

NATURAL HEALING AGENT: GARLIC, AN APPROACH TO HEALTHY LIFE

Nagori B.P., Solanki Renu, Sharma Neha*

Lachoo Memorial College of Science and Technology, Pharmacy Wing, Jodhpur, India

Received: 03-11-2010; Revised: 28-11-2010; Accepted: 03-12-2010

ABSTRACT

We have grown up in the era of so-called wonder drugs. Garlic is one such drug which is grown globally. China is by far the largest producer of garlic, with approximately 10.5 million tonnes (23 billion pounds) annually, accounting for over 77% of world output. This leaves 16% of global garlic production in countries that each produces less than 2% of global output. The purpose of this study is to highlight new applications of cultivated as well as wild garlic in medicine. Areas of beneficial activity include anti-AIDS, anti-cancer and anti-cardiovascular disease and anti-infectious properties, amongst others. Garlic is uniquely the richest dietary source of many otherwise rare healthful sulphur compounds, plus organic selenium and germanium besides other essential nutrients and active health-promoting phytochemicals. Various forms of garlic are available, the most effective being fresh, powdered, distilled and especially aged garlic, which later lacks the irritant effect of fresh garlic, yet possesses equal or greater bio-active range and potency.

Since many years cultivated garlic (*Allium sativum*) has served the medicinal purpose. As demand of garlic is continuously increasing due to its valuable features, other garlic species are screened for potential benefits of cultivated garlic with less side effects. Wild garlic grows abundantly in many areas of country. It is a plant that seldom needs to be cultivated. They have a distinct garlic flavor, though are milder than garlic cloves. Hence extensive study is required for both cultivated and wild species so as to establish them as a future wonder drug.

KEYWORDS: Cultivated garlic, Wild garlic, Wonder drug, Phytochemicals, Cloves, Beneficial activity

*For Correspondence

Neha Sharma

M.Pharm Student

Lachoo Memorial College of Science and Technology

Pharmacy wing, Sector A, Shastri Nagar

Jodhpur-342003 (Rajasthan)

E-mail: neha_sharma417@yahoo.com

INTRODUCTION

Garlic has been used for culinary and medicinal purposes by many cultures for centuries. Garlic is particularly a rich source of organo sulfur compounds, which are thought to be responsible for its flavor and aroma, as well as its potential health benefits.

Garlic is marketed as certified seed or as a fresh or dehydrated product. The majority of garlic is dehydrated and used in a wide variety of processed foods. Dehydrated garlic accounts for roughly 75 percent of U.S. garlic consumption. Gilroy, California, is known as the garlic capital of the United States, largely because that is where a large portion of U.S. garlic is grown, processed and shipped.

HISTORY

It is said that when Lord Garuda, the giant eagle and the personal carrier of Lord Vishnu, ran away after snatching the pot of “nectar – the elixir of life” from the hands of Lord Indra, the king of Heaven, some drops of nectar spilled from the pot and fell in the Himalayan region of the earth. The place where the spilled drops of nectar had fallen, a small plant grew in which all the divine properties of the nectar were found and it was named as “Rason”. This Rason is also known as Lahsun in hindi, Garlic in English, *Allium sativum* in Latin, which is used worldwide as a natural medicine as well as a taste builder for food item.

The name is of Anglo-Saxon origin, being derived from gar (a spear) and lac (a plant), in reference to the shape of its leaves¹.

CLASSIFICATION

Botanists classify all true garlics under the species *Allium sativum*.

There are two subspecies; *Ophioscorodon*, or hard-necked garlics (*Ophios* for short) and *Sativum*, or soft-necked garlics.

A number of different plant species of the genus *Allium* are known as Wild Garlic: *Allium nigrum* (Black Garlic), *Allium tuberosum* (Chinese Chive, Oriental), *Allium canadense* (Meadow Garlic; Wild Garlic), *Allium pendulinum* (Italian Garlic), *Allium ramosum*, *Allium senescens* (German Garlic), *Allium tuberosum* (Chinese Chives), *Allium vineale* (Wild Garlic; Crow Garlic; Stag's Garlic), *Allium ursinum* (Ramsons), *Allium canadense* (Wild onion), *Allium triquetrum* (Three-cornered leek)².

Taxonomic classification

Kingdom : Plantae
Subdivision : Angiosperm
Class : Monocot
Order : Asparagales
Family : Alliaceae
Sub family : Allioideae
Genus : *Allium*

CHARACTERISTICS OF CULTIVATED AND WILD GARLIC SPECIES

Garlic which is widely used and studied is *Allium sativum*. This species has become cultivated by process of selection. Garlic which is available in market is soft neck subspecies of *Allium sativum*. Besides this species other garlic species are also being explored for their potential benefits.

Allium sativum (Cultivated garlic)

The leaves of *Allium sativum* are long, narrow and flat like grass. The bulb (the only part eaten) is of a compound nature, consisting of numerous bulblets, known technically as 'cloves,' grouped together between the membranous scales and enclosed within a whitish skin, which holds them as in a sac. The flowers are placed at the end of a stalk rising direct from the bulb and are whitish, grouped together in a

globular head, or umbel, with an enclosing kind of leaf or spathae, and among them are small bulbils¹. Garlic (**Figure 1**) flourishes best in a rich, moist, sandy soil².

The majority of garlic (65%) is water, and the bulk of the dry weight is composed of fructose-containing carbohydrates, followed by sulfur compounds, protein, fiber, and free amino acids. It also contains high levels of saponins, flavonoids³, phosphorus, potassium, sulfur, zinc, moderate levels of selenium and Vitamins A and C, and low levels of calcium, magnesium, sodium, iron, manganese and B-complex vitamins; garlic also has a high phenolic content. A majority of the compounds present in garlic are water-soluble (97%) with small amounts (0.15–0.7%) of oil-soluble compounds are also present. Main organosulfur compound is allicin. It is produced by an enzymatic reaction when raw garlic is either crushed or somehow injured⁴. The enzyme, alliinase, stored in a separate compartment in garlic, combines with a compound called alliin in raw garlic and produces allicin. Allicin on decomposition forms diallyldisulfide⁵. Alliinase is denatured by heat, at a pH of < 3.5, such as that in the stomach, and by many nonpolar solvents^{6,7}.

Allium tuberosum

Garlic chives (**Figure 2**) leaves are flat, solid, and paler green, and taste and smell of mild garlic, with a sweetish undertone. Spreads by means of rhizomes (underground stems). Garlic chive seeds contained high amounts of oil (15.8%), dietary fiber (18.2%) and crude protein (12.3%). Oil of seeds composed of 10.1% saturated and 90.0% unsaturated fatty acids. Linoleic(69.1%) and palmitic (7.0%) are the most abundant unsaturated and saturated fatty acids. Chinese chive seed is a rich source of the essential amino acids, isoleucine, tryptophan and lysine.

Allium ursinum

A. ursinum (**Figure 3**) is found in areas of damp woods and wooded ravines and flourishes in the hills and mountains of central Europe. The active substances in *A. ursinum* are found in its green leaves. It is odorless after digestion and has high adenosine content and γ -glutamyl peptide (GLUT) content.

It contains allicin (**Figure 5**) and its related forms, as well as more ajoene (a degraded form of allicin) and its related forms, more γ -glutamyl peptides (GLUT), and more than 20 times as much adenosine. Comparative nutritional profile with *A. sativum* is shown in **Table 1**⁸.

A. ursinum was called "the new star" of garlic in the German health journal Therapiewoche (Therapy Week) and in 1992, was declared the European medicinal "Plant of the Year" by the Association for the Protection and Research on European Medicinal Plants.

Allium vineale

Allium vineale (**Figure 4**) can be used as a substitute for garlic. The underground bulb is 1-2 cm diameter, with a fibrous outer layer. The main stem grows to 30-120 cm tall, bearing 2-4 leaves and an apical inflorescence 2-5 cm diameter comprising a number of small bulbils and none to a few flowers, subtended by a basal bract. The flowers are 2-5 mm long, with six petals varying in color from pink to red or greenish-white. It is resistant to herbicides due to the structure of its leaves, being vertical, smooth and waxy. Herbicides do not cling well to it and are therefore not as effective⁹.

