

Ginger - production & trade

Ginger or **ginger root** is the rhizome of the plant *Zingiber officinale*, consumed as a delicacy, medicine, or spice. It lends its name to its genus and family (Zingiberaceae). Other notable members of this plant family are turmeric, cardamom, and galangal. The distantly related dicots in the Asarum genus have the common name wild ginger because of their similar taste. Ginger is an important spice crop of the world. Ginger is an important spice in Asian and western cooking, and has an increasing reputation as a medicinal plant

Its scientific name is *Zingiber officinale*. It's a valuable cash crop and plays an important role in ayurvedic medicines in India. It has been used for cleaning body through perspiration, to calm down nausea, and to stimulate the appetite. Ginger tea is used as carminative and in the symptomatic treatment of colds. Ginger contains gingerol, an oleo resin that accounts for the characteristic aroma and therapeutic properties. Components of gingerol possess beneficial properties for the treatment of poor digestion, heart burn, vomiting and preventing motion sickness.

India is one of the prime producers of ginger. From pots in gardens to large-scale, mechanised operations, it is cultivated on a local and commercial scale. It is grown on a smaller extent in Bangladesh and Pakistan. In India there are at least 400 different cultivars, each with varying properties such as the level of potent ginger oil.

Climate and soil Requirements

Soil Requirements:

- Ginger adapts well to variety of Soils ranging from peat to light clays, but performs best on light textured soils.
- Soil should be loose and friable so that little resistance is encountered as the rhizomes develop.
- A friable loam, rich in humus is ideal for ginger while stiff clay is unsuitable
- It is important that the soils are well drained to avoid root rot.

Climatic Requirements

Growing outdoors in the tropics, it needs a minimum annual rainfall of 150cm, temperatures of 30°C or over, a short dry season and a deep fertile soil. It usually takes nine months to produce a crop.

- Ginger thrives in a hot moist climate.
- Annual rainfall in excess of 3,000mm accompanied by a prolonged hot season is preferred.
- Ginger requires a moist climate for optimum growth during the early Rapid growth phase.
- Ginger also requires along hot period for the development and maturity of rhizomes

Ginger requires tropical, subtropical and humid climate for its commercial production. It can be successfully grown to an altitude of 1500m.

A well distributed rainfall during growing season and dry season during the land preparation as well as before harvesting is required for good growth and yield of the crop.

Dry weather with a temperature range of 28-30 degree Centigrade for about a month before harvesting is ideal.

High humidity throughout the crop period is necessary. Ginger prefers good garden soil, rich in humus, light, loose, friable, well drained and of at least 30 cm depth. Rhizome growth is better on slightly acidic soil.

Seasonality

- Ginger is a seasonal crop
- Land preparation begins in July/ August followed by planting in September to November before the onset of the wet season.
- Mature ginger takes 9-11 months to mature and is harvested from July-December.
- Planting of immature ginger is usually completed by the end of September and the crop is harvested April.

Varieties

Most promising varieties of ginger are Himgiri, Varad, surbhi, suruchi, Ernas, Nadia, Maran, Rio de jenerio and China.

1. Canton Group

Preferred for fresh export because of its largest rhizome “knob” size with pale yellow flesh attractive appearance and is highly suitable for the fresh ginger market. Also commonly grown by Asian and Hawaiian producers.

2. Fijian Variety or Fiji Tall

Rhizomes have medium size elongated knobs and end to be high yielding. Cut rhizomes have a strong citrus like Aroma. It’s part of the Chinese group and in Australia includes”Queensland Ginger”. The latter is the fact believed to be originally Fiji ginger by origin.

The plant

Ginger plants can grow to about 1 m tall. