
Bulbus Allii Sativi

Definition

Bulbus Allii Sativi consists of the fresh or dried bulbs of *Allium sativum* L. (Liliaceae) (1, 2).

Synonyms

Porvium sativum Rehb. (1, 3).

Selected vernacular names

It is most commonly known as “garlic”. Ail, ail commun, ajo, akashneem, allium, alubosa elewe, ayo-ishi, ayu, banlasun, camphor of the poor, dai tóan, dasuan, dawang, dra thiam, foom, Gartenlauch, hom khaao, hom kía, hom thiam, hua thiam, kesumphin, kitunguu-sumu, Knoblauch, kra thiam, krathiam, krathiam cheen, krathiam khaao, l’ail, lahsun, lai, lashun, lasan, lasun, lasuna, Lauch, lay, layi, lehsun, lesun, lobha, majo, naharu, nectar of the gods, ninniku, pa-se-waa, poor man’s treacle, rason, rasonam, rasun, rustic treacles, seer, skordo, sluôn, stinking rose, sudulunu, ta-suam, ta-suan, tafanuwa, tellagada, tellagaddalu, thiam, toi thum, tum, umbi bawang putih, vallaipundu, velluli, vellulli (1–13).

Description

A perennial, erect bulbous herb, 30–60 cm tall, strong smelling when crushed. The underground portion consists of a compound bulb with numerous fibrous rootlets; the bulb gives rise above ground to a number of narrow, keeled, grass-like leaves. The leaf blade is linear, flat, solid, 1.0–2.5 cm wide, 30–60 cm long, and has an acute apex. Leaf sheaths form a pseudostem. Inflorescences are umbellate; scape smooth, round, solid, and coiled at first, subtended by membranous, long-beaked spathe, splitting on one side and remaining attached to umbel. Small bulbils are produced in inflorescences; flowers are variable in number and sometimes absent, seldom open and may wither in bud. Flowers are on slender pedicels; consisting of perianth of 6 segments, about 4–6 mm long, pinkish; stamens 6, anthers exerted; ovary superior, 3-locular. Fruit is a small loculicidal capsule. Seeds are seldom if ever produced (8, 9).

Plant material of interest: fresh or dried bulbs

General appearance

Bulbus Allii Sativi consists of several outer layers of thin sheathing protective leaves which surround an inner sheath. The latter enclose the swollen storage leaves called “cloves”. Typically, the bulb possesses a dozen sterile sheathing leaves within which are 6–8 cloves bearing buds making a total of 10–20 cloves and 20–40 well-developed but short and embedded roots. The cloves are asymmetric in shape, except for those near the centre (1).

Organoleptic properties

Odour strong, characteristic alliaceous (1, 6, 8); taste very persistently pungent and acrid (1, 6, 8).

Microscopic characteristics

The bulbs show a number of concentric bulblets; each is 5–10 mm in diameter and consists of an outer scale, an epidermis enclosing a mesophyll free from chlorophyll, a ground tissue and a layer of lower epidermal cells. Dry scales consist of 2 or 3 layers of rectangular cells having end walls with a broadly angular slant. These cells contain many rhomboid crystals of calcium oxalate. The upper epidermal cells next to the dry scale layer consist of a single layer of rectangular to cubical cells next to which are several layers of large parenchymatous cells. Among these cells are interspaced many vascular bundles, each of which consists of xylem and phloem arranged alternately. Lower epidermis consists of cubical cells which are much smaller than the upper epidermal cells. The same arrangement of tissues is met within different bulblets, 2 or 3 of which are arranged concentrically (1, 6).

Powdered plant material

Pale buff to greyish or purplish white, with characteristic aromatic alliaceous odour and taste. It is characterized by the presence of sclereids of the epidermis of protective leaves, thin epidermis of storage cells, latex tubes, swollen parenchyma cells with granular contents, and lignified narrow spiral and annular vessels (1).

Geographical distribution

Bulbus Allii Sativi is probably indigenous to Asia (1, 7), but it is commercially cultivated in most countries.

General identity tests

Macroscopic and microscopic examinations and microchemical analysis are used to identify organic sulfur compounds (1), thin-layer chromatographic analysis to determine the presence of alliin (14).

Purity tests

Microbiology

The test for *Salmonella* spp. in Bulbus Allii Sativi products should be negative. The maximum acceptable limits of other microorganisms are as follows (2, 15, 16). Preparations for internal use: aerobic bacteria—not more than 10^5 /g or ml; fungi—not more than 10^4 /g or ml; enterobacteria and certain Gram-negative bacteria—not more than 10^3 /g or ml; *Escherichia coli*—0/g or ml.

Total ash

Not more than 5.0% (2).

Acid-insoluble ash

Not more than 1.0% (4).

Water-soluble extractive

Not less than 5.0% (4).

Alcohol-soluble extractive

Not less than 4.0% (4).

Moisture

Not more than 7% (2).

Pesticide residues

To be established in accordance with national requirements. Normally, the maximum residue limit of aldrin and dieldrin for Bulbus Allii Sativi is not more than 0.05 mg/kg (2). For other pesticides, see WHO guidelines on quality control methods for medicinal plants (15) and guidelines for predicting dietary intake of pesticide residues (17).

Heavy metals

Recommended lead and cadmium levels are no more than 10 and 0.3 mg/kg, respectively, in the final dosage form of the plant material (15).

Radioactive residues

For analysis of strontium-90, iodine-131, caesium-134, caesium-137, and plutonium-239, see WHO guidelines on quality control methods for medicinal plants (15).