DRYING AND EXTRACTION OF GARLIC

Freeze-drying

Freeze-drying (also known as lyophilization or cryodesiccation) is a dehydration process typically used to preserve a perishable material or make the material more convenient for transport. Freeze-drying works by freezing the material and then reducing the surrounding pressure and adding enough heat to allow the frozen water in the material to sublime directly from the solid phase to the gas phase.

The freeze-drying of fresh garlic cloves is a method of flash evaporation at low temperature in a partial vacuum. This method results in virtually no changes in chemical composition, and the resulting product is often used for culinary purposes.

Low Temperature Drying

This process involves drying sliced fresh cloves at temperatures less than 50°C for 3–4 d. Some allicin is formed due to the slicing process. Allicin is converted to allyl sulfides, which are largely responsible for the typical garlic odor. The final product has many of the attributes of the fresh garlic clove, which include γ -glutamyl cysteine, the precursor to allin and S-allylcysteine.

Distillation

Distillation is a method of separating mixtures based on differences in their volatilities in a boiling liquid mixture.

Steam-distilled garlic contains principally allyl sulfides. Allicin is a volatile compound and may be lost or converted to the allyl sulfide degradation compounds. The oil generated may be dissolved in soybean oil or other vegetable oils to form a product.

Maceration in Oil

In this method drug is soaked in oil for 24 hours or 7 days. Chopped garlic is homogenized and slowly extracted (maceration) in soybean or another vegetable oil. Such products contain vinylidithins, allyl sulfides and ajoene.

Hydro alcoholic Short Extraction

In this method drug is extracted using hydroalcoholic mixture with the the aid of heat. The resulting product is often referred to as a Tincture, and may be made in 10, 20 or 30% wt/v concentrations in 70% ethanol.

Hydro alcoholic Long Maceration

In this method sliced drug is placed in ethanol water mixture for longer period of time. Sliced drug is placed in 20% ethanol and macerated for a long period of time (6–20 month), filtered and concentrated. Allicin is completely converted to allyl sulfides, including diallyl disulfides, diallyl trisulfide and allyl methyl trisulfide, which are largely all volatilized or converted to other compounds. A major ingredient of this process is S-allylcysteine¹⁰.

STORAGE

Fresh garlic can be stored in a cool, dry and dark place. Garlic extracts and oils should be kept in dark bottles and can be refrigerated. Properly stored garlic can be kept upto 3 months.

DOSAGE

For high blood pressure 600-1200 mg of garlic extract (three times daily), Aged garlic extract 600 mg to 7.2 grams per day and Fresh garlic 4 grams (approximately one clove) once daily can be used. Fresh garlic typically contains 1% alliin. For prevention of colon, rectal, and stomach cancer: fresh or cooked garlic 3.5-29 grams weekly. For fungal skin infections (ringworm, jock itch, athlete's foot): garlic ingredient ajoene as a 0.4% cream, 0.6% gel, and 1% gel applied twice daily for one week¹¹.

SIDE EFFECTS AND WARNINGS

Bad breath, body odor, and allergic reactions are the most common reported side effects of garlic. Fresh garlic has caused rash or skin burns, both in people taking garlic therapy and in food preparers handling garlic. Other reported side effects include dizziness, increased sweating, headache, itching, fever, chills, asthma flares, and runny nose.

REGULATORY STATUS

Herbal not necessarily means safe. They may also produce adverse effects if used in high amount or may be due to interactions with other drug (**Table 2**)¹²⁻¹⁵. Garlic is used as such in many Ayurvedic formulations (**Table 3**). They are also subjected to regulations just like conventional medicines. Regulatory status of garlic in different countries is as follows: generally recognized as safe (US), general sales list (UK), Over-the-counter drug status (Canada), traditional medicinal use (France).

USES

Allium sativum

It inhibits platelet aggregation and arterial smooth muscle proliferation. Garlic-derived organosulfur compounds have been found to inhibit the activity of the inflammatory enzymes, cyclooxygenase and lipoxygenase, in vitro. Garlic extracts have been found to have antibacterial and antifungal properties. Thiosulfonates, particularly allicin, are thought to play an important role in the antimicrobial activity of garlic.

Allicin-derived compounds, including DATS and ajoene, also have some antimicrobial activity in vitro, although generally less than allicin¹⁶. Garlic is effective against *Salmonella enterica*¹⁷, Experimental Murine Disseminated Cryptococcosis¹⁸ and *Streptococcus mutans*¹⁹. Currently, there are several National Health Service hospitals in the UK that use allicin to treat methicillin resistant *Staphylococcus aureus* (MRSA) that have become resistant to all penicillin drugs, like methicillin, oxacillin, and amoxicillin.

Garlic supplements could cut the incidence of stroke by anything from 30-40 per cent, while heart disease could be reduced by 20-25 percent.

Results of several meta-analyses indicated that garlic supplementation results in modest (6-11%) reductions in serum total cholesterol, LDL cholesterol, and triglyceride levels compared to placebo²⁰⁻²².

Garlic is used as antioxidant due to tetrahydro- β -carboline which is present in aged garlic extract²³⁻²⁵.

The results of epidemiological studies in human populations suggested that high intakes of garlic and other *Allium* vegetables may help in protecting against gastric and colorectal cancer, but evidence that high intake of garlic can reduce the risk of other types of cancer in humans is limited and inconsistent. Study participants consuming the most garlic had a 39% reduced risk for cancer of the oral cavity and pharynx, 57% reduced risk for esophageal cancer, 26% reduced risk for colorectal cancer, 44% reduced risk for laryngeal cancer, 10% reduced risk for breast cancer, 22% reduced risk for ovarian cancer, 19% reduced risk for prostate cancer and 31% reduced risk for renal cell cancer as compared to those eating the least garlic²⁶. An allyl sulphide in different cancer is shown in **Table 4**.

Garlic (*Allium sativum*) is used in treatment of acne, allergies, arthritis, diabetes, diarrhea, emphysema, hypoglycemia, Insomnia, pneumonia, rheumatism, ulcers, warts and worms.

Allium tuberosum (Garlic chives)

In Chinese herbal medicine, garlic chives have long been used to treat fatigue, help control excessive bleeding, and as an antidote for ingested poisons. The leaves and bulbs are applied to insect bites, cuts, and wounds.

Seeds are used to treat kidney, liver, and digestive system problems^{27,28}.

Allium ursinum

γ -glutamyl peptides and ajoene in *A. ursinum* result in an increase in the difference across the membrane of the smooth muscle. This in turn results in a widening of blood vessels, which may affect blood pressure. γ -glutamyl peptides have been demonstrated to inhibit the actions of angiotensin I-converting enzyme (ACE), an enzyme released from the kidneys which regulates blood pressure. Adenosine helps increase blood vessel width and can also reduce platelet aggregation (blood stickiness). Adenosine acts as a muscle relaxant and as a protectant against poisons, such as caffeine. It activates macrophages to reduce the synthesis of LDL cholesterol and protect against plaques and blood clots. It also has antioxidant properties that protect against free radicals, antibacterial and antifungal properties^{29,30}.

CONCLUSION

Garlic seems to be the greatest wonder drug that could prevent heart attacks, reduce cancer risk, lower cholesterol, and lower blood pressure, improve digestion, and act as an antibiotic. Demand of garlic will continue to increase in near future as natural agent. Hence it is required to realize the importance of wild garlic along with cultivated garlic so as to fulfill the requirement in a more economic way. Modern science is adding to this traditional knowledge and many applications areas are yet to be explored in order to establish it as a future magic drug.

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Table 1: Comparative Nutritional Profile of wild garlic with cultivated garlic

S. No.	Constituent	<i>Allium ursinum</i>	<i>Allium sativum</i>
1.	Magnesium	7,000 mg/kg	6,114 mg/kg
2.	Manganese	1,600 mg/kg	952 mg/kg
3.	Iron	230 mg/kg	14 mg/kg
4.	Adenosine	120 mg/kg	107 mg/kg

Table 2: Garlic (*A. sativum*) Herb/Drug interactions

S. No.	Herb/Drug	Interaction
1.	Herb: Ginkgo biloba , saw palmetto. Drug: Indomethacin, Dipyridamole, Plavix, Warfarin and Aspirin	Increased risk of bleeding
2.	Aconite/monkshood, betel nut, bilberry, black cohosh, calendula, curcumin, eucalyptol, eucalyptus oil, flax/flaxseed oil, ginger, ginkgo, goldenseal, hawthorn, Indian tobacco, jaborandi, periwinkle, Texas milkweed, turmeric, and wild cherry.	Enhanced antihypertensive effect
3.	Aloe Vera, American ginseng, bilberry, bitter melon, burdock, fenugreek, fish oil, gymnema, horse chestnut seed extract (HCSE), milk thistle, Panax ginseng, rosemary, Siberian ginseng, stinging nettle, and white horehound.	Enhanced antidiabetic effect

4.	Herb: Fish oil, EPA (eicosapentaenoic acid, found in deep-sea fish oils), guggul, red yeast, or niacin. Drug: Lovastatin and other statin	Enhanced reduction of cholesterol
5.	Indinavir, Ritonavir, and Saquinavir.	Reduced antiviral effect of drug
6.	Cytarabine and fludarabine	Enhanced antileukemic effect

Table 3: Ayurvedic Formulations of Garlic (*A.sativum*)

S.No.	Formulation	Composition	Indications
1.	Lasuna Kshiram	The formulation of Kshira (milk) and Garlic (Lasuna)	Abdominal tumor, Malarial fever, Cardiac disease, Abscess, Swelling etc.
2.	Lasunadi nasyam (snuff)	A combination of Garlic (Lasuna) and other (adi) herb like pepper (white).	Alleviates Kapha (phlegm) from stomach, lungs, brain and throat.
3.	Rasona Prayoga	Rasona (garlic) juice	Alleviates Abdominal tumor, Reverse peristalsis, and Colic.
4.	Rasona Sura	A form of Alcoholic preparation (Sura), with Garlic (Rasona) with other accompanying herb long Pepper, Dry ginger, Pepper etc.	Vata roga, Rheumatism, Worms, Skin disease, Phthisis, Intestinal obstruction, Gulma (abdominal tumor), Piles, Enlargement of spleen, Gonorrhoea, Anemia etc.
5.	Plihari vatika (Tablet)	The composition also includes garlic and the purified powder form of Mica, and Diamond.	Spleen and Liver disorder, Atonic dyspepsia, Abdominal tumor, Swelling.

Table 4: Allyl Sulfides with Antineoplastic Properties

S. No.	Product	Principle organosulfur compounds
1.	Ajoene	Lymphocytes, colonic, leukemic
2.	Allicin	Lymphoid
3.	Diallyl sulfide	Prostate, leukocytes
4.	Diallyl disulfide	Lung, colonic, skin, prostate, mammary
5.	Diallyl trisulfide	Lung
6.	S-allyl cysteine	Neuroblastoma, melanoma



Figure 1: *Allium sativum*



Figure 2: *Allium tuberosum*



Figure 3: *Allium ursinum*



Figure 4: *Allium vineale*

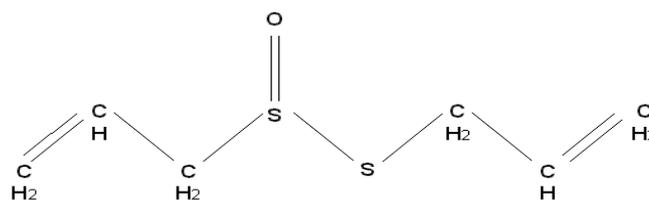


Figure 5: Chemical Structure of Allicin