



Medicinal Plants

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Chapter- 1

Achillea Millefolium

Achillea millefolium



near Amiens, France

Scientific classification

Kingdom: Plantae

(unranked): Angiosperms

(unranked): Eudicots

(unranked): Asterids

Order: Asterales

Family: Asteraceae

Genus: *Achillea*

Species: *A. millefolium*



Budding

Achillea millefolium or **yarrow** is a flowering plant in the family Asteraceae, native to the Northern Hemisphere. In Spanish-speaking New Mexico and southern Colorado, it is called *plumajillo*, or "little feather", for the shape of the leaves. In antiquity, yarrow was known as *herbal militaris*, for its use in staunching the flow of blood from wounds. Other common names for this species include **common yarrow**, **gordaldo**, **nosebleed plant**, **old man's pepper**, **devil's nettle**, **sanguinary**, **milfoil**, **soldier's woundwort**, **thousand-leaf** (as its binomial name affirms), and **thousand-seal**.

Description

Common yarrow is an erect herbaceous perennial plant that produces one to several stems (0.2 to 1m tall) and has a rhizomatous growth form. Leaves are evenly distributed along the stem, with the leaves near the middle and bottom of the stem being the largest. The leaves have varying degrees of hairiness (pubescence). The leaves are 5–20 cm long, bipinnate or tripinnate, almost feathery, and arranged spirally on the stems. The leaves are cauline and more or less clasping. The inflorescence has 4 to 9 phyllaries and contains ray and disk flowers which are white to pink. There are generally 3 to 8 ray flowers that are ovate to round. Disk flowers range from 15 to 40. The inflorescence is produced in a flat-topped cluster. Yarrow grows up to 3500m above sea level. The plant commonly flowers from May through June, and is a frequent component in butterfly gardens.

Common yarrow is frequently found in the mildly disturbed soil of grasslands and open forests. Active growth occurs in the spring.



Illustration in Franz Eugen Köhler, *Koehlers Medizinal-Pflanzen in naturgetreuen Abbildungen und kurz erläuterndem Texte* (1883-1914)



Yarrow at BioTrek, California State Polytechnic University, Pomona

In North America, there are both native and introduced genotypes, and both diploid and polyploid plants.

Establishment

Common yarrow is a drought tolerant species of which there are several different ornamental cultivars. Seeds require light for germination, so optimal germination occurs when planted no deeper than $\frac{1}{4}$ inch. Seeds also require a germination temperature of 18–24 °C (64–75 °F). Common yarrow responds best to soil that is poorly developed and well drained. The plant has a relatively short life, but may be prolonged by dividing the plant every other year, and planting 12 to 18 inches apart. Common yarrow is a weedy species and can become invasive. It may suffer from mildew or root rot if not planted in well-drained soil.

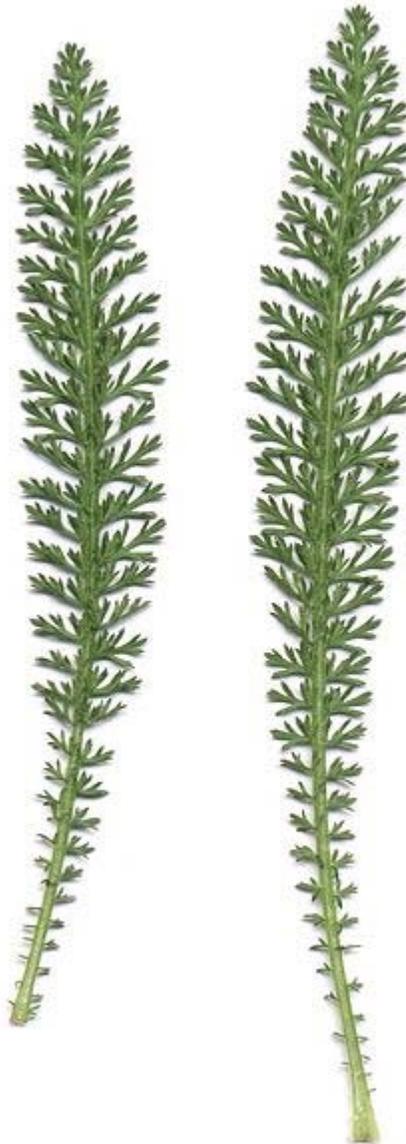
There are several varieties and subspecies:

- *Achillea millefolium* subsp. *millefolium*
 - *Achillea millefolium* subsp. *millefolium* var. *millefolium* - Europe, Asia
 - *Achillea millefolium* subsp. *millefolium* var. *alpicola* - Rocky Mountains
 - *Achillea millefolium* subsp. *millefolium* var. *borealis* - Arctic regions
 - *Achillea millefolium* subsp. *millefolium* var. *californica* - California
 - *Achillea millefolium* subsp. *millefolium* var. *occidentalis* - North America
 - *Achillea millefolium* subsp. *millefolium* var. *pacifica* - west coast of North America
 - *Achillea millefolium* subsp. *millefolium* var. *puberula* - California
 - *Achillea millefolium* subsp. *millefolium* var. *rubra* - Southern Appalachians
- *Achillea millefolium* subsp. *chitralensis* - western Himalaya
- *Achillea millefolium* subsp. *sudetica* - Alps, Carpathians

Cultivation and uses



Yarrow flowers, late summer, Yosemite National Park.



Yarrow leaves

Yarrows can be planted to combat soil erosion due to the plant's resistance to drought.

The herb is purported to be a diaphoretic, astringent, tonic, stimulant and mild aromatic. It contains isovaleric acid, salicylic acid, asparagin, sterols, flavonoids, bitters, tannins, and coumarins. The plant also has a long history as a powerful 'healing herb' used topically for wounds, cuts and abrasions. The genus name *Achillea* is derived from mythical Greek character, Achilles, who reportedly carried it with his army to treat battle wounds. This medicinal action is also reflected in some of the common names mentioned below, such as Staunchweed and Soldier's Woundwort.

The stalks of yarrow are dried and used as a randomising agent in I Ching divination.

In the Middle Ages, yarrow was part of a herbal mixture known as gruit used in the flavouring of beer prior to the use of hops.

Old folk names for yarrow include arrowroot, bad man's plaything, carpenter's weed, death flower, devil's nettle, eerie, field hops, gearwe, hundred leaved grass, knight's milefoil, knyghten, milefolium, milfoil, millefoil, noble yarrow, nosebleed, old man's mustard, old man's pepper, sanguinary, seven year's love, snake's grass, soldier, soldier's woundwort, stanch weed, thousand seal, woundwort, yarroway, yerw.

The English name yarrow comes from the Saxon (Old English) word *gearwe*, which is related to both the Dutch word *gerw* and the Old High German word *garawa*.

Yarrow has also been used as a food, and was very popular as a vegetable in the seventeenth century. The younger leaves are said to be a pleasant leaf vegetable when cooked as spinach, or in a soup. Yarrow is sweet with a slight bitter taste. The leaves can also be dried and used as a herb in cooking.

Cultivars

The species is generally too weedy for gardens but cultivars include 'Paprika', 'Cerise Queen' and 'Red Beauty'; and the many hybrids of this species designated *Achillea x taygetea* including 'Appleblossom', 'Fanal' and 'Hoffnung' are useful garden subjects.

Agricultural Use: before the arrival of monocultures of Ryegrass, both grass leys and permanent pasture always contained Yarrow (*Achillea millefolium*) at a rate of ca. 0.3kg/ha. At least one of the reasons for Yarrow's inclusion in grass mixtures was that it is a deep rooted herb, whose leaves are rich in minerals. Thus its inclusion helped to prevent mineral deficiencies in the ruminants to whom it was fed.



Yarrow, flower closeup



Red Yarrow

Herbal medicine

Yarrow has seen historical use as a medicine, often because of its astringent effects. Decoctions have been used to treat inflammations, such as hemorrhoids, and headaches. Confusingly, it has been said to both stop bleeding and promote it. Infusions of yarrow, taken either internally or externally, are said to speed recovery from severe bruising. The most medicinally active part of the plant is the flowering tops. They also have a mild stimulant effect, and have been used as a snuff. Today, yarrow is valued mainly for its action in colds and influenza, and also for its effect on the circulatory, digestive, excretory, and urinary systems. In the nineteenth century, yarrow was said to have a greater number of indications than any other herb.

It is believed that anti-allergenic compounds can be extracted from the flowers by steam distillation. The flowers are used to treat various allergic mucus problems, including hay fever. Flowers used in this way are harvested in summer or autumn, and an infusion drunk for upper respiratory phlegm or used externally as a wash for eczema. Inhale for hay fever and mild asthma, use fresh in boiling water.

The dark blue essential oil, extracted by steam distillation of the flowers, is generally used as an anti-inflammatory or in chest rubs for colds and influenza. For a massage oil

for inflamed joints, dilute 5-10 drops yarrow oil in 25 ml infused St. John's wort oil. A chest rub can be made for chesty colds and influenza. Combine yarrow with eucalyptus, peppermint, hyssop, or thyme oil, diluting a total of 20 drops of oil in 25 ml almond or sunflower oil.

The leaves encourage clotting, so it can be used fresh for nosebleeds. However, inserting a leaf in the nostril may also start a nosebleed; this was once done to relieve migraines. Harvest throughout the growing season.

The aerial parts of the plant are used for phlegm conditions, as a bitter digestive tonic to encourage bile flow, and as a diuretic. The aerial parts act as a tonic for the blood, stimulate the circulation, and can be used for high blood pressure. Also useful in menstrual disorders, and as an effective sweating remedy to bring down fevers. Harvest during flowering. The tincture is used for urinary disorders or menstrual problems. Prescribed for cardiovascular complaints. Soak a pad in an infusion or dilute tincture to soothe varicose veins.

Yarrow intensifies the medicinal action of other herbs taken with it, and helps eliminate toxins from the body. It is reported to be associated with the treatment of the following ailments:

Analgesic Amenorrhea, antiphlogistic, anti-inflammatory, bowels, bleeding, blood clots, blood pressure (lowers), blood purifier, blood vessels (tones), catarrh (acute, repertory), colds, chicken pox, circulation, contraceptive (unproven), cystitis, diabetes treatment, digestion (stimulates)gastro-intestinal disorders, choleric dyspepsia, eczema, fevers, flu's, gastritis, glandular system, gum ailments, heartbeat (slow), influenza, insect repellent, inflammation, emmenagogue, internal bleeding, liver (stimulates and regulates), lungs (hemorrhage), measles, menses (suppressed), menorrhagia, menstruation (regulates, relieves pain), nipples (soreness), nosebleeds, piles (bleeding), smallpox, stomach sickness, toothache, thrombosis, ulcers, urinary antiseptic, uterus (tighten and contract), gastroprotective varicose veins, vision, may reduce autoimmune responses.

The salicylic acid derivatives are a component of aspirin, which may account for its use in treating fevers and reducing pain. Yarrow tea is also said to be able to clear up a cold within 24 hours. Yarrow has also been used as a Quinine substitute.

Yarrow was also used in traditional Native American herbal medicine. Navajo Indians considered it to be a "life medicine", chewed it for toothaches, and poured an infusion into ears for earaches. Several tribes of the Plains region of the United States used common yarrow. The Pawnee used the stalk for pain relief. The Chippewa used the leaves for headaches by inhaling it in a steam. They also chewed the roots and applied the saliva to their appendages as a stimulant. The Cherokee drank a tea of common yarrow to reduce fever and aid in restful sleep.

Shakers used yarrow for complaints from haemorrhages to flatulence.

The English herbalist John Gerard is said to have recommended it for relieving "swelling of those secret parts", but the 1597 edition of his Herbal does not include an entry for this species of yarrow but for *Achillea ptarmica*, and the entry for that plant does not include this phrase either.

Companion planting

Yarrow is considered an especially useful companion plant, not only repelling some bad insects while attracting good, predatory ones, but also improving soil quality. It attracts predatory wasps, which drink the nectar and then use insect pests as food for their larvae. Similarly, it attracts ladybugs and hoverflies. Its leaves are thought to be good fertilizer, and a beneficial additive for compost.

It is also considered directly beneficial to other plants, improving the health of sick plants when grown near them.

Use by birds

Several cavity-nesting birds, including the common starling, use yarrow to line their nests. Experiments conducted on the tree swallow, which does not use yarrow, suggest that adding yarrow to nests inhibits the growth of parasites.

Insecticidal (EO on larvae of the Culicidae mosquito *Aedes albopictus*)

Dangers

In rare cases, yarrow can cause severe allergic skin rashes; prolonged use can increase the skin's photosensitivity. This can be triggered initially when wet skin comes into contact with cut grass and yarrow together.

In one study aqueous extracts of yarrow impaired the sperm production of laboratory rats.

History

Yarrow was one herb identified at Shanidar IV, a Neanderthal flower burial of northern Iraq, dated c.60,000BCE along with a number of other medicinal herbs.

Similar species

Other plants with white flowers in large compound umbels that maybe confused with *Achillea millefolium* include: water parsnip, (swamp parsnip, sium suave) and western water hemlock, (*Cicuta douglasii*, poison hemlock) and spotted water hemlock (*Cicuta maculata*, spotted water hemlock, spotted parsley, spotted cowbane). Water parsnip and water hemlock have clusters of small white flowers that are shaped like umbrellas, both grow in moist soils. Water parsnip leaves are once compound, and water hemlock leaves

are three times compound. Water hemlock has a large swelling at the stem base. All parts of water hemlock are highly poisonous. Other yarrow species have similar foliage and flowers, including: *Achillea ageratifolia* and *Achillea nobilis*.

Chapter- 2

Agaricus Subrufescens

Agaricus subrufescens



Agaricus subrufescens

Scientific classification

Kingdom:	Fungi
Subkingdom:	Dikarya
Phylum:	Basidiomycota
Subphylum:	Agaricomycotina
Class:	Agaricomycetes
Order:	Agaricales
Family:	Agaricaceae
Genus:	<i>Agaricus</i>
Species:	<i>A. subrufescens</i>

Binomial name

Agaricus subrufescens
Peck (1893)

Synonyms

Agaricus rufotegulis

Nauta (1999)

Agaricus brasiliensis

Wasser, M. Didukh, Amazonas & Stamets (2002)[*nom. illegit.*, non *A. brasiliensis* Fr. (1830)]

Agaricus blazei

Murrill (1945) *sensu auct.*

Agaricus sylvaticus

Schaeff. (1833) *sensu auct. brasil.*

Agaricus subrufescens (incorrectly known as *Agaricus blazei*, *Agaricus blazei Murrill*, *Agaricus brasiliensis*, *Agaricus sylvaticus* or *Agaricus rufotegulis*) is a species of mushroom, commonly known as **Almond mushroom**, **Mushroom of the Sun**, **God's Mushroom**, **Mushroom of Life**, **Royal Sun Agaricus**, **Jisongrong** or **Himematsutake** (Japanese: 姫松茸, "princess matsutake") and by a number of other names. *Agaricus subrufescens* is a choice edible, with a somewhat sweet taste and fragrance of almonds. This mushroom is also well known as a medicinal mushroom, for its purported medicinal properties, due to research which indicates it may stimulate the immune system.

Taxonomy

Agaricus subrufescens was first described by the American botanist Charles Horton Peck in 1893. During the late 19th and early 20th century, it was cultivated for the table in the eastern United States. It was discovered again in Brazil during the 1970s, and misidentified as *Agaricus blazei* Murrill, a species originally described from Florida. It was soon marketed for its purported medicinal properties under various names, including *ABM* (for *Agaricus blazei* Murrill), *Cogumelo do Sol* (mushroom of the sun), *Cogumelo de Deus* (mushroom of God), *Cogumelo de Vida* (mushroom of life), *Himematsutake*, *Royal Sun Agaricus*, *Mandelpilz*, and *Almond Mushroom*.

In 2002, Didukh and Wasser correctly rejected the name *A. blazei* for this species, but unfortunately called the Brazilian fungus *A. brasiliensis*, a name that had already been used for a different species, *Agaricus brasiliensis* Fr. (1830). Richard Kerrigan undertook genetic and interfertility testing on several fungal strains and showed that samples of the Brazilian strains called *A. blazei* and *A. brasiliensis* were genetically similar to, and interfertile with, North American populations of *Agaricus subrufescens*. These tests also found European samples called *A. rufotegulis* to be of the same species. Because *A. subrufescens* is the oldest name, it has taxonomical priority.

Note that *Agaricus blazei* Murrill is a perfectly valid name, but for a completely different mushroom. *Agaricus silvaticus* Schaeff. is also a perfectly valid name for a common, north temperate, woodland mushroom. Neither is a synonym of *Agaricus subrufescens*.

Description



The floccose stipe and annulus of *A. subrufescens*

The cap is initially hemispherical, later becoming convex, with a diameter of 5 to 18 centimetres (2.0 to 7.1 in). The cap surface is covered with silk-like fibers, although in maturity it develops small scales (*squamulose*). The color of the cap may range from white to grayish or dull reddish-brown; the cap margin typically splits with age. The flesh of *A. subrufescens* is white, and has the taste of "green nuts", with the odor of almonds. The gills are not attached to the stalk (free), narrow, and crowded closely together. They start out whitish in color, then later pinkish and finally black-brown as the spores mature. Spores are ellipsoid, smooth, dark-purplish brown when viewed microscopically, with dimensions of 6–7.5 by 4–5 μm . The stipe is 6 to 15 centimetres (2.4 to 5.9 in) by 1 to 1.5 centimetres (0.39 to 0.59 in) thick, and bulbous at the base. Initially solid, the stipe becomes hollow with age; it is cottony (*floccose*) to scaly towards the base. The annulus is abundant and double-layered; it is bent downwards towards the stem, smooth and whitish on the upper side, and covered with cottony scales on the lower side.

Distribution and habitat

Agaricus subrufescens forms fruitbodies singly or in clusters in leaf litter in rich soil, often in domestic habitats. It was originally described from the northeastern United States, but has been found growing in California, Hawaii, Great Britain, the Netherlands, Israel, Taiwan, and Brazil.

Edibility

Aroma

Agaricus subrufescens is a choice edible, with a somewhat sweet taste and fragrance of almonds. The almond smell of the mushroom is mostly due to the presence of benzaldehyde, benzyl alcohol, benzonitrile, and methyl benzoate.

Commercial use

Due to the fact *Agaricus subrufescens* contains a high level of beta glucans, compounds known for stimulating the immune system, the fungus is used in oncological therapy in Japan and Brazil. In addition to beta-glucans, the mushroom's effect on the immune system is believed to be due to other polysaccharides such as alpha-glucans. In Japan, *Agaricus subrufescens* is sold under the brand names Sen-Sei-Ro Gold, and ABMK, and is used by an estimated 500,000 people. In Japan, *Agaricus subrufescens* is also the most popular complementary and alternative medicine used by cancer patients. Although *Agaricus subrufescens* is cultivated in the United States, the largest exporters are China and Brazil. It has been noted in a scientific review of *A. subrufescens* research, that the range of quality in *A. subrufescens* cultivation can affect the mushroom's ability to impact cells of the immune system.

Recently, *Watanabe et al.* published a report in the *Biological & Pharmaceutical Bulletin* on a novel hybrid of *A. subrufescens* called *Basidiomycetes-X* (BDM-X) and a US patent was issued on a novel hybrid of the *A. subrufescens* edible mushroom which was cross-bred (hybridized) with another medicinal mushroom resulting in a new hybrid claimed to possess 10 to 3000 times the potency of similar but unpatented mushrooms.

Research

Many researchers have studied *Agaricus subrufescens*, as well as other medicinal mushrooms for close to 50 years, due to laboratory tests which show they may stimulate immune system cells and the production of immune system cytokines. Below is a summary of this research, which is often based on animal or cellular models.

Cancer research

Animal and cellular research has shown that *Agaricus subrufescens* application or consumption appears to offer anti-cancer properties.

Experimental Model	Experimental Effect (Cell culture)	Experimental Effect (Animal research)	Experimental Effect (Clinical)
Colorectal cancer			Benefited hematological and immunological parameters
Fibrosarcoma	Inhibited growth via apoptosis	Inhibited growth	
Sarcoma		Inhibited angiogenesis. Inhibited growth	
Gynaecological cancer			Increased NK cell activity, quality of life
Ovarian cancer	Inhibited growth and metastasis via apoptosis induction	Inhibited metastasis, growth	
Lung cancer	Inhibited growth via apoptosis	Inhibited metastasis, growth	
Leukaemia	Inhibited growth via apoptosis	Inhibited growth	
Myeloma		Inhibited growth	
Hepatocarcinoma	Inhibited abnormal collagen formation	Inhibited growth	
Stomach cancer	Inhibited growth via apoptosis		
Prostate cancer	Inhibited growth via apoptosis	Inhibited growth	
Skin cancer		Inhibited growth when applied orally or topically	

Immune system

Cellular and animal research has shown that *Agaricus subrufescens* may stimulate immune system cells and the production cytokines, like interferons and interleukins (reviewed by G. Hetland).

Direct anti-viral properties

Agaricus subrufescens mushrooms are known to have anti-viral properties in cell culture. The ability of *Agaricus subrufescens* to inhibit viruses in the human body has not been studied. Other mushrooms are also known to have anti-viral, anti-bacterial, and anti-fungal activity in cell culture.

Other possible effects

Besides evidence *Agaricus subrufescens* may up-regulate the immune system, additional research suggests the mushroom has a beneficial effect on cholesterol, inhibiting pathogenic factors, and inhibiting angiogenesis.

Limited clinical and animal research suggests, *Agaricus subrufescens* consumption may lower blood glucose levels and improve insulin resistance.

Chapter- 3

Garlic



Allium sativum, known as garlic, from William Woodville, *Medical Botany*, 1793.

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
Order:	Asparagales
Family:	Alliaceae

Subfamily: Allioideae
Tribe: Allieae
Genus: *Allium*
Species: *A. sativum*

Allium sativum, commonly known as **garlic**, is a species in the onion family Alliaceae. Its close relatives include the onion, shallot, leek, chive, and rakkyo. Garlic has been used throughout history for both culinary and medicinal purposes. The garlic plant's bulb is the most commonly used part of the plant. With the exception of the single clove types, the bulb is divided into numerous fleshy sections called cloves. The cloves are used for consumption (raw or cooked), or for medicinal purposes, and have a characteristic pungent, spicy flavor that mellows and sweetens considerably with cooking. The leaves, and flowers (bulbils) on the head (spathe) are also edible, and being milder in flavor than the bulbs, they are most often consumed while immature and still tender. Additionally, the immature flower stalks (scapes) of the hardneck and elephant types are sometimes marketed for uses similar to asparagus in stir-fries. The papery, protective layers of "skin" over various parts of the plant are generally discarded during preparation for most culinary uses, though in Korea immature whole heads are sometimes prepared with the tender skins intact. The root cluster attached to the basal plate of the bulb is the only part not typically considered palatable in any form. The sticky juice within the bulb cloves is used as an adhesive in mending glass and porcelain in China.

The irrational fear of garlic is *alliumphobia*.

Origin and major types



bulbils

The ancestry of cultivated garlic is not definitively established. According to Zohary and Hopf "A difficulty in the identification of its wild progenitor is the sterility of the cultivars", though it is thought to be descendent from the species *Allium longicuspis*, which grows wild in central and southwestern Asia. *Allium sativum* grow in the wild in areas where it has become naturalised. The "wild garlic", "crow garlic", and "field garlic" of Britain are members of the species *Allium ursinum*, *Allium vineale*, and *Allium oleraceum*, respectively. In North America, *Allium vineale* (known as "wild garlic" or "crow garlic") and *Allium canadense*, known as "meadow garlic" or "wild garlic" and "wild onion", are common weeds in fields. One of the best-known "garlics", the so-called elephant garlic, is actually a wild leek (*Allium ampeloprasum*), and not a true garlic. Single clove garlic (also called Pearl garlic or Solo garlic) also exists, originating in the Yunnan province of China.

European garlic

There are a number of garlics with Protected Geographical Status in Europe; these include:

- Aaglio Bianco Polesano from Veneto, Italy (*PDO*)
- Aaglio di Voghiera from Ferrara, Emilia-Romagna, Italy (*PDO*)
- Ail blanc de Lomagne from Lomagne in the Gascony area of France (*PGI*)
- Ail de la Drôme from Drôme in France (*PGI*)
- Ail rose de Lautrec a rose/pink garlic from Lautrec in France (*PGI*)
- Ajo Morado de Las Pedroñeras a rose/pink garlic from Las Pedroñeras in Spain (*PGI*)

Varieties

Consumer garlic can come in many varieties, including fresh, frozen, dried, fermented (Black Garlic) and shelf stable products (in tubes or jars).

Cultivation

Garlic is easy to grow and can be grown year-round in mild climates. While sexual propagation of garlic is indeed possible, nearly all of the garlic in cultivation is done so asexually, by planting individual cloves in the ground. In cold climates, cloves are planted in the ground in the fall, about six weeks before the soil freezes and harvested in late spring. Garlic plants are usually very hardy, and are not attacked by many pests or diseases. Garlic plants are said to repel rabbits and moles. Two of the major pathogens that attack garlic are nematodes and white rot disease, which remain in the soil indefinitely once the ground has become infected. Garlic also can suffer from pink root, a typically nonfatal disease that stunts the roots and turns them pink or red. Garlic plants can be grown close together, leaving enough room for the bulbs to mature, and are easily grown in containers of sufficient depth. When selecting garlic for planting, it is important to pick large heads to separate cloves from. Large cloves will also improve head size, along with proper spacing in the planting bed. Garlic plants prefer to grow in a soil with a high organic material content, but it is capable of growing in a wide range of soil conditions and pH levels.



Garlic bulbs and cloves



Garlic growing in a container.



Garlic bulbs and individual cloves, one peeled.

There are different types or subspecies of garlic, most notably hardneck garlic and softneck garlic. The latitude where the garlic is grown affects the choice of type as garlic can be day-length sensitive. Hardneck garlic is generally grown in cooler climates; softneck garlic is generally grown closer to the equator.

Garlic scapes are removed in order to focus all the garlic's energy into bulb growth. The scapes are sold separately for cooking.

Production trends



Garlic output in 2005

Garlic is grown globally, but 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. India (4.1%) and South Korea (2%) follow, with Russia (1.6%) in fourth place and the United States (where garlic is grown primarily as a cash crop in every state except for Alaska) in fifth place (1.4%). This leaves 16% of global garlic production in countries that each produce less than 2% of global output. Much of the garlic production in the United States is centered on Gilroy, California, which calls itself the "garlic capital of the world".

Top 10 garlic producers — 11 June 2008

Country	Production (tonnes)	Footnote
China	12,088,000	F
India	645,000	F
South Korea	325,000	F
Egypt	258,608	F
Russia	254,000	F
United States	221,810	
Spain	142,400	
Argentina	140,000	F
Myanmar	128,000	F
Ukraine	125,000	F
World	15,686,310	A

Uses

Culinary uses



Garlic being crushed using a garlic press.

Garlic is widely used around the world for its pungent flavor as a seasoning or condiment. It is a fundamental component in many or most dishes of various regions, including eastern Asia, south Asia, Southeast Asia, the Middle East, northern Africa, southern Europe, and parts of South and Central America. The flavour varies in intensity and aroma with the different cooking methods. It is often paired with onion, tomato, or ginger. The parchment-like skin is much like the skin of an onion and is typically removed before using in raw or cooked form. An alternative is to cut the top off the bulb, coat the cloves by dribbling olive oil (or other oil-based seasoning) over them, and roast them in an oven. Garlic softens and can be extracted from the cloves by squeezing the (root) end of the bulb, or individually by squeezing one end of the clove. In Korea, heads of garlic are fermented at high temperature; the resulting product, called black garlic, is sweet and syrupy, and is now being sold in the United States, United Kingdom and Australia.

Garlic may be applied to breads to create a variety of classic dishes such as garlic bread, garlic toast, bruschetta, crostini and canapé.



Garlic being rubbed onto a slice of bread

Oils are often flavored with garlic cloves. These infused oils are used to season all categories of vegetables, meats, breads and pasta.

In some cuisine, the young bulbs are pickled for 3–6 weeks in a mixture of sugar, salt, and spices. In eastern Europe, the shoots are pickled and eaten as an appetizer.

Immature scapes are tender and edible. They are also known as "garlic spears", "stems", or "tops". Scapes generally have a milder taste than the cloves. They are often used in stir frying or braised like asparagus. Garlic leaves are a popular vegetable in many parts of Asia. The leaves are cut, cleaned, and then stir-fried with eggs, meat, or vegetables.

Mixing garlic with egg yolks and olive oil produces aioli. Garlic, oil, and a chunky base produce skordalia. Blending garlic, almond, oil, and soaked bread produces ajoblanco.

Garlic powder has a different taste from fresh garlic. If used as a substitute for fresh garlic, 1/8 teaspoon of garlic powder is equivalent to one clove of garlic.

Storage



A basket of garlic bulbs

Domestically, garlic is stored warm (above 18°C [64°F]) and dry to keep it dormant (so that it does not sprout). It is traditionally hung; softneck varieties are often braided in strands, called "plaits" or grappes. Garlic is often kept in oil to produce flavoured oil; however, the practice requires measures to be taken to prevent the garlic from spoiling. Untreated garlic kept in oil can support the growth of deadly *Clostridium botulinum*. Refrigeration will not assure the safety of garlic kept in oil. Peeled cloves may be stored in wine or vinegar in the refrigerator.

Commercially prepared oils are widely available, but when preparing and storing garlic-infused oil at home, there is a risk of botulism if the product is not stored properly. To reduce this risk, the oil should be refrigerated and used within one week. Manufacturers add acids and/or other chemicals to eliminate the risk of botulism in their products. Two outbreaks of botulism related to garlic stored in oil have been reported.

Commercially, garlic is stored at 0°C [32°F], in a dry, low humidity environment. Garlic will keep longer if the tops remain attached.



Garlic scapes are often harvested early so that the bulbs will grow bigger.

Historical use

Garlic has been used as both food and medicine in many cultures for thousands of years, dating at least as far back as the time that the Giza pyramids were built. Garlic is still grown in Egypt, but the Syrian variety is the kind most esteemed now.

Garlic is mentioned in the Bible and the Talmud. Hippocrates, Galen, Pliny the Elder, and Dioscorides all mention the use of garlic for many conditions, including parasites, respiratory problems, poor digestion, and low energy. Its use in China was first mentioned in A.D. 510.

It was consumed by ancient Greek and Roman soldiers, sailors, and rural classes (Virgil, *Eclogues* ii. 11), and, according to Pliny the Elder (*Natural History* xix. 32), by the African peasantry. Galen eulogizes it as the "rustic's theriac" (cure-all), and Alexander Neckam, a writer of the 12th century, recommends it as a palliative for the heat of the sun in field labor.

In the account of Korea's establishment as a nation, gods were said to have given mortal women with bear and tiger temperaments an immortal's black garlic before mating with them. This is a genetically unique six-clove garlic that was to have given the women supernatural powers and immortality. This garlic is still cultivated in a few mountain areas today.

In his *Natural History*, Pliny gives an exceedingly long list of scenarios in which it was considered beneficial (*N.H.* xx. 23). Dr. T. Sydenham valued it as an application in confluent smallpox, and, says Cullen (*Mat. Med.* ii. p. 174, 1789), found some dropsies cured by it alone. Early in the 20th century, it was sometimes used in the treatment of pulmonary tuberculosis or phthisis.



Harvesting garlic, from *Tacuinum sanitatis*, 15th century (Bibliothèque nationale).

Garlic was rare in traditional English cuisine (though it is said to have been grown in England before 1548) and has been a much more common ingredient in Mediterranean Europe. Garlic was placed by the ancient Greeks on the piles of stones at crossroads, as a supper for Hecate (Theophrastus, *Characters, The Superstitious Man*). A similar practice of hanging garlic, lemon and red chilli at the door or in a shop to ward off potential evil,

is still very common in India. According to Pliny, garlic and onions were invoked as deities by the Egyptians at the taking of oaths. (Pliny also states that garlic demagnetizes lodestones, which is not factual.) The inhabitants of Pelusium, in lower Egypt (who worshiped the onion), are said to have had an aversion to both onions and garlic as food.

To prevent the plant from running to leaf, Pliny (*N.H.* xix. 34) advised bending the stalk downward and covering with earth; seeding, he observes, may be prevented by twisting the stalk (by "seeding", he most likely meant the development of small, less potent bulbs).

Medicinal use and health benefits

Garlic, raw

Nutritional value per 100 g (3.5 oz)

Energy	623 kJ (149 kcal)
Carbohydrates	33.06 g
Sugars	1.00g
Dietary fiber	2.1 g
Fat	0.5 g
Protein	6.39 g
- beta-carotene	5 µg (0%)
Thiamine (Vit. B ₁)	0.2 mg (15%)
Riboflavin (Vit. B ₂)	0.11 mg (7%)
Niacin (Vit. B ₃)	0.7 mg (5%)
Pantothenic acid (B ₅)	0.596 mg (12%)
Vitamin B ₆	1.235 mg (95%)
Folate (Vit. B ₉)	3 µg (1%)
Vitamin C	31.2 mg (52%)
Calcium	181 mg (18%)
Iron	1.7 mg (14%)
Magnesium	25 mg (7%)
Phosphorus	153 mg (22%)
Potassium	401 mg (9%)
Sodium	17 mg (1%)

Zinc

1.16 mg (12%)

In test tube studies garlic has been found to have antibacterial, antiviral, and antifungal activity. However, these actions are less clear in humans. Garlic is also claimed to help prevent heart disease (including atherosclerosis, high cholesterol, and high blood pressure) and cancer. Garlic is used to prevent certain types of cancer, including stomach and colon cancers. In fact, countries where garlic is consumed in higher amounts, due to traditional cuisine, have been found to have a lower prevalence of cancer. Animal studies, and some early investigational studies in humans, have suggested possible cardiovascular benefits of garlic. A Czech study found that garlic supplementation reduced accumulation of cholesterol on the vascular walls of animals. Another study had similar results, with garlic supplementation significantly reducing aortic plaque deposits of cholesterol-fed rabbits. Another study showed that supplementation with garlic extract inhibited vascular calcification in human patients with high blood cholesterol. The known vasodilative effect of garlic is possibly caused by catabolism of garlic-derived polysulfides to hydrogen sulfide in red blood cells, a reaction that is dependent on reduced thiols in or on the RBC membrane. Hydrogen sulfide is an endogenous cardioprotective vascular cell-signaling molecule.



A bulb of garlic, split.



A bulb of garlic, not separated from the stem.

Although these studies showed protective vascular changes in garlic-fed subjects, a randomized clinical trial funded by the National Institutes of Health (NIH) in the United States and published in the *Archives of Internal Medicine* in 2007 found that the consumption of garlic in any form did not reduce blood cholesterol levels in patients with moderately high baseline cholesterol levels.

According to the Heart.org, "despite decades of research suggesting that garlic can improve cholesterol profiles, a new NIH-funded trial found absolutely no effects of raw garlic or garlic supplements on LDL, HDL, or triglycerides... The findings underscore the hazards of meta-analyses made up of small, flawed studies and the value of rigorously studying popular herbal remedies."

In 2007, the BBC reported that *Allium sativum* may have other beneficial properties, such as preventing and fighting the common cold. This assertion has the backing of long tradition in herbal medicine, which has used garlic for hoarseness and coughs. The Cherokee also used it as an expectorant for coughs and croup.

Garlic is also alleged to help regulate blood sugar levels. Regular and prolonged use of therapeutic amounts of aged garlic extracts lower blood homocysteine levels and has

shown to prevent some complications of diabetes mellitus. People taking insulin should not consume medicinal amounts of garlic without consulting a physician.

In 1858, Louis Pasteur observed garlic's antibacterial activity, and it was used as an antiseptic to prevent gangrene during World War I and World War II. More recently, it has been found from a clinical trial that a mouthwash containing 2.5% fresh garlic shows good antimicrobial activity, although the majority of the participants reported an unpleasant taste and halitosis.

Garlic cloves are used as a remedy for infections (especially chest problems), digestive disorders, and fungal infections such as thrush.

Garlic has been found to enhance thiamin absorption and therefore reduce the likelihood for developing the thiamin deficiency beriberi.

In 1924 it was found that garlic is an effective way to prevent scurvy, due to its high vitamin C content.

Garlic has been used reasonably successfully in AIDS patients to treat cryptosporidium in an uncontrolled study in China. It has also been used by at least one AIDS patient to treat toxoplasmosis, another protozoal disease.

Garlic supplementation in rats, along with a high protein diet, has been shown to boost testosterone levels.

A 2010 double-blind, parallel, randomised, placebo-controlled trial involving 50 patients whose routine clinical records in general practice documented treated but uncontrolled hypertension. Concluded that "Our trial suggests that aged garlic extract is superior to placebo in lowering systolic blood pressure similarly to current first line medications in patients with treated but uncontrolled hypertension."

Adverse effects and toxicology

Garlic is known for causing halitosis as well as causing sweat to have a pungent 'garlicky' smell which is caused by allyl methyl sulfide (AMS). AMS is a gas which is absorbed into the blood during the metabolism of garlic; from the blood it travels to the lungs (and from there to the mouth causing bad breath) and skin where it is exuded through skin pores. Washing the skin with soap is only a partial and imperfect solution to the smell. Studies have shown that sipping milk at the same time as consuming garlic can significantly neutralize bad breath. Mixing garlic with milk in the mouth before swallowing reduced the odor better than drinking milk afterward. Plain water, mushrooms and basil may also reduce the odor; the mix of fat and water found in milk, however, was the most effective.

Raw garlic is more potent; cooking garlic reduces the effect. The green dry 'folds' in the center of the garlic clove are especially pungent. The sulfur compound allicin, produced

by crushing or chewing fresh garlic produces other sulfur compounds: ajoene, allyl sulfides, and vinylthiols. Aged garlic lacks allicin, but may have some activity due to the presence of S-allylcysteine.

In a rat study, allicin, was found to be an activator of TRPA1. The neurons released neurotransmitters in the spinal cord to generate pain signals and released neuropeptides at the site of sensory nerve activation, resulting in vasodilation as well as inflammation. Allicin is released only by crushing or chewing raw garlic and cannot be formed from cooked garlic. This explains short term back pain when garlic is eaten raw.

Some people suffer from allergies to garlic and other plants in the allium family. Symptoms can include irritable bowel, diarrhea, mouth and throat ulcerations, nausea, breathing difficulties, and in rare cases anaphylaxis. Garlic-sensitive patients show positive tests to diallyl disulfide, allylpropylsulfide, allylmercaptan and allicin, all of which are present in garlic. People who suffer from garlic allergies will often be sensitive to many plants in the lily family (Liliaceae), including onions, garlic, chives, leeks, shallots, garden lilies, ginger, and bananas.

Garlic can also cause indigestion, nausea, vomiting, and diarrhea. It thins the blood (as does aspirin); this had caused very high quantities of garlic and garlic supplements to be linked with an increased risk of bleeding, particularly during pregnancy and after surgery and childbirth, although culinary quantities are safe for consumption. There have been several reports of serious burns resulting from garlic being applied topically for various purposes, including naturopathic uses and acne treatment, so care must be taken to test a small area of skin using a very low concentration of garlic. On the basis of numerous reports of such burns, including burns to children, topical use of raw garlic, as well as insertion of raw garlic into body cavities, is discouraged. In particular, topical application of raw garlic to young children is not advisable. The side effects of long-term garlic supplementation, if any exist, are largely unknown, and no FDA-approved study has been performed. However, garlic has been consumed for several thousand years without any adverse long-term effects, suggesting that modest quantities of garlic pose, at worst, minimal risks to normal individuals. Possible side effects include gastrointestinal discomfort, sweating, dizziness, allergic reactions, bleeding, and menstrual irregularities. The safety of garlic supplements had not been determined for children.; some breastfeeding mothers have found their babies slow to feed and have noted a garlic odour coming from their baby when they have consumed garlic.

Garlic may interact with warfarin, antiplatelets, saquinavir, antihypertensives, calcium channel blockers, and hypoglycemic drugs, as well as other medications. Members of the *allium* family might be toxic to cats or dogs. Some degree of liver toxicity has been demonstrated in rats, particularly in extremely large quantities exceeding those that a rat would consume under normal situations.

Properties

When crushed, *Allium sativum* yields allicin, a powerful antibiotic and antifungal compound (phytoncide). It has been claimed that it can be used as a home remedy to help speed recovery from strep throat or other minor ailments because of its antibiotic properties. It also contains the sulfur containing compounds alliin, ajoene, diallylsulfide, dithiin, S-allylcysteine, and enzymes, vitamin B, proteins, minerals, saponins, flavonoids, and maillard reaction products, which are non-sulfur containing compounds. Furthermore a phytoalexin called allixin (3-hydroxy-5-methoxy-6-methyl-2-pentyl-4H-pyran-4-one) was found, a non-sulfur compound with a γ -pyrone skeleton structure with anti-oxidative effects, anti-microbial effects, anti-tumor promoting effects, inhibition of aflatoxin B2 DNA binding, and neurotrophic effects. Allixin showed an anti-tumor promoting effect in vivo, inhibiting skin tumor formation by TPA in DMBA initiated mice. Analogs of this compound have exhibited anti tumor promoting effects in in vitro experimental conditions. Herein, allixin and/or its analogs may be expected useful compounds for cancer prevention or chemotherapy agents for other diseases.

The composition of the bulbs is approximately 84.09% water, 13.38% organic matter, and 1.53% inorganic matter, while the leaves are 87.14% water, 11.27% organic matter, and 1.59% inorganic matter.

The phytochemicals responsible for the sharp flavor of garlic are produced when the plant's cells are damaged. When a cell is broken by chopping, chewing, or crushing, enzymes stored in cell vacuoles trigger the breakdown of several sulfur-containing compounds stored in the cell fluids. The resultant compounds are responsible for the sharp or hot taste and strong smell of garlic. Some of the compounds are unstable and continue to evolve over time. Among the members of the onion family, garlic has by far the highest concentrations of initial reaction products, making garlic much more potent than onions, shallots, or leeks. Although many humans enjoy the taste of garlic, these compounds are believed to have evolved as a defensive mechanism, deterring animals like birds, insects, and worms from eating the plant.

A large number of sulfur compounds contribute to the smell and taste of garlic. Diallyl disulfide is believed to be an important odour component. Allicin has been found to be the compound most responsible for the "hot" sensation of raw garlic. This chemical opens thermoTRP (transient receptor potential) channels that are responsible for the burning sense of heat in foods. The process of cooking garlic removes allicin, thus mellowing its spiciness.

Due to its strong odor, garlic is sometimes called the "stinking rose". When eaten in quantity, garlic may be strongly evident in the diner's sweat and breath the following day. This is because garlic's strong-smelling sulfur compounds are metabolized, forming allyl methyl sulfide. Allyl methyl sulfide (AMS) cannot be digested and is passed into the blood. It is carried to the lungs and the skin, where it is excreted. Since digestion takes several hours, and release of AMS several hours more, the effect of eating garlic may be present for a long time.

This well-known phenomenon of "garlic breath" is alleged to be alleviated by eating fresh parsley. The herb is, therefore, included in many garlic recipes, such as pistou, persillade, and the garlic butter spread used in garlic bread. However, since the odour results mainly from digestive processes placing compounds such as AMS in the blood, and AMS is then released through the lungs over the course of many hours, eating parsley provides only a temporary masking. One way of accelerating the release of AMS from the body is the use of a sauna.

Because of the AMS in the bloodstream, it is believed by some to act as a mosquito repellent. However, there is no evidence to suggest that garlic is actually effective for this purpose.

Spiritual and religious perceptions

Garlic has been regarded as a force for both good and evil. According to Cassell's Dictionary of Superstitions, there is an Islamic myth that considers that after Satan left the Garden of Eden, garlic arose in his left footprint and onion in the right. In Europe, many cultures have used garlic for protection or white magic, perhaps owing to its reputation as a potent preventative medicine. Central European folk beliefs considered garlic a powerful ward against demons, werewolves, and vampires. To ward off vampires, garlic could be worn, hung in windows, or rubbed on chimneys and keyholes.

The association of garlic to evil spirits may be based on the antibacterial, antiparasitic value of garlic, which could prevent infections that lead to delusions and other related mental illness symptoms.

In both Hinduism and Jainism, garlic is considered to stimulate and warm the body and to increase one's desires. Some devout Hindus generally avoid using garlic and the related onion in the preparation of foods for religious festivities and events. Followers of the Jain religion avoid eating garlic and onion on a daily basis.

In connection with the odor associated with garlic, Islam views eating garlic and subsequently going to the mosque as inappropriate because the smell from the mouth will irritate the fellow worshippers.

Chapter- 4

Aloe Ferox

Aloe ferox



Scientific classification

Kingdom: Plantae
(unranked): Angiosperms
(unranked): Monocots
Order: Asparagales
Family: Asphodelaceae
Genus: *Aloe*
Species: *A. ferox*

Aloe ferox, also known as **Cape Aloe**, **Bitter Aloe**, **Red Aloe** and **Tap Aloe**, is a species of aloe indigenous to South Africa's Western Cape, Eastern Cape, Free State, KwaZulu-Natal, and Lesotho.

Aloe ferox is listed on the plant list of endangered plants (CITES - Appendix II) along with other wild species of this genus.



Aloe ferox, Jardín de aclimatación de La Orotava







Growth

Aloe ferox can grow to 10 feet (3.0 m) in height, and can be found on rocky hills, in grassy fynbos and on the edges of the Karoo. The plants may differ physically from area to area due to local conditions. Its leaves are thick and fleshy, arranged in rosettes, and have reddish-brown spines on the margins with smaller spines on the upper and lower surfaces. Its flowers are orange or red, and stand between 2 and 4 feet (0.61 and 1.2 m) above the leaves.



Aloe ferox on the R61 route between Cofimvaba and Ngcobo.

Cultivation

Aloe Ferox plants are propagated mainly from seed and head cuttings. The plants are sowed one meter apart from each other in rows and columns. It takes about 4 to 5 years for the plants to reach the first harvest, from the seed stage. At the time of harvest, each leaf weighs about 1.5 kg to 2 kg. Aloe Ferox prefers dry-tropical climates, open areas, sandy-loamy soils, full sun, and moderate watering with good drainage system.









Medicinal uses

Its leaves contain two juices; the yellow bitter sap is used as a laxative, and the white aloe gel is used in health drinks and skin care products. The sap is toxic to pregnant and breast feeding mothers.

The home remedies with *Aloe ferox* is same as that of with *Aloe vera*.

- Cuts, wounds, burns, pimples and skin problems: apply the sap over the affected parts.
- Spleen disorders: intake a table spoon gel with a pinch of turmeric, twice a day, one hour after food.
- Indigestion, cancer, HIV/AIDS: intake a table spoon of fresh gel, twice a day, one hour after food.
- Constipation: mix the spoonful of gel in a cup of lukewarm water and take it one hour after dinner.

Aloe ferox has less demand than that of *Aloe vera*. The products of *Aloe ferox* are merely confined to South Africa, United States and few European Countries. Asian markets are mainly dominated by *Aloe vera* products.

Chapter- 5

Dill

Dill



Scientific classification

Kingdom: Plantae
(unranked): Angiosperms
(unranked): Eudicots
(unranked): Asterids
Order: Apiales
Family: Apiaceae
Genus: *Anethum*
L.
Species: *A. graveolens*

Dill (*Anethum graveolens*) is a short-lived perennial herb. It is the sole species of the genus *Anethum*, though classified by some botanists in a related genus as *Peucedanum graveolens* (L.) C.B.Clarke.

Growth

40–60 cm (16–24 in), with slender stems and alternate, finely divided, softly delicate leaves 10–20 cm (3.9–7.9 in) long. The ultimate leaf divisions are 1–2 mm (0.039–0.079 in) broad, slightly broader than the similar leaves of fennel, which are threadlike, less than 1 mm (0.039 in) broad, but harder in texture. The flowers are white to yellow, in small umbels 2–9 cm (0.79–3.5 in) diameter. The seeds are 4–5 mm (0.16–0.20 in) long and 1 mm (0.039 in) thick, and straight to slightly curved with a longitudinally ridged surface.

Origins and history



Dried dill umbel

Dill originated in Eastern Europe. Zohary and Hopf remark that "wild and weedy types of dill are widespread in the Mediterranean basin and in West Asia."

Although several twigs of dill were found in the tomb of Amenhotep II, they report that the earliest archeological evidence for its cultivation comes from late Neolithic lake shore settlements in Switzerland. Traces have been found in Roman ruins in Great Britain.

In Semitic languages it is known by the name of **Shubit**. In Marathi, it is known as *shepu*. The Talmud requires that tithes shall be paid on the seeds, leaves, and stem of dill.

Nomenclature and taxonomy

The name *dill* comes from Old English *dile*, thought to have originated from a Norse or Anglo-Saxon word *dylle* meaning to soothe or lull, the plant having the carminative property of relieving gas. In Sanskrit, this herb is called Shatapushpa. In Gujarati it is called as hariz.

Uses

Fresh and dried dill leaves (sometimes called "dill weed" to distinguish it from dill seed) are used as herbs, mainly in the Baltic, in Russia, and in central Asia.

Like caraway, its fernlike leaves are aromatic and are used to flavor many foods, such as gravlax (cured salmon), borscht and other soups, and pickles (where the dill flower is sometimes used). Dill is best when used fresh, as it loses its flavor rapidly if dried; however, freeze-dried dill leaves preserve their flavor relatively well for a few months.

Dill seed is used as a spice, with a flavor somewhat similar to caraway but also resembling that of fresh or dried dill weed. Dill seeds were traditionally used to soothe the stomach after meals. And, dill oil can be extracted from the leaves, stems and seeds of the plant.

In Arabic, dill seed is called *ain jaradeh* (means cricket eye) used as a spice in cold dishes like fattosh and pickles. In Lao cuisine and parts of northern Thailand and Vietnam, dill is known in English as **Laotian coriander** and **Lao cilantro** (Lao: ຜັກຊີລາວ, Thai: ผักชีลาว, Vietnamese: *Thì là*). In the Lao language, it is called *Phak See*, and in Thai, it is known as *Phak Chee Lao*. In Lao cuisine, the herb is typically used in mok pa (steamed fish in banana leaf) and several coconut milk-based curries that contain fish or prawns. Lao coriander is also an essential ingredient in Vietnamese dishes like *chả cá* and *canh cá thì là*.

In Iran, dill is known as "Shevid" and is sometimes used with rice and called "Shevid-Polo". In India, dill is known as 'Savaa' in Hindi or 'Soa' not related to Soy, in Punjabi. It is also called 'sapsige soppu' in Kannada.

In Gujarat, India, dill is prepared in the manner of yellow Moong dal as a main-course dish. It is considered to have very good anti-gas properties, and hence it is used as mukhwas, or an after-meal digestive. It is also traditionally given to mothers immediately after childbirth.

Cultivation

Successful cultivation requires warm to hot summers with high sunshine levels; even partial shade will reduce the yield substantially. It also prefers rich, well drained soil. The seeds are viable for 3–10 years.

The seed is harvested by cutting the flower heads off the stalks when the seed is beginning to ripen. The seed heads are placed upside down in a paper bag and left in a warm dry place for a week. The seeds then separate from the stems easily for storage in an airtight container.

Companion Planting

When used as a companion planting, dill draws in many beneficial insects as the umbrella flower heads go to seed. Fittingly, it makes a good companion plant for cucumbers. It is a poor companion for carrots and tomatoes.

Aroma profile

- Apiole
- Carvone
- Myristicin
- Umbelliferone

Toxicology

- Antibacterial potent of *Staphylococcus aureus*
- Antimicrobial activity against *Saccharomyces cerevisiae*

Chapter- 6

Konjac



Inflorescences of Konjac

Scientific classification

Kingdom: Plantae
(unranked): Angiosperms
(unranked): Monocots
Order: Alismatales
Family: Araceae
Subfamily: Aroideae
Tribe: Thomsonieae
Genus: *Amorphophallus*
Species: *A. konjac*

Konjac, also known as **konjak**, **konjaku**, **devil's tongue**, **voodoo lily**, **snake palm**, or **elephant yam** (though this name is also used for *A. paeoniifolius*), is a plant of the genus *Amorphophallus*. It is native to warm subtropical to tropical eastern Asia, from Japan and China south to Indonesia.

It is a perennial plant, growing from a large corm up to 25 cm in diameter. The single leaf is up to 1.3 m across, bipinnate, and divided into numerous leaflets. The flowers are produced on a spathe enclosed by a dark purple spadix up to 55 cm long.

The corm of the konjac is often colloquially referred to as a yam, although it bears no marked relation to tubers of the family *Dioscoreaceae*.



Inflorescence







Cultivation and use



Konjac gel



Sashimi konnyaku, usually served with miso-based dipping instead of soy sauce.

Konjac is grown in India, China, Japan and Korea for its large starchy corms, used to create a flour and jelly of the same name. It is also used as a vegan substitute for gelatin.

In Japanese cuisine, konjac (known as konnyaku) appears in dishes such as *oden*. It is typically mottled grey and firmer in consistency than most gelatins. It has very little taste; the common variety tastes vaguely like salt. It is valued more for its texture than flavor.

Ito konnyaku (糸蒟蒻) is a type of Japanese food consisting of konjac cut into noodle-like strips. It is usually sold in plastic bags with accompanying water. It is often used in sukiyaki and oden. The name literally means "thread-konjac."

Japanese konnyaku is made by mixing konjac flour with water and limewater. Hijiki is often added for the characteristic dark color and flavor. Without additives for color, konnyaku is pale white. It is then boiled and cooled to solidify. Konnyaku made in noodle form is called **shirataki** and used in foods such as sukiyaki and gyudon.

Konjac is consumed in parts of China's Sichuan province; the corm is called *moyu* (魔芋, or Devil's Taro), and the jelly is called "konjac tofu" (魔芋豆腐 *moyu doufu*) or "snow konjac" (雪魔芋 *xue moyu*).



trunk



leaves from top, not fully unfolded



Leaves from the bottom, crown not fully unfolded



Crown from below, not fully unfolded



Crown from above, not fully unfolded

The dried corm of the konjac plant contains around 40% glucomannan gum. This polysaccharide makes konjac jelly highly viscous.

Konjac has almost no calories but is very high in fiber. Thus, it is often used as a diet food.

It can also be used for facial massage accessories which are currently popular in Korea.

Fruit jelly

Konjac can also be made into a popular Asian fruit jelly snack, known variously in the United States as lychee cups (after a typical flavor and Nata de coco cube suspended in the gel) or konjac candy, usually served in bite-sized plastic cups.

Choking risk

Perhaps due to several highly publicized deaths and near-deaths in the San Francisco Bay Area among children and elderly due to suffocation while eating konjac candy, there were FDA product warnings in 2001 and subsequent recalls in the United States and Canada. Unlike gelatine and some other commonly used gelling agents, konjac fruit jelly does not melt readily in the mouth. Some products that were on the market formed a gel strong enough such that only chewing, but not tongue pressure or breathing pressure, could disintegrate the gel. Instead of gently squeezing the miniature cup in which the gel was served to eject and chew the product, a naive consumer might attempt to suck the product out with enough force to unintentionally lodge the product in the opening of the trachea. Konjac fruit jelly was subsequently also banned in the European Union.

Some konjac jelly snacks are not of a size and consistency to pose any unusual choking risk but are nonetheless affected by the government bans. Some products that remain in Asian markets have an increased size, unusual shape, and more delicate consistency than the round plug-like gels that were associated with the choking incidents. The snacks usually have warning labels advising parents to make sure that their children chew the jelly thoroughly before swallowing. Japan's largest manufacturer of konjac snacks, MannanLife, has temporarily stopped production of the jellies after it was revealed that a 21-month-old Japanese boy had choked to death on a frozen MannanLife konjac jelly. As of this incident, 17 children and elderly people have died from choking on konjac since 1995.

Chapter- 7

Arnica Montana

Arnica montana



Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Asterids
Order:	Asterales
Family:	Asteraceae
Genus:	<i>Arnica</i>
Species:	<i>A. montana</i>

Synonyms

- *Doronicum montanum* Lam.
- *Doronicum arnica* Desf.

- *Doronicum arnica* Garsault
- *Doronicum oppositifolium* Lam.
- *Arnica helvetica* Loudon
- *Arnica petiolata* Schur
- *Arnica plantaginifolia* Gilib.

Arnica montana, known commonly as **leopard's bane**, **wolf's bane**, **mountain tobacco** and **mountain arnica**, is a European flowering plant with large yellow capitula.

Distribution and habitat



Arnica montana

A. montana is endemic to Europe, from southern Iberia to southern Scandinavia and the Carpathians. It is absent from the British Isles and the Italian and Balkan Peninsulas. *A. montana* grows in nutrient-poor silicaceous meadows up to nearly 3,000 metres (9,800 ft). It is rare overall,

but may be locally abundant. It is becoming rarer, particularly in the north of its distribution, largely due to increasingly intensive agriculture. In more upland regions, it may also be found on nutrient-poor moors and heaths.



Habitat (*Festuco-Genistetum sagittalis*) - Schwäbisch-Fränkischer Wald, Germany





Form

A. montana has tall stems, 20–60 centimetres (7.9–24 in) high, supporting usually a single flower head. Most of the leaves are in a basal rosette, but one or two pairs may be found on the stem and are, unusually for composites, opposite. The flower heads are yellow, approximately 5 cm in diameter, and appear from May to August.

Uses and toxicity

Arnica montana
5-8mm long



Seeds

Arnica montana is sometimes grown in herb gardens and has long been used medicinally. It contains the toxin helenalin, which can be poisonous if large amounts of the plant are eaten. It produces severe gastroenteritis and internal bleeding of the digestive tract if enough material is ingested. Contact with the plant can also cause skin irritation. The roots contain derivatives of thymol, which are used as fungicides and preservatives and may have some anti-inflammatory effect. When used topically in a gel, arnica was found to have the same effect as the use of NSAIDs (such as ibuprofen) in treating the symptoms of hand osteoarthritis.





A scientific study found that the application of topical arnica had no better effect than a placebo in the treatment of laser-induced bruising. Reputable bodies such as the Royal Society of Medicine have also found arnica to be "no better than placebo" in treating bruising and swelling. The RSM suggests that its claimed benefits could be due to positive selection bias and that tests such as the previously mentioned study that supposedly prove its efficacy could perhaps be false due to factors such as methodological limitations.

Chapter- 8

Artemisia Annua

Artemisia annua



Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Asterids
Order:	Asterales
Family:	Asteraceae
Genus:	<i>Artemisia</i>
Species:	<i>A. annua</i>

Artemisia annua, also known as **Sweet Wormwood**, **Sweet Annie**, **Sweet Sagewort** or **Annual Wormwood** (Chinese: 青蒿; pinyin: *qīnghāo*), is a common type of wormwood that is native to temperate Asia, but naturalized throughout the world.

Characteristics

It has fern-like leaves, bright yellow flowers, and a camphor-like scent. Its height averages about 2 m tall, and the plant has a single stem, alternating branches, and alternating leaves which range 2.5–5 cm in length. It is cross-pollinated by wind or insects. It is a diploid plant with chromosome number, $2n=18$.

Medicinal uses

Sweet Wormwood was used by Chinese herbalists in ancient times to treat fever, but had fallen out of common use, but was rediscovered in 1970's when the *Chinese Handbook of Prescriptions for Emergency Treatments* (340 AD) was found. This pharmacopeia contained recipes for a tea from dried leaves, prescribed for fevers (not specifically malaria).

Extractions

In 1971, scientists demonstrated that the plant extracts had antimalarial activity in primate models, and in 1972 the active ingredient, artemisinin (formerly referred to as *arteannuin*), was isolated and its chemical structure described. Artemisinin may be extracted using a low boiling point solvent such as diethylether and is found in the glandular trichomes of the leaves, stems, and inflorescences, and it is concentrated in the upper portions of plant within new growth.

Parasite treatment

It is commonly used in tropical nations which can afford it, preferentially as part of a combination-cocktail with other antimalarials in order to prevent the development of parasite resistance.

Malaria treatment



Qinghao (*Artemisia annua*) has been long used as antimalarial herb in China

Artemisinin itself is a sesquiterpene lactone with an endoperoxide bridge and has been produced semi-synthetically as an antimalarial drug. The efficacy of tea made from *A. annua* in the treatment of malaria is contentious. According to some authors, artemisinin is not soluble in water and the concentrations in these infusions are considered insufficient to treatment malaria. Other researchers have claimed that *Artemisia annua* contains a cocktail of anti-malarial substances, and insist that clinical trials be conducted to demonstrate scientifically that artemisia tea is effective in treating malaria. This simpler use may be a cheaper alternative to commercial pharmaceuticals, and may enable health dispensaries in the tropics to be more self-reliant in their malaria treatment. In 2004, the Ethiopian Ministry of Health changed Ethiopia's first line anti-malaria drug from Fansidar, a Sulfadoxine agent which has an average 36% treatment failure rate, to Coartem, a drug therapy containing artemisinin which is 100% effective when used correctly, despite a worldwide shortage at the time of the needed derivative from *A. annua*.





Artemisia annua habitus



Artemisia annua: detail of a inflorescence



Seeds

Cancer treatment

The plant has also been shown to have anti-cancer properties. It is said to have the ability to be selectively toxic to some breast cancer cells [Cancer Research 65:(23).Dec 1, 2005] and some form of prostate cancer, there have been exciting preclinical results against leukemia, and other cancer cells.

Mechanism

The proposed mechanism of action of artemisinin involves cleavage of endoperoxide bridges by iron producing free radicals (hypervalent iron-oxo species, epoxides, aldehydes, and dicarbonyl compounds) which damage biological macromolecules causing oxidative stress in the cells of the parasite. Malaria is caused by Apicomplexans, primarily Plasmodium falciparum, which largely resides in red blood cells and itself contains iron-rich heme-groups (in the form of hemozoin).

Other uses

In modern-day central China, specifically Hubei Province, the stems of this wormwood are used as food in a salad-like form. The final product, literally termed "cold-mixed wormwood", is a slightly bitter salad with strong acid overtones from the spiced rice vinegar used as a marinade. It is considered a delicacy and is typically more expensive to buy than meat.

Chapter- 9

Artemisia Absinthium

Artemisia absinthium



Artemisia absinthium growing wild in the Caucasus

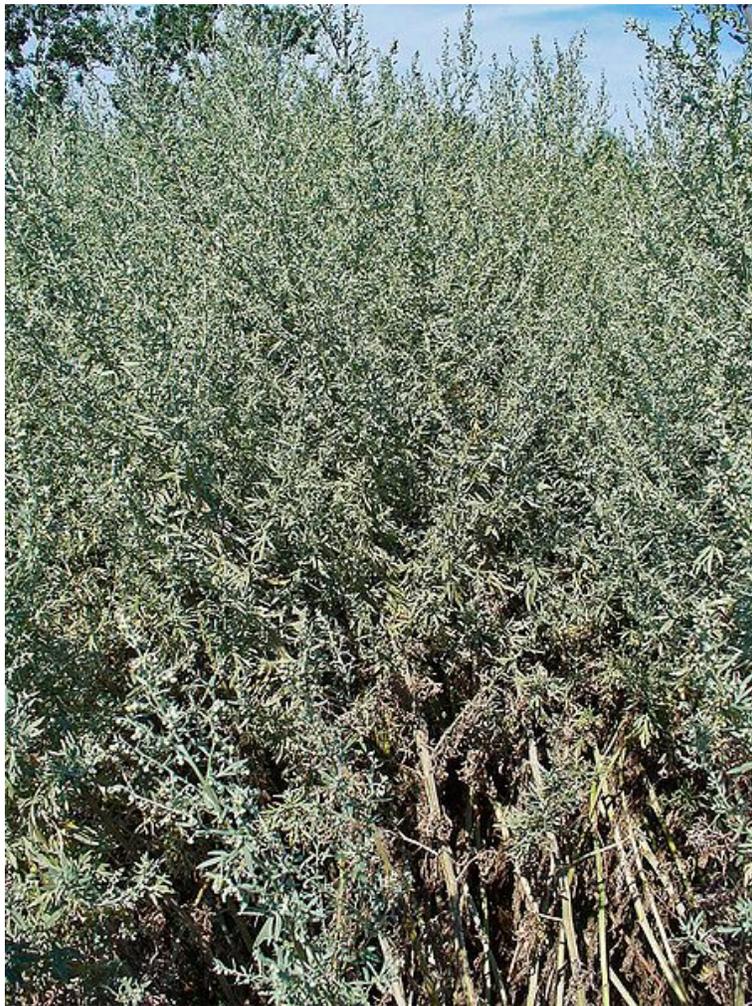
Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Asterids
Order:	Asterales
Family:	Asteraceae
Genus:	<i>Artemisia</i>
Species:	<i>A. absinthium</i>

***Artemisia absinthium* (absinthium, absinthe wormwood, wormwood, common wormwood, Green Ginger or grand wormwood)** is a species of wormwood, native to temperate regions of Eurasia and northern Africa.

It is a herbaceous perennial plant with a hard, woody rhizome. The stems are straight, growing to 0.8-1.2 m (rarely 1.5 m) tall, grooved, branched, and silvery-green. The leaves are spirally arranged, greenish-grey above and white below, covered with silky silvery-white trichomes, and bearing minute oil-producing glands; the basal leaves are up to 25 cm long, bipinnate to tripinnate with long petioles, with the cauline leaves (those on the stem) smaller, 5–10 cm long, less divided, and with short petioles; the uppermost leaves can be both simple and sessile (without a petiole). Its flowers are pale yellow, tubular, and clustered in spherical bent-down heads (capitula), which are in turn clustered in leafy and branched panicles. Flowering is from early summer to early autumn; pollination is anemophilous. The fruit is a small achene; seed dispersal is by gravity.

It grows naturally on uncultivated, arid ground, on rocky slopes, and at the edge of footpaths and fields.







Cultivation and uses



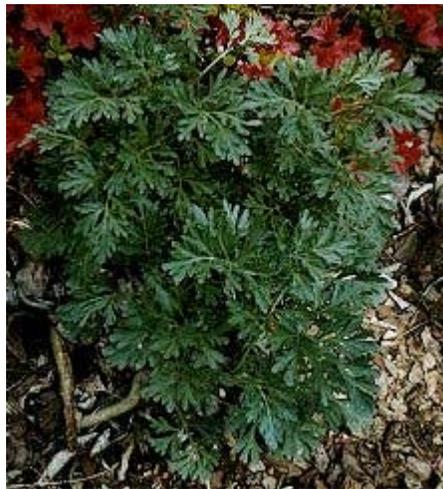
Artemisia absinthium. Inflorescence

The plant can easily be cultivated in dry soil. It should be planted under bright exposure in fertile, mid-weight soil. It prefers soil rich in nitrogen. It can be propagated by growth (ripened cuttings taken in March or October in temperate climates) or by seeds in nursery beds. It is naturalised in some areas away from its native range, including much of North America.

The plant's characteristic odor can make it useful for making a plant spray against pests. It is used in companion planting to suppress weeds, because its roots secrete substances that inhibit the growth of surrounding plants. It can repel insect larvae when planted on the edge of the cultivated area. It has also been used to repel fleas and moths indoors.

It is an ingredient in the spirit absinthe, and also used for flavouring in some other spirits and wines, including bitters, vermouth and pelinkovac. In the Middle Ages it was used to spice mead. In 18th century England, wormwood was sometimes used instead of hops in beer.

Wormwood is the traditional color and flavor agent for green songpyeon (a type of *dduk/tteok*, or steamed dumpling/'cookie' made of fine rice flour), eaten during the Korean thanksgiving festival of *chuseok* in the Autumn. Wormwood is picked in the spring when it is still young. The juice from macerated fresh (or reconstituted dry) provides the coloring and flavoring ingredient in the dough prepared to make green songpyeon. The other traditional color for these small desserts is white, made with rice flour dough sans wormwood extract.





It is also an additional ingredient to mint tea in Moroccan tea culture.

Therapeutic uses

The leaves and flowering tops are gathered when the plant is in full bloom, and dried naturally or with artificial heat. Its active substances include silica, two bitter substances (absinthin and anabsinthine), thujone, tannic and resinous substances, malic acid, and succinic acid. It is used medicinally as a tonic, stomachic, antiseptic, antispasmodic, carminative, cholagogue, febrifuge and anthelmintic. It has also been used to remedy indigestion and gastric pain. Wormwood tea is used as a remedy for labor pain. A dried encapsulated form of the plant is used as an anthelmintic. Consumption of the herb is thought by some to help induce lucid dreaming.

A wine can also be made by macerating the herb. It is also available in powder form and as a tincture. The oil of the plant can be used as a cardiac stimulant to improve blood circulation. Pure wormwood oil is very poisonous, but with proper dosage poses little or no danger. Wormwood is mostly a stomach medicine.

Etymology and folklore

Artemisia comes from Ancient Greek ἀρτεμισία, from Ἄρτεμις (Artemis). In Hellenistic culture, Artemis was a goddess of the hunt, and protector of the forest and children.

Absinthium comes from Ancient Greek ἄψινθιον (apsinthion), possibly meaning "unenjoyable", and probably referring to the bitter nature of the derived beverage. Consider the following quote by Lucretius found in *Institutio Oratoria*, an ancient work on rhetoric by the philosopher Quintilian:

"And as physicians when they seek to give
A draught of **bitter** wormwood to a child,
First smearing along the edge that rims the cup
The liquid sweets of honey, golden-hued,"

The word "wormwood" comes from Middle English "wormwode" or "wermode". The form "wormwood" is influenced by the traditional use as a cure for intestinal worms. Webster's Third New International Dictionary attributes the etymology to Old English "wermōd" (compare with German *Wermut* and the derived drink *vermouth*), which the OED (*s.v.*) marks as "of obscure origin". An alternative explanation dubiously combines the Old English "wer", meaning "man" (as in "werewolf"), with Old English "mōd", meaning "mood".

Wormwood is mentioned seven times in the Jewish Bible and once in the New Testament, always with the implication of bitterness.

Chapter- 10

Cannabis Sativa

Cannabis sativa



Scientific classification

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magnoliopsida
Order:	Rosales
Family:	Cannabaceae
Genus:	<i>Cannabis</i>
Species:	<i>C. sativa</i>

Subspecies

- C. sativa* subsp. *sativa*
- C. sativa* subsp. *indica*

Cannabis sativa is an annual plant in the Cannabaceae family. Humans have cultivated this herb throughout recorded history as a source of industrial fibre, seed oil, and food. Humans have long used the plant as a drug, as medicine, and as a spiritual tool. Each part of the plant is harvested differently, depending on the purpose of its use.

Common uses



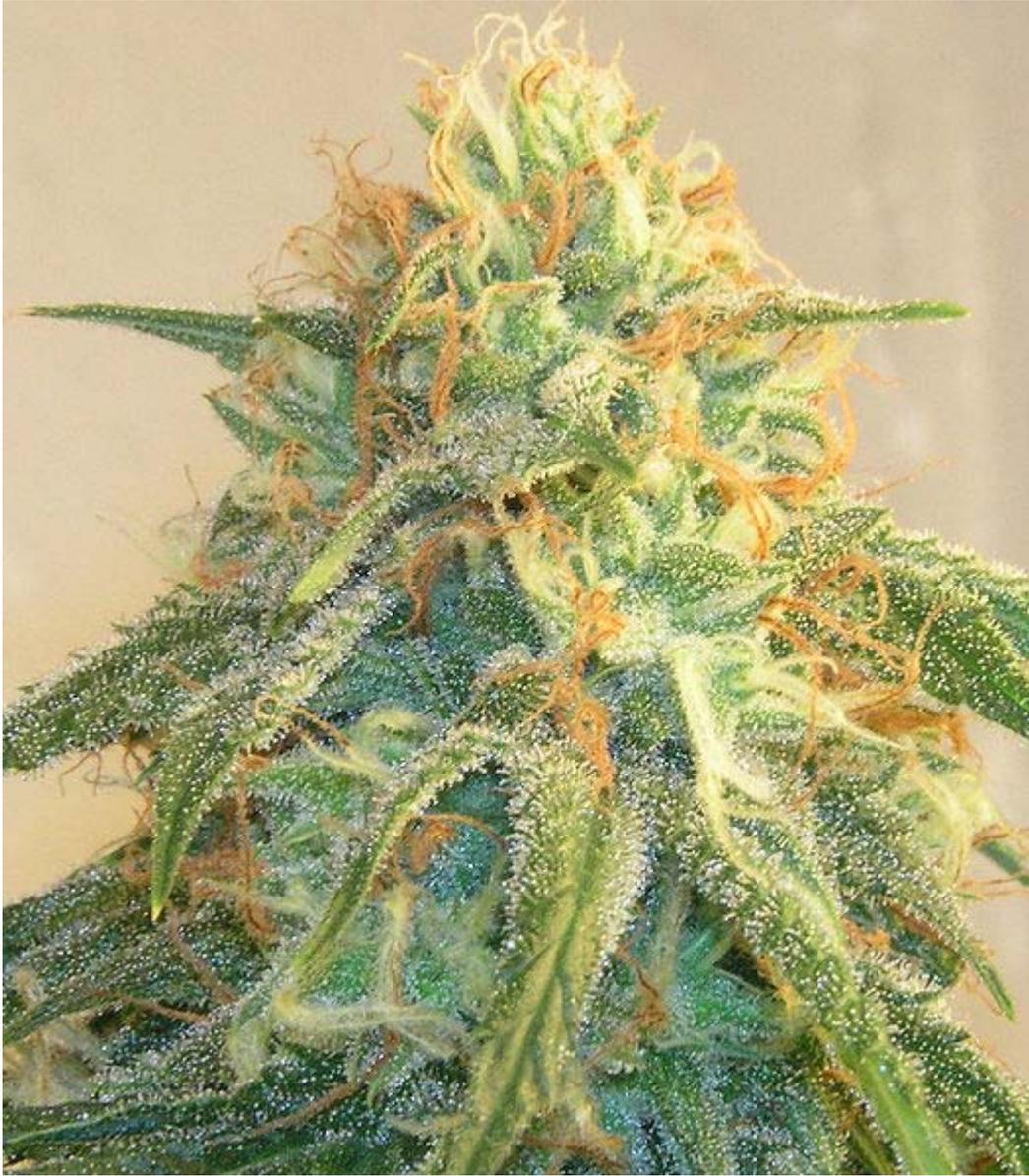
A sack made from hemp fiber

Its seed, chiefly used as caged-bird feed, is a valuable source of protein. The flowers (and to a lesser extent the leaves, stems, and seeds) contain psychoactive and physiologically active chemical compounds known as cannabinoids that are consumed for recreational, medicinal, and spiritual purposes. When so used, preparations of flowers (marijuana) and leaves and preparations derived from resinous extract (hashish) are consumed by smoking, vaporizing and oral ingestion. Historically, tinctures, teas, and ointments have also been common preparations.





Plant physiology



The bud of a *Cannabis sativa* plant



Cannabis sativa, scientific drawing from c1900

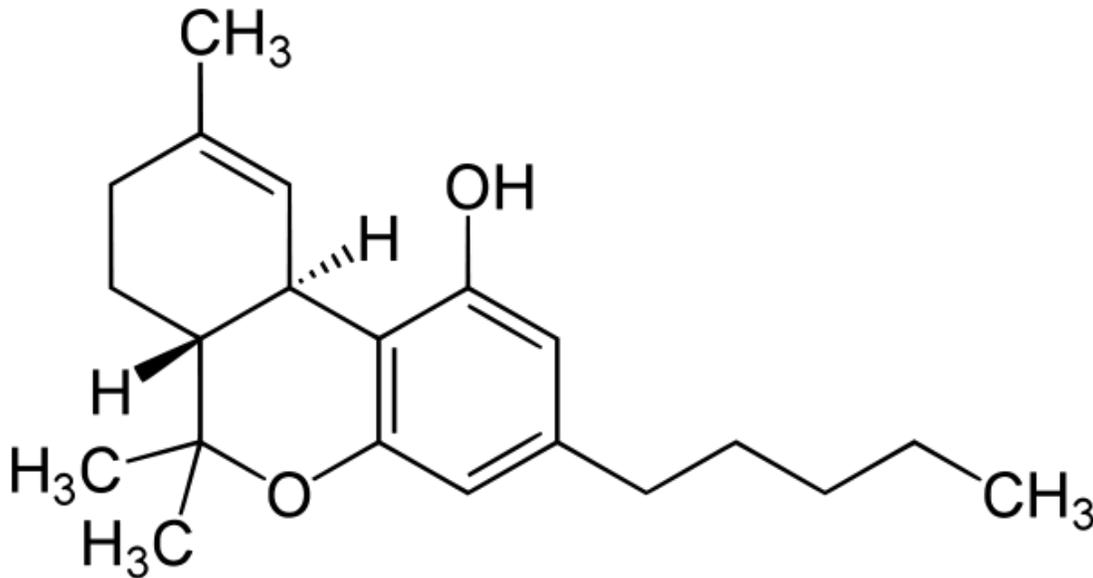
The flowers of the female plant are arranged in racemes and can produce hundreds of seeds. Male plants shed their pollen and die several weeks prior to seed ripening on the female plants. Although genetic factors dispose a plant to become male or female, environmental factors including the diurnal light cycle can alter sexual expression. Naturally occurring monoecious plants, with both male and female parts, are either sterile or fertile but artificially induced "hermaphrodites" (a commonly used misnomer) can have fully functional reproductive organs. "Feminized" seed sold by many commercial seed suppliers are derived from artificially "hermaphroditic" females that lack the male gene, or by treating the seeds with hormones or silver thiosulfate.

A *Cannabis* plant in the vegetative growth phase of its life requires more than 12–13 hours of light per day to stay vegetative. Flowering usually occurs when darkness equals at least 12 hours per day. The flowering cycle can last anywhere between nine to fifteen weeks, depending on the strain and environmental conditions.

In soil, the optimum pH for the plant is 6.3 to 6.8. In hydroponic growing, the nutrient solution is best at 5.2 to 5.8, making *Cannabis* well-suited to hydroponics because this pH range is hostile to most bacteria and fungi.

- Cultivars primarily cultivated for their fiber, characterized by long stems and little branching.
- Cultivars grown for seed from which hemp oil is extracted.
- Cultivars grown for medicinal or recreational purposes. A nominal if not legal distinction is often made between industrial hemp, with concentrations of psychoactive compounds far too low to be useful for that purpose, and it is also known as marijuana.

Pharmacology



Δ^9 -tetrahydrocannabinol (THC)

Although the main psychoactive chemical compound in *Cannabis* is Δ^9 -tetrahydrocannabinol (THC), the plant is known to contain about sixty cannabinoids; however, most of these "minor" cannabinoids are only produced in trace amounts. Besides THC, another cannabinoid produced in high concentrations by some plants is cannabidiol (CBD), which is not psychoactive but has recently been shown to block the effect of THC in the nervous system. Differences in the chemical composition of *Cannabis* varieties may produce different effects in humans. Synthetic THC, called

dronabinol, does not contain CBD, CBN, or other cannabinoids, which is one reason why its pharmacological effects may differ significantly from those of natural *Cannabis* preparations.





Chemical constituents

Cannabis chemical constituents including about 100 compounds responsible for its characteristic aroma. These are mainly volatile terpenes and sesquiterpenes.

- Δ^9 -Tetrahydrocannabinol
- α -Pinene
- Myrcene
- Trans- β -ocimene
- α -Terpinolene
- Trans-caryophyllene
- α -Humulene, contributes to the characteristic aroma of *Cannabis sativa*
- Caryophyllene-oxide, with which some hashish detection dogs are trained

Chapter- 11

Crataegus

Hawthorn



Fruit of four different species of
Crataegus

Scientific classification

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Rosales
Family: Rosaceae
Subfamily: Maloideae or
Spiraeoideae
Tribe: Pyreae or Crataegeae
Subtribe: Pyrinae
Genus: ***Crataegus***
Tourn. ex L.

Crataegus, commonly called **hawthorn** or **thornapple**, is a large genus of shrubs and trees in the rose family, Rosaceae, native to temperate regions of the Northern Hemisphere in Europe, Asia and North America. The White hawthorn (*C. punctata*) is the state flower of Missouri. The name *hawthorn* was originally applied to the species native to northern Europe, especially the Common Hawthorn *C. monogyna*, and the unmodified name is often so used in Britain and Ireland. However the name is now also applied to the entire genus, and also to the related Asian genus *Rhaphiolepis*.



Plant of *Crataegus monogyna*



Close up of the flowers of *C. monogyna*

They are shrubs or small trees, mostly growing to 5–15 m tall, with small pome fruit and (usually) thorny branches. The most common type of bark is smooth grey in young individuals, developing shallow longitudinal fissures with narrow ridges in older trees. The thorns are small sharp-tipped branches that arise either from other branches or from the trunk, and are typically 1–3 cm long (recorded as up to 11.5 cm in one case^{page 97}). The leaves grow spirally arranged on long shoots, and in clusters on spur shoots on the branches or twigs. The leaves of most species have lobed or serrate margins and are somewhat variable in shape. The fruit, sometimes known as a "haw", is berry-like, but structurally a pome containing from 1 to 5 pyrenes that resemble the "stones" of plums, peaches, etc. which are drupaceous fruit in the same subfamily.

Hawthorns provide food and shelter for many species of birds and mammals, and the flowers are important for many nectar-feeding insects. Hawthorns are also used as food plants by the larvae of a large number of Lepidoptera species. Haws are important for wildlife in winter, particularly thrushes and waxwings; these birds eat the haws and disperse the seeds in their droppings.

Many species and hybrids are used as ornamental and street trees. The Common Hawthorn is extensively used in Europe as a hedge plant. Several cultivars of the Midland Hawthorn *C. laevigata* have been selected for their pink or red flowers. Hawthorns are among the trees most recommended for water conservation landscapes.

Taxonomy

The number of species in the genus depends on taxonomic interpretation. Some botanists in the past recognised a thousand or more species, many of which are apomictic microspecies. It is estimated that a reasonable number is 200 species, but it is not yet clear how many species should be recognized because "a large portion of the synonymy, especially in North American *Crataegus*, has not been worked out."

Selected species

- *Crataegus aemula* - Rome Hawthorn
- *Crataegus aestivalis* - May Hawthorn
- *Crataegus altaica* - Altai Hawthorn
- *Crataegus ambigua* - Russian Hawthorn
- *Crataegus ambitiosa* - Grand Rapids Hawthorn
- *Crataegus anamesa* - Fort Bend Hawthorn
- *Crataegus ancisa* - Mississippi Hawthorn
- *Crataegus annosa* - Phoenix City Hawthorn
- *Crataegus apiifolia* - illegitimate name
- *Crataegus apiomorpha* - Fort Sheridan Hawthorn
- *Crataegus aprica* - Sunny Hawthorn
- *Crataegus arborea* - Montgomery Hawthorn
- *Crataegus arcana* - Carolina Hawthorn
- *Crataegus arnoldiana*
- *Crataegus ater* - Nashville Hawthorn
- *Crataegus austromontana* - Valley Head Hawthorn
- *Crataegus azarolus* - Azarole Hawthorn
- *Crataegus berberifolia*
- *Crataegus biltmoreana*
- *Crataegus boyntonii*
- *Crataegus brachyacantha* - Blueberry Haw
- *Crataegus calpodendron* - Late Hawthorn
- *Crataegus canbyi*
- *Crataegus chlorosarca*

- *Crataegus chrysoarpa*
- *Crataegus coccinea*
- *Crataegus coccinioides*
- *Crataegus collina*
- *Crataegus columbiana*
- *Crataegus compta*
- *Crataegus crus-galli* - Cockspur Thorn
- *Crataegus cuneata* - Japanese Hawthorn
- *Crataegus cupulifera*
- *Crataegus dahurica*
- *Crataegus douglasii* - Black Hawthorn, Douglas hawthorn
- *Crataegus dsungarica* (*C. ×dsungarica*)
- *Crataegus ellwangeriana*
- *Crataegus erythropoda*
- *Crataegus flabellata*
- *Crataegus flava* - Yellow-fruited Hawthorn
- *Crataegus fontanesiana*
- *Crataegus harbisonii*
- *Crataegus heldreichii*
- *Crataegus heterophylla* - Various-leaved Hawthorn
- *Crataegus holmesiana*
- *Crataegus hupehensis*
- *Crataegus intricata* - Thicket Hawthorn, Intricate Hawthorn
- *Crataegus iracunda*
- *Crataegus jackii*
- *Crataegus jonesae*
- *Crataegus laevigata* - Midland Hawthorn- English Hawthorn
- *Crataegus lavalleyi* (*C. ×lavalleyi*)
- *Crataegus lepida*
- *Crataegus macrocarpa* (*C. ×macrocarpa*)
- *Crataegus macrosperma*
- *Crataegus marshallii* - Parsley-leaved Hawthorn
- *Crataegus maximowiczii*
- *Crataegus mercerensis*
- *Crataegus mexicana* - tejocote,
- *Crataegus mollis* - Downy Hawthorn
- *Crataegus monogyna* - Common Hawthorn
- *Crataegus nigra* - Hungarian Hawthorn
- *Crataegus okanaganensis*
- *Crataegus orientalis*
- *Crataegus oxyacantha* - rejected name
- *Crataegus pedicellata* - Scarlet Hawthorn
- *Crataegus pentagyna*
- *Crataegus peregrina*
- *Crataegus phaenopyrum* - Washington Hawthorn
- *Crataegus phippsii*

- *Crataegus pinnatifida* - Chinese Hawthorn
- *Crataegus pruinosa* - Frosted Hawthorn
- *Crataegus pulcherrima*
- *Crataegus punctata* - Dotted Hawthorn, White Haw
- *Crataegus putnamiana*
- *Crataegus rhipidophylla*
- *Crataegus rivularis*
- *Crataegus saligna*
- *Crataegus sanguinea* - Redhaw Hawthorn
- *Crataegus sargentii*
- *Crataegus scabrida*
- *Crataegus scabrifolia*
- *Crataegus sinaica* - (*C. ×sinaica*) - Za'rur
- *Crataegus songarica*
- *Crataegus spathulata* - Littlehip Hawthorn
- *Crataegus submollis*
- *Crataegus succulenta* - Fleshy Hawthorn
- *Crataegus tanacetifolia*
- *Crataegus tracyi*
- *Crataegus triflora*
- *Crataegus uniflora*
- *Crataegus vailiae* (*C. ×vailiae*)
- *Crataegus viridis* - Green Hawthorn, including cultivar 'Winter King'
- *Crataegus visenda*
- *Crataegus vulsa*
- *Crataegus wattiana*
- *Crataegus wilsonii*

Some horticulturally important hybrids

- *Crataegus × lavalleyi* Lavallée hawthorn, including *Crataegus × carrieri*
- *Crataegus × media* the name for *C. monogyna*–*C. laevigata* hybrids
- *Crataegus × mordenensis* Morden hawthorn, including 'Toba' and 'Snowbird'
- *Crataegus × grignonensis* Grignon hawthorn, an unpublished name
- *Crataegus × smithiana* Red Mexican hawthorn, an unpublished name
- *Crataegus × ariifolia* (= *C. ariaefolia*)

Propagation

Although it is commonly stated that hawthorns can be propagated by cutting, this is difficult to achieve with rootless stem pieces. Small plants or suckers are often transplanted from the wild. Seeds require stratification and take one or two years to germinate. Seed germination is improved if the pyrenes that contain the seed are

subjected to extensive drying at room temperature, before stratification. Uncommon forms can be grafted onto seedlings of other species.



The fruit of Common Hawthorn (*C. monogyna*)



Spring flowers, probably of the hybrid *C. laevigata x monogyna*

Uses

Culinary use

The fruits of the species *Crataegus pinnatifida* (Chinese Hawthorn) are tart, bright red, and resemble small crabapple fruits. They are used to make many kinds of Chinese snacks, including haw flakes and *tanghulu* (糖葫芦). The fruits, which are called *shānzhā* (山楂) in Chinese, are also used to produce jams, jellies, juices, alcoholic beverages, and other drinks. In South Korea, a liquor called *sansachun* (산사춘) is made from the fruits.

The fruits of *Crataegus pubescens* are known in Mexico as *tejocotes* and are eaten raw, cooked, or in jam during the winter months. They are stuffed in the *piñatas* broken during the traditional pre-Christmas celebration known as *Las Posadas*. They are also cooked with other fruits to prepare a Christmas punch. The mixture of *tejocote* paste, sugar, and chili powder produces a popular Mexican candy called *rielitos*, which is manufactured by several brands.

In the southern United States fruits of three native species are collectively known as mayhaws and are made into jellies which are considered a great delicacy. On Manitoulin Island in Canada, some red-fruited species are called **hawberries**. They are common there thanks to the island's distinctive alkaline soil. During the pioneer days, white settlers ate these fruits during the winter as the only remaining food supply. People born on the island are now called "haweaters".

In Iran, the fruits of *Crataegus azarolus* (var. *aronia*) are known as *zalzalak* and are eaten raw as a snack, or used as in a jam known by the same name.

The leaves are edible and, if picked in spring when still young, they are tender enough to be used in salads.

Medicinal use

Several species of hawthorn have been used in traditional medicine, and there is considerable interest in testing hawthorn products for evidence-based medicine. The products being tested are often derived from *C. monogyna*, *C. laevigata*, or related *Crataegus* species, "collectively known as hawthorn", not necessarily distinguishing between these species, which are very similar in appearance. A meta-analysis of previous studies concluded that there is evidence of benefit for an extract in treating chronic heart failure. A 2010 review cites the need for further study of the best dosages and concludes that although "many different theoretical interactions between *Crataegus* and orthodox medications have been postulated ... none have [yet] been substantiated.



Leaf of an unidentified American species



Pyrenes from the fruit of *C. punctata*



Unopened flower buds of *Crataegus monogyna*

The dried fruits of *Crataegus pinnatifida* (called *shān zhā* in Chinese) are used in naturopathic medicine and traditional Chinese medicine, primarily as a digestive aid. A closely related species, *Crataegus cuneata* (Japanese Hawthorn, called *sanzashi* in Japanese) is used in a similar manner. Other species (especially *Crataegus laevigata*) are used in herbal medicine where the plant is believed to strengthen cardiovascular function.

Another use of this herb is as a mild sedative in promotion of sleep. Hawthorn should not be used during pregnancy.

Active ingredients found in hawthorn include tannins, flavonoids (such as vitexin, rutin, quercetin, and hyperoside), oligomeric proanthocyanidins (OPCs, such as epicatechin, procyanidin, and particularly procyanidin B-2), flavone-C, triterpene acids (such ursolic acid, oleanolic acid, and crataegolic acid), and phenolic acids (such as caffeic acid, chlorogenic acid, and related phenolcarboxylic acids). Standardization of hawthorn products is based on content of flavonoids (2.2%) and OPCs (18.75%).

Human studies

Several pilot studies have assessed the ability of hawthorn to help improve exercise tolerance in people with NYHA class II cardiac insufficiency compared to placebo. One

experiment, at (300 mg/day) for 4 to 8 weeks, found no difference from placebo. The second study, including 78 subjects (600 mg/day) for 8 weeks, found "significant improvement in exercise tolerance" and lower blood pressure and heart rate during exercise. The third, including 32 subjects (900 mg/day) for 8 weeks, found improved exercise tolerance as well as a reduction in the "incidence and severity of symptoms such as dyspnea" and fatigue decreased by approximately 50%.

In the HERB-CHF (Hawthorn Extract Randomized Blinded Chronic HF Study) clinical study, 120 patients took 450 mg of hawthorn extract twice daily for 6 months in combination with standard therapy and a standardized exercise program. "No effects of hawthorn were seen on either quality-of-life endpoint (Tables 1 and 2), or when adjusted for LVEF".

One research program, consisting of 1,011 patients taking one tablet (standardized to 84.3 mg procyanidin) twice daily for 24 weeks, found "improvements in clinical symptoms (such as fatigue, palpitations, and exercise dyspnea), performance and exercise tolerance test, and ejection fraction".

Side effects

Overdose can cause cardiac arrhythmia and dangerously lower blood pressure. Milder side effects include nausea and sedation.

Other uses



Hawthorn rootstock on a medlar tree in Totnes, United Kingdom

The wood of some hawthorn species is very hard and resistant to rot. In rural North America it was prized for use as tool handles and fence posts.

Grafting

Hawthorn can also be used as a rootstock in the practice of grafting. It is graft-compatible with *Mespilus* (medlar), and with pear, and makes a hardier rootstock than quince, but the thorny suckering habit of the hawthorn can be problematic.

Seedlings of *Crataegus monogyna*, have been used to graft multiple species on the same trunk, such as Pink hawthorn, pear tree and medlar, the result being trees which give pink and white flowers in May and fruits during the summer. "Chip budding" has also been performed on hawthorn trunks in order to have several branches of several varieties on the same tree. Such trees can be seen in Vigo, Spain and in the north west of France (mainly in Brittany).

Folklore

The custom of employing the flowering branches for decorative purposes on the 1st of May is of very early origin; but since the adoption of the Gregorian calendar in 1752, the tree has rarely been in full bloom in England before the second week of that month. In the Scottish Highlands the flowers may be seen as late as the middle of June. The saying "Ne'er cast a clout til Mey's oot" conveys a warning not to shed any cloths (clothes) before the summer has fully arrived and the may flowers (hawthorn blossoms) are in full bloom.

The hawthorn has been regarded as the emblem of hope, and its branches are stated to have been carried by the ancient Greeks in wedding processions, and to have been used by them to deck the altar of Hymenaios. The supposition that the tree was the source of Jesus's crown of thorns gave rise doubtless to the tradition current (as of 1911) among the French peasantry that it utters groans and cries on Good Friday, and probably also to the old popular superstition in Great Britain and Ireland that ill-luck attended the uprooting of hawthorns. Branches of Glastonbury Thorn, (*C. monogyna* 'Biflora', sometimes called *C. oxyacantha* var. *praecox*), which flowers both in December and in spring, were formerly highly valued in England, on account of the legend that the tree was originally the staff of Joseph of Arimathea.

In Celtic lore, the hawthorn plant was used commonly for rune inscriptions along with Yew and Apple. It was once said to heal the broken heart. In Ireland, the red fruit is, or was in living memory, called the Johnny MacGorey or Magory.

Serbian and Croatian folklore notes hawthorn (Serbian *glog* / *glog*, Croatian *glog*) is particularly deadly to vampires, and stakes used for their slaying must be made from the wood of the thorn tree.

In Gaelic folklore, hawthorn (in Scottish Gaelic, *Sgitheach* and in Irish, *sceach*) 'marks the entrance to the otherworld' and is strongly associated with the fairies. Lore has it that it is very unlucky to cut the tree at any time other than when it is in bloom, however during this time it is commonly cut and decorated as a May Bush. This warning persists to modern times; it has been questioned by folklorist Bob Curran whether the ill luck of the De Lorean Motor Company was associated with the destruction of a fairy thorn to make way for a production facility.



Botanical drawing of *Crataegus laevigata* from Thomé's Flora von Deutschland, Österreich und der Schweiz, 1885

Hawthorn trees are often found beside cloutie wells; at these types of holy wells they are sometimes known as 'rag trees', for the strips of cloth which are tied to them as part of healing rituals. 'When all fruit fails, welcome haws' was once a common expression in Ireland.

Chapter- 12

Quince

Quince



Cydonia oblonga flowers

Scientific classification

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Rosales
Family: Rosaceae
Subfamily: Maloideae or
Spiraeoideae
Genus: *Cydonia*
Species: *C. oblonga*



Quince - *Cydonia oblonga* Mill



Quince

Quince, raw

Nutritional value per 100 g (3.5 oz)

Energy	238 kJ (57 kcal)
Carbohydrates	15.3 g
Sugars	12.53 g
Dietary fiber	1.9 g
Fat	.10 g

Protein	.4 g
Water	83.8 g
Vitamin A equiv.	40 µg (4%)
Niacin (Vit. B ₃)	0.2 mg (1%)
Vitamin B ₆	0.04 mg (3%)
Folate (Vit. B ₉)	8 µg (2%)
Vitamin C	15.0 mg (25%)
Calcium	8 mg (1%)
Iron	0.7 mg (6%)
Magnesium	8 mg (2%)
Phosphorus	17 mg (2%)
Potassium	197 mg (4%)
Sodium	4 mg (0%)

The **quince**, or *Cydonia oblonga*, is the sole member of the genus *Cydonia* and native to warm-temperate southwest Asia in the Caucasus region. It is a small deciduous tree, growing 5–8 m tall and 4–6 m wide, related to apples and pears, and like them has a pome fruit, which is bright golden yellow when mature, pear-shaped, 7–12 cm long and 6–9 cm broad.

The immature fruit is green with dense grey-white pubescence, most of which rubs off before maturity in late autumn when the fruit changes colour to yellow with hard, strongly perfumed flesh. The leaves are alternately arranged, simple, 6–11 cm long, with an entire margin and densely pubescent with fine white hairs. The flowers, produced in spring after the leaves, are white or pink, 5 cm across, with five petals.

Quince is used as a food plant by the larvae of some Lepidoptera species including Brown-tail, *Bucculatrix bechsteinella*, *Bucculatrix pomifoliella*, *Coleophora cerasivorella*, *Coleophora malivorella*, Green Pug and Winter Moth.

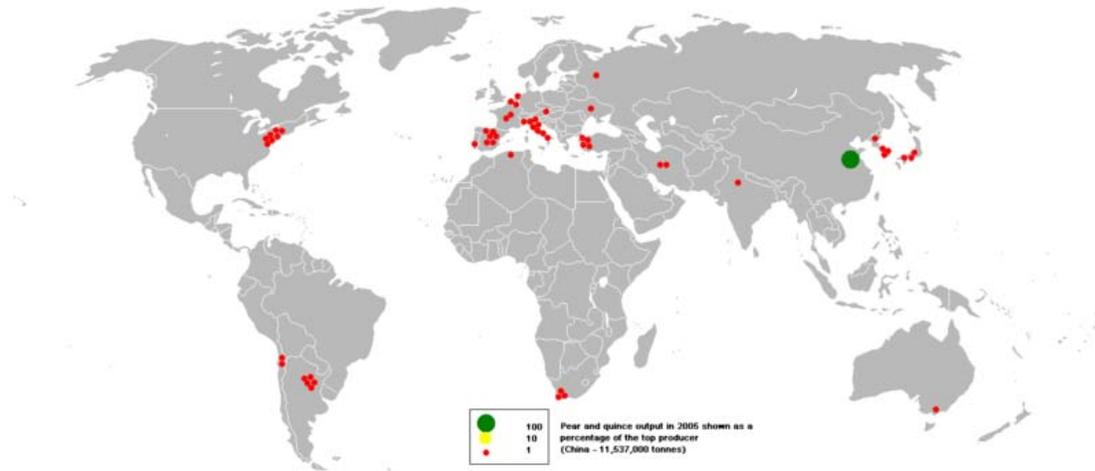
Four other species previously included in the genus *Cydonia* are now treated in separate genera. These are the Chinese Quince *Pseudocydonia sinensis*, a native of China, and the three flowering quinces of eastern Asia in the genus *Chaenomeles*. Another unrelated fruit, the Bael, is sometimes called the "Bengal Quince".

Turkey ranks first in world quince production by producing a quarter of the total world production.

List of the cultivars

Bereczki, Champion, Cooke's Jumbo (Syn. Jumbo), Dwarf Orange, Gamboa, Le Bourgeaut, Lescovacz, Ludovic, Maliformis, Meeches Prolific, Morava, Orange (Syn. Apple quince), Perfume, Pineapple, Portugal (Syn. Lusitanica), Siebosa, Smyrna, Van Deman, Vrajna (Syn. Bereczki).

Origins



Pear and quince output in 2005

The fruit was known to the Akkadians, who called it *supurgillu*; Arabic لجرفس *safarjal* "quinces" (collective plural). The modern name originated in the 14th century as a plural of *quoyne*, via Old French *cooin* from Latin *cotoneum malum* / *cydonium malum*, ultimately from Greek κυδώνιον μήλον, *kydonion melon* "Kydonian apple". The quince tree is native to Iran, Armenia, Azerbaijan, Georgia, Pakistan and was introduced to Syria, Croatia, Bosnia, Turkey, Serbia, Republic of Macedonia, Albania, Greece, Romania, Hungary, Ukraine and Bulgaria.

Cultivation of quince may have preceded apple culture, and many references translated to "apple", such as the fruit in *Song of Solomon*, may have been to a quince. Among the ancient Greeks, the quince was a ritual offering at weddings, for it had come from the Levant with Aphrodite and remained sacred to her. Plutarch reports that a Greek bride would nibble a quince to perfume her kiss before entering the bridal chamber, "in order that the first greeting may not be disagreeable nor unpleasant" (*Roman Questions* 3.65). It was a quince that Paris awarded Aphrodite. It was for a golden quince that Atalanta paused in her race. The Romans also used quinces; the Roman cookbook of Apicius gives recipes for stewing quince with honey, and even combining them, unexpectedly, with leeks. Pliny the Elder mentioned the one variety, Mulvian quince, that could be eaten raw. Columella mentioned three, one of which, the "golden apple" that may have been the

paradise fruit in the Garden of the Hesperides, has donated its name in Italian to the tomato, *pomodoro*.

Cultivation and uses



Quince foliage and ripening fruit

Quince is resistant to frost and requires a cold period below 7 °C to flower properly. The tree is self-fertile, however yield can benefit from cross-fertilization. The fruit can be left on the tree to ripen further which softens the fruit to the point where it can be eaten raw in warmer climates, but should be picked before the first frosts.

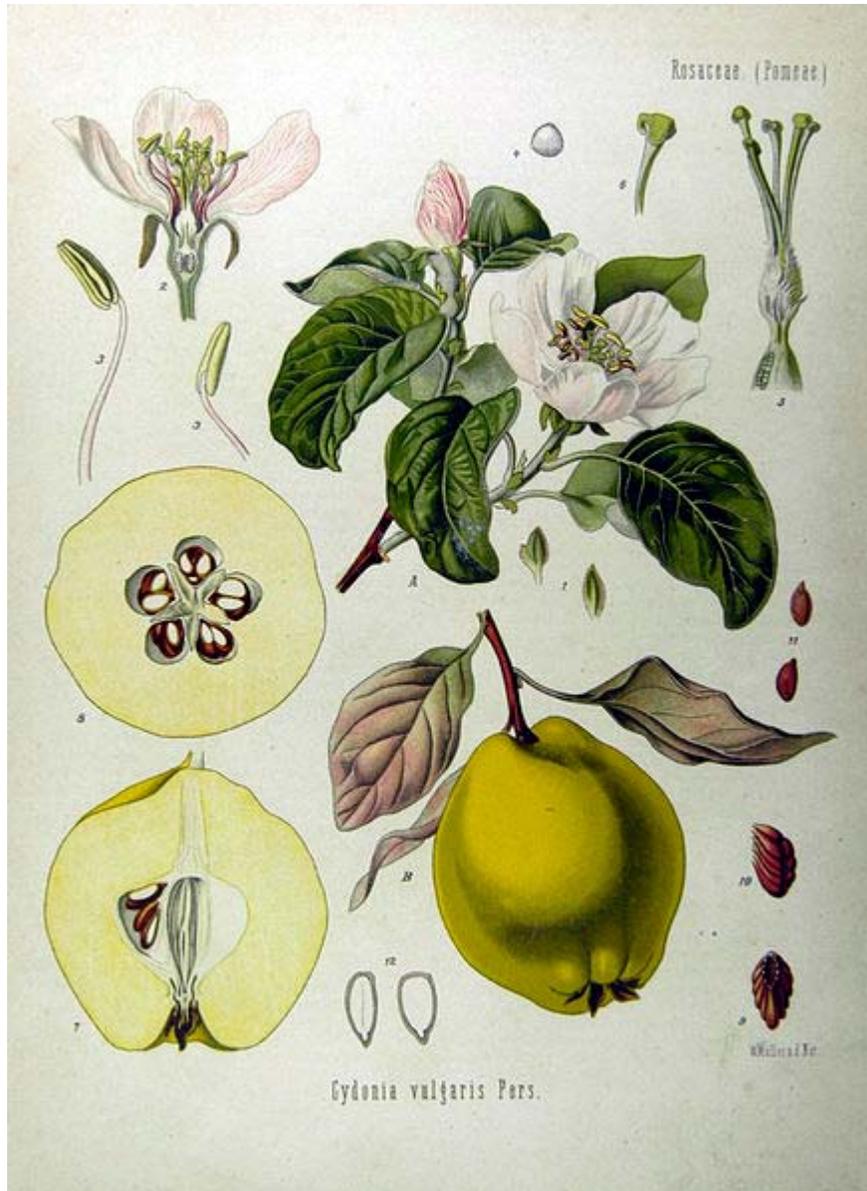
Most varieties of quince are too hard, astringent and sour to eat raw unless 'bled' (softened by frost and subsequent decay). They are used to make jam, jelly and quince pudding, or they may be peeled, then roasted, baked or stewed. The flesh of the fruit turns red after a long cooking time. The very strong perfume means they can be added in small quantities to apple pies and jam to enhance the flavour. Adding a diced quince to apple sauce will enhance the taste of the applesauce with the chunks of relatively firm, tart quince. The term "marmalade", originally meaning a quince jam, derives from "marmelo," the Portuguese word for this fruit. The fruit, like so many others, can be used to make a type of wine. Because of its often high acidity which is mainly due to its malic

acid content, these wines are more often than not sweet dessert wines that are high in alcohol.

In Iran and other parts of the Middle East, the dried pits of the fruit are used to treat sore throat and to relieve cough. The pits are soaked in water; the viscous product is then drunk like cough medicine. It is commonly used for children, as it is alcohol free and 100% natural. A variety of quince which is grown in the Middle East, does not require cooking and is often eaten raw.

In Europe, quinces are commonly grown in central and southern areas where the summers are sufficiently hot for the fruit to fully ripen. They are not grown in large amounts; typically one or two quince trees are grown in a mixed orchard with several apples and other fruit trees. Charlemagne directed that quinces be planted in well-stocked orchards. Quinces are mentioned for the first time in an English text in the later 13th century, though cultivation in England is not very successful due to inadequate summer heat to ripen the fruit fully. Instead *Chaenomeles* bushes are grown - their fruit is regarded as a good substitute for quinces and they are known commonly as quinces. Quince juice, *Quittensaft*, is a common drink in Germany, which is also where the saying "A quince for you, a quince for me, quinces we shall eat" is believed to have originated. In the Balkans and elsewhere quince brandy is made. In Slavonia, Croatia when a baby is born, quince tree gets planted as a symbol of fertility, love and life.

In Malta, a jam is made from the fruit (*gamm ta' l-isfargel*). According to local tradition, a teaspoon of the jam dissolved in a cup of boiling water relieves intestinal discomfort. In Lebanon, it is called *sfarjel* and also used to make jam. In Syria, quince is cooked in pomegranate paste (*dibs rouman*) with shank meat and *kibbeh* (a middle eastern meat pie with burghul and mince meat) and is called *kibbeh safarjalieh*. In Iran, quince is called *beh* (بِه) and is used raw or in stews and jam, and the seeds are used as a remedy for pneumonia and lung disease. In parts of Afghanistan, the quince seeds are collected and boiled and then ingested to combat pneumonia. In Pakistan quinces are stewed together with sugar until they turn bright red. The resulting stewed quince, called *Muraba* is then preserved in jars and eaten like jam.



Quince

Quince was also introduced to the New World and also Australia, in temperate states where in some locations it has grown wild, and New Zealand. It has become rare in North America due to its susceptibility to fireblight disease caused by the bacterium *Erwinia amylovora*. They are still widely grown in Argentina, Chile and Uruguay. Almost all of the quinces in North American specialty markets come from Argentina. In Latin America the gel-like, somewhat adhesive substance surrounding the seeds was used to shape and style hair.

In Argentina, Chile, Mexico, Spain, Uruguay and Venezuela the *membrillo*, as the quince is called in Spanish, is cooked into a reddish jelly-like block or firm reddish paste known as **dulce de membrillo**. It is then eaten in sandwiches and with cheese, traditionally

manchego cheese, or accompanying fresh curds. In Portugal, a similar sweet is called *marmelada*. It is also produced and consumed in Hungary where it is called "quince cheese". The sweet and floral notes of *carne de membrillo* (quince meat) contrast nicely with the tanginess of the cheese. Boiled quince is also popular in desserts such as the *murta con membrillo* that combines *ugni molinae* with quince. Similar dish exists in Dalmatia, Croatia.

Used as a rootstock for grafted plants, quince has the property of dwarfing the growth of pears, of forcing them to produce more precociously, and relatively more fruit-bearing branches, instead of vegetative growth, and of accelerating the maturity of the fruit.

In the Canary Islands and some places in South America a quince is used to play an informal beach toss-and-swim game, usually among young teens. When mixed with salt water a mature quince will turn its sour taste to sweet. The game is played by throwing a quince into the sea. All players race to catch the quince and whoever catches it, takes one bite and tosses the quince again, then the whole process gets repeated until the quince is fully eaten.

In the Alsace region of France and the Valais region of Switzerland *liqueur de coing* is made from quince and used as a *digestif*.

Quince can also be used as a tea additive to mainly green tea, giving it a rather sweetish taste and scent.

Cultural associations

- Although the book of Genesis does not name the specific type of the fruit that Adam and Eve ate from the tree of knowledge of good and evil in the garden of Eden, some ancient texts suggest that Eve's fruit of temptation might have been a quince. This was referenced during the Jeopardy scene of the film *White Men Can't Jump*.
- The film *El Sol del Membrillo* (1992) is a documentary about a painter, Antonio López García, who spends September through December painting a quince tree in his garden.
- In Edward Lear's famous poem "The Owl and the Pussycat" the protagonists "dined on mince and slices of quince, Which they ate with a runcible spoon".
- In Plutarch's *Lives*, Solon is said to have decreed that "bride and bridegroom shall be shut into a chamber, and eat a quince together."
- The quince and quince tree are the main symbol in Carmel Bird's short story "The Quince Tree".
- Popular song by a Bosnian band Indexi is named "Žute dunje" (Yellow Quinces).
- Quince is the closing track on Texan progressive metal band Fair to Midland's album *inter.funda.stifle*.

Toxicology

The seeds contain nitriles (RCN), which are common in seeds of the rose family. In the stomach, enzymes or stomach acid or both cause some of the nitriles to be hydrolyzed and produce HCN (hydrogen cyanide), which is a volatile gas. The seeds are only likely to be toxic if a large quantity is eaten.

Chapter- 13

Echinacea Purpurea

Echinacea purpurea



Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Asterids
Order:	Asterales
Family:	Asteraceae
Tribe:	Heliantheae
Genus:	<i>Echinacea</i>
Species:	<i>E. purpurea</i>

Synonyms

Brauneria purpurea (L.) Britt.
Echinacea purpurea (L.) Moench var.
arkansana Steyerm.
Rudbeckia purpurea L.

Echinacea purpurea (**Eastern purple coneflower** or **Purple coneflower**) is a species of flowering plant in the genus *Echinacea*. Its cone-shaped flowering heads are usually, but not always purple. It is native to eastern North America and present to some extent in the wild in much of the eastern, southeastern and midwest United States. It is also grown as

an ornamental plant, and numerous cultivars have been developed for flower quality and plant form.

Description

This perennial flowering plant is 1.2 m tall and 0.5 m wide at maturity. Depending on the climate, it begins to bloom in late May or early July. Its individual flowers (florets) within the flower head are hermaphroditic, having both male and female organs on each flower. It is pollinated by butterflies and bees. Its habitats include dry open woods, prairies and barrens, as well as cultivated beds. Although the plant prefers loamy or sandy, well-drained soils, it is little affected by the soil's pH. Unable to grow in the shade, *E. purpurea* thrives in either dry or moist soil and can tolerate drought, once established.

Cultivation

E. purpurea can be propagated either vegetatively or from seeds. Useful vegetative techniques include division, root cuttings, and basal cuttings. Clumps can be divided, or broken into smaller bunches, which is normally done in the spring or autumn. Cuttings made from roots that are "pencil-sized" will develop into plants when started in late autumn or early winter. Cuttings of basal shoots in the spring may be rooted when treated with rooting hormones.



Plants raised outdoors

Seed germination occurs best with daily temperature fluctuations or after stratification, which help to end dormancy. Seeds may be started indoors in advance of the growing season or outdoors after the growing season has started.

Predators

Slugs eat this plant.

Medicinal properties

One study shows *E. purpurea* has antidepressant properties in white rats as it increased the stimulating action of L-DOPA. Echinacea is known by many people to stimulate the immune system.



Closeup of *E. purpurea*, centre of the head showing many individual flowers



A stand of *E. purpurea*

Chapter- 14

Liquorice

Liquorice



Scientific classification

Kingdom: Plantae
(unranked): Angiosperms
(unranked): Eudicots
(unranked): Rosids
Order: Fabales
Family: Fabaceae
Subfamily: Faboideae
Tribe: Galegeae
Genus: *Glycyrrhiza*
Species: ***G. glabra***

Synonyms

- *Glycyrrhiza glandulifera*
Waldst. & Kit.

Liquorice or **licorice** is the root of *Glycyrrhiza glabra* from which a popular, somewhat sweet flavour can be extracted. The liquorice plant is a legume (related to beans and peas) that is native to southern Europe and parts of Asia. It is not related to anise, star anise, or fennel, which are the sources of similar-tasting flavouring compounds.

It is an herbaceous perennial, growing to 1 m in height, with pinnate leaves about 7–15 centimetres (3–6 in) long, with 9–17 leaflets. The flowers are 0.8–1.2 cm ($\frac{1}{2}$ – $\frac{1}{3}$ in) long, purple to pale whitish blue, produced in a loose inflorescence. The fruit is an oblong pod,

2–3 centimetres (1 in) long, containing several seeds. The flavor of liquorice comes mainly from a sweet-tasting compound called anethole ("trans"-1-methoxy-4-(prop-1-enyl)benzene), an aromatic, unsaturated ether compound also found in anise, fennel, and several other herbs. Much of the sweetness in liquorice comes from glycyrrhizin, a compound sweeter than sugar.

Cultivation and uses

Liquorice grows best in deep, fertile, well-drained soils, with full sun, and is harvested in the autumn, two to three years after planting.

Today, liquorice extract is produced by boiling liquorice root and subsequently evaporating most of the water. In fact, the name 'liquorice'/'licorice' is derived (via the Old French *licoresse*), from the Greek γλυκύρριζα (*glukurrhiza*), meaning "sweet root", from γλυκός (*glukus*), "sweet" + ῥίζα (*rhiza*), "root". Liquorice extract is traded both in solid and syrup form. Its active principle is glycyrrhizin, a sweetener between 30 to 50 times as sweet as sucrose which also has pharmaceutical effects.

Liquorice flavour is found in a wide variety of liquorice candies. The most popular in the United Kingdom are liquorice allsorts. In continental Europe, however, far stronger, saltier candies are preferred. In most of these candies the taste is reinforced by aniseed oil, and the actual content of liquorice is very low.

In the Netherlands, where liquorice candy ("drop") is one of the most popular forms of sweet, only a few of the many forms that are sold contain aniseed (although mixing it with mint, menthol or with laurel is popular, and mixing it with ammonium chloride creates the very popular salty liquorice known in Dutch as zoute drop.)

Pontefract in Yorkshire was the first place where liquorice mixed with sugar began to be used as a sweet in the same way it is in the modern day. Pontefract Cakes were originally made there. In Yorkshire and Lancashire it is colloquially known as *Spanish*, supposedly because Spanish monks grew liquorice root at Rievaulx Abbey near Thirsk.

Liquorice flavouring is also used in soft drinks, and in some herbal teas where it provides a sweet aftertaste. The flavour is common in medicines to disguise unpleasant flavours. Dutch youth often make their own "dropwater" (liquorice water) by putting a few pieces of laurel liquorice and a piece of liquorice root in a bottle with water and then shaking it to a frothy liquid.



Liquorice root

Liquorice is popular in Italy (particularly in the South) and Spain in its natural form. The root of the plant is simply dug up, washed and chewed as a mouth freshener. Throughout Italy unsweetened liquorice is consumed in the form of small black pieces made only from 100% pure liquorice extract; the taste is bitter and intense. In Calabria a popular liqueur is made from pure liquorice extract. Liquorice is also very popular in Syria where it is sold as a drink. Dried liquorice root can be chewed as a sweet. Black liquorice contains approximately 100 calories per ounce (15 kJ/g).

Chinese cuisine uses liquorice as a culinary spice for savoury foods. It is often employed to flavour broths and foods simmered in soy sauce.

Other herbs and spices of similar flavour include anise, star anise, tarragon, and fennel.

It is also the main ingredient of a very well known soft drink in Egypt, called سوسقورع ('erk-soos).

Sticks of liquorice typically have a diameter between two and ten millimetres. Although they resemble plain wooden sticks, they are soft enough to be chewed on. They used to be popular among Dutch, Danish and Swedish children. In Yorkshire in the early 1950s, wooden sticks of liquorice, around 8mm diameter, were readily available (and popular)

in sweet shops. They were bought as 'sticks of liquorice', and they were chewed by young children. The wood was yellowish, and fibrous when chewed. Liquorice root can have either a salty or sweet taste. The thin sticks are usually quite salty and sometimes taste like salmiak (salty liquorice), whereas the thick sticks are usually quite sweet, with a salty undertone. Liquorice root is also widely available in Denmark, especially in The Old Town of Århus. It is also sold by the drugstore and drysalter chain Matas and most greengrocers.

Use in medicine



Glycyrrhiza glabra from Koehler's *Medicinal-Plants*

The compound glycyrrhizic acid, found in liquorice, is now routinely used throughout Japan for the treatment and control of chronic viral hepatitis, and there is a possible transaminase-lowering effect. Hepatoprotective mechanisms have been demonstrated in mice. Recent studies indicate that glycyrrhizic acid disrupts latent Kaposi sarcoma (as also demonstrated with other herpesvirus infections in the active stage), exhibiting a strong anti-viral effect.



Sliver of liquorice root



Various liquorice root slivers



Liquorice root with bark



Liquorice spirit

Liquorice affects the body's endocrine system as it contains isoflavones (phytoestrogens). It might lower the amount of serum testosterone slightly, but whether it affects the amount of free testosterone is unclear. Consuming liquorice can prevent hyperkalemia. Large doses of glycyrrhizinic acid and glycyrrhetic acid in liquorice extract can lead to hypokalemia and serious increases in blood pressure, a syndrome known as apparent mineralocorticoid excess. These side effects stem from the inhibition of the enzyme 11 β -hydroxysteroid dehydrogenase (type 2) and subsequent increase in activity of cortisol on the kidney. 11 β -hydroxysteroid dehydrogenase normally inactivates cortisol in the kidney; thus, liquorice's inhibition of this enzyme makes the concentration of cortisol appear to increase. Cortisol acts at the same receptor as the hormone aldosterone in the kidney and the effects mimic aldosterone excess, although aldosterone remains low or normal during liquorice overdose. To decrease the chances of these serious side effects, deglycyrrhizinated liquorice preparations are available. The disabling of similar enzymes in the gut by glycyrrhizinic acid and glycyrrhetic acid also causes increased mucus and decreased acid secretion. It inhibits *Helicobacter pylori*, is used as an aid for healing stomach and duodenal ulcers, and in moderate amounts may soothe an upset stomach. Liquorice can be used to treat ileitis, leaky gut syndrome, irritable bowel syndrome and Crohn's disease as it is antispasmodic in the bowels.

The compounded carbenoxolone is derived from liquorice. Some studies indicate it may inhibit an enzyme in the brain that is involved in making stress-related hormones, which have been associated with age-related mental decline.

Use in alternative medicine

In traditional Chinese medicine, liquorice(甘草) is commonly used in herbal formulae to "harmonize" the other ingredients in the formula and to carry the formula to the twelve "regular meridians" and to relieve a spasmodic cough.

In herbalism it is used in the Hoxsey anti-cancer formula, and is a considered adaptogen which helps reregulate the hypothalamic-pituitary-adrenal axis. It can also be used for auto-immune conditions including lupus, scleroderma, rheumatoid arthritis and animal dander allergies.

Liquorice may be useful in conventional and naturopathic medicine for both mouth ulcers and peptic ulcers. Liquorice is also a mild laxative and may be used as a topical antiviral agent for shingles, ophthalmic, oral or genital herpes.

Uses with tobacco

Much liquorice production goes toward flavouring, sweetening and conditioning tobacco products. Liquorice adds a mellow, sweet woody flavour and enhances the taste of tobacco. The burning liquorice also generates some toxins found in the smoke, and the glycyrrhizin expands the airways, which allows users to inhale more smoke.

Toxicity

Excessive consumption of liquorice or liquorice candy is known to be toxic to the liver and cardiovascular system, and may produce hypertension and oedema. In occasional cases blood pressure has increased with excessive consumption of liquorice tea, but such occasions are rare and reversible when the herb is withdrawn. Most cases of hypertension from liquorice were caused by eating too much concentrated liquorice candy. Doses as low as 50 grams (2 oz) of liquorice daily for two weeks can cause a significant rise in blood pressure.

The European Commission 2008 report suggested that “people should not consume any more than 100mg of glycyrrhizic acid a day, for it can raise blood pressure or cause muscle weakness, chronic fatigue, headaches or swelling, and lower testosterone levels in men.” Haribo, manufacturer of Pontefract cakes, stated: “Haribo advises, as with any other food, liquorice products should be eaten in moderation.” A 56-year-old Yorkshire woman was hospitalized after liquorice overdose (200 grams or 7 oz a day), which caused muscle failure. The hospital restored her potassium levels, by intravenous drip and tablets, allowing her to recover after 4 days.

Comparative studies of pregnant women suggest that liquorice can also adversely affect both IQ and behaviour traits of offspring.