a variety of culinary preparations to enhance flavor and provide health benefits.
Primary studies in humans and reviews of garlic preparations and blood pressure were indicative. A meta-analysis done by Silagyi and Neil (1994) reported promising results in subjects with mild hypertension but insufficient evidence to recommend garlic for clinical therapy.[37]

Garlic as Antihyperlipidemic

Protective effects of garlic in atherosclerosis may be due to its ability to reduce deposition of fat on artery wall by depressing the hepatic activities of lipogenic and cholesterogenic enzymes such as malic enzyme, fatty acid synthase, glucose-6-phosphate dehydrogenase and 3-hydroxy-3-methylglutaryl-CoA (HMG CoA) reductase increasing the excretion of cholesterol.115

Water-soluble organosulfur compounds, especially S-allyl cysteine of aged garlic extract and diallyl-di-sulfide of garlic oil are also potent inhibitors of cholesterol synthesis.117,74 Administration of garlic (1–4% in diet) and garlic protein in hypercholesterolemic rats significantly reduced serum cholesterol, triglyceride and LDL cholesterol but not serum HDL.118 Silagyi and Neil analyzed sixteen trials showed that Garlic, in powder and non-powder form significantly lowered serum lipid levels over a 1–3 month period. Serum cholesterol fell by 8% with dried powder preparations and 15% with non-powder preparations. Serum triglyceride level also dropped significantly, while HDL-cholesterol was essentially unchanged.119 However a more recent meta-analysis of thirteen trials, revealed a no significant difference between garlic and placebo groups.[37]

Garlic showing antiobiotic activity and antifungal activity

Garlic, a natural antibiotic is active against a number of bacteria, viruses, fungi, and many more.120 It inhibits the growth of Staphylococcus, Streptococcus, Bacillus, Brucella, Vibrio and Candida species115,120 and shows antimycotic activity stronger than that of nystatin and other antimycotics.121

It shows a virucidal activity against Herpes simplex type 1 and 2, Parainfluenza virus type 3, Vaccinia virus, Vesicular exanthem and Human rhinovirus type 2.122 Garlic has only 1% of the impact of synthetic penicillin but it is more effective with gram negative bacteria than penicillin.

Aqueous extracts of bulbs of garlic (Allium sativum L.) were fungidal for 39 of 41 recent clinical isolates of Candida albicans at 68 µg total dry weight of crude extract per ml of 2% (w/v) malt extract broth in standing culture and in shake culture the crude extract was fungistatic between 50 and 300 µg/ml and fungicidal above 400 µg/ml.[123]

Garlic showing as an anticaner agent

Garlic have the ability to accumulate the selenium (a cancer fighting mineral found in garlic) to the skin for 1 month markedly decreased (69-%) adenomas (non-cancerous tumors.124 Another study involving 21 persons showed that ingestion of 120 mg garlic extract plus 4 mg steam-distilled garlic oil daily) did not improve the incidence (number of new cases) of gastric cancer.125 Though there are several common use and benefits, the most popular frequent use is as a spice. Prolongation of garlic extract leads to the formation of antioxidant phytochemicals which include unique water soluble organosulfur compounds, lip soluble organosulfur compounds and flavonoids that prevent oxidant damage and as a result plays an important role in aging and disease, including cardiovascular, neurodegenerative and inflammatory diseases even in cancer. It is contraindicated to pregnant women, lactating mother and people about to undergo surgery and having ulcer to stomachs.

REFERENCES


CONCLUSIONS

There are many claims to the benefits of garlic and its use; it belongs to the family liliaceae. The garlic native to central Asia is a herb providing widest range of physiological effects however results of some studies conducted to explore the beneficial effects of garlic were positive and some were negative. Though there are several common use and benefits, the most popular frequent use is as a spice. Prolongation of garlic extract leads to the formation of antioxidant phytochemicals which include unique water soluble organosulfur compounds, lip soluble organosulfur compounds and flavonoids that prevent oxidant damage and as a result plays an important role in aging and disease, including cardiovascular, neurodegenerative and inflammatory diseases even in cancer. It is contraindicated to pregnant women, lactating mother and people about to undergo surgery and having ulcer to stomachs.