Other purity tests

Chemical tests and tests for foreign organic matter to be established in accordance with national requirements.

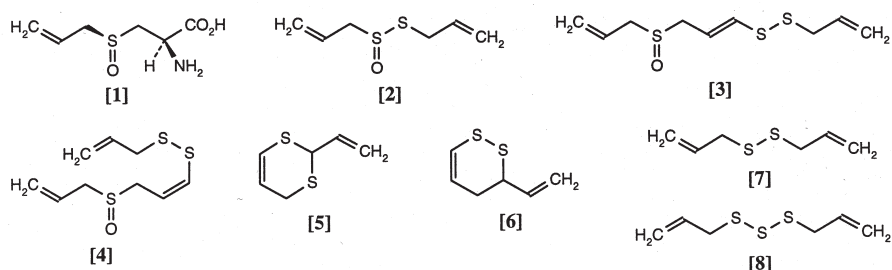
Chemical assays

Qualitative and quantitative assay for sulfur constituents (alliin, allicin etc.) content by means of high-performance liquid chromatography (18–22) or gas chromatography–mass spectroscopy (23) methods.

Major chemical constituents

The most important chemical constituents reported from *Bulbus Allii Sativi* are the sulfur compounds (7, 9, 24, 25). It has been estimated that cysteine sulfoxides (e.g. alliin [1]) and the non-volatile γ -glutamylcysteine peptides make up more than 82% of the total sulfur content of garlic (25).

The thiosulfinates (e.g. allicin [2]), ajoenes (e.g. *E*-ajoene [3], *Z*-ajoene [4]), vinylidithiins (e.g. 2-vinyl-(4*H*)-1,3-dithiin [5], 3-vinyl-(4*H*)-1,2-dithiin [6]), and sulfides (e.g. diallyl disulfide [7], diallyl trisulfide [8]), however, are not naturally occurring compounds. Rather, they are degradation products from the naturally occurring cysteine sulfoxide, alliin [1]. When the garlic bulb is crushed, minced, or otherwise processed, alliin is released from compartments and interacts with the enzyme alliinase in adjacent vacuoles. Hydrolysis and immediate condensation of the reactive intermediate (allylsulfenic acid) forms allicin [2]. One milligram of alliin is considered to be equivalent to 0.45 mg of allicin (26). Allicin itself is an unstable product and will undergo additional reactions to form other derivatives (e.g. products [3]–[8]), depending on environmental and processing conditions (24–26). Extraction of garlic cloves with ethanol at $<0^{\circ}\text{C}$ gave alliin [1]; extraction with ethanol and water at 25°C led to allicin [2] and no alliin; and steam distillation (100°C) converted the alliin totally to diallyl sulfides [7], [8] (24, 25). Sulfur chemical profiles of *Bulbus Allii Sativi* products reflected the processing procedure: bulb, mainly alliin, allicin; dry powder, mainly alliin, allicin; volatile oil, almost entirely diallyl sulfide, diallyl disulfide, diallyl trisulfide, and diallyl tetrasulfide; oil macerate, mainly 2-vinyl-[4*H*]-1,3-dithiin, 3-vinyl-[4*H*]-1,3-dithiin, *E*-ajoene, and *Z*-ajoene (18–22, 24). The content of alliin



was also affected by processing treatment: whole garlic cloves (fresh) contained 0.25–1.15% alliin, while material carefully dried under mild conditions contained 0.7–1.7% alliin (18–21).

Gamma-glutamylcysteine peptides are not acted on by alliinase. On prolonged storage or during germination, these peptides are acted on by γ -glutamyl transpeptidase to form thiosulfinates (25).

Dosage forms

Fresh bulbs, dried powder, volatile oil, oil macerates, juice, aqueous or alcoholic extracts, aged garlic extracts (minced garlic that is incubated in aqueous alcohol (15–20%) for 20 months, then concentrated), and odourless garlic products (garlic products in which the alliinase has been inactivated by cooking; or in which chlorophyll has been added as a deodorant; or aged garlic preparations that have low concentrations of water-soluble sulfur compounds) (18, 24).

The juice is the most unstable dosage form. Alliin and allicin decompose rapidly, and those products must be used promptly (18).

Dried *Bulbus Allii Sativi* products should be stored in well-closed containers, protected from light, moisture, and elevated temperature.

Medicinal uses

Uses supported by clinical data

As an adjuvant to dietetic management in the treatment of hyperlipidaemia, and in the prevention of atherosclerotic (age-dependent) vascular changes (5, 27–31). The drug may be useful in the treatment of mild hypertension (11, 28).

Uses described in pharmacopoeias and in traditional systems of medicine

The treatment of respiratory and urinary tract infections, ringworm and rheumatic conditions (1, 4, 7, 9, 11). The herb has been used as a carminative in the treatment of dyspepsia (32).

Uses described in folk medicine, not supported by experimental or clinical data

As an aphrodisiac, antipyretic, diuretic, emmenagogue, expectorant, and sedative, to treat asthma and bronchitis, and to promote hair growth (6, 9, 13).

Pharmacology

Experimental pharmacology

Bulbus Allii Sativi has a broad range of antibacterial and antifungal activity (13). The essential oil, water, and ethanol extracts, and the juice inhibit the *in vitro* growth of *Bacillus* species, *Staphylococcus aureus*, *Shigella sonnei*, *Erwinia carotovora*, *Mycobacterium tuberculosis*, *Escherichia coli*, *Pasteurella multocida*, *Proteus*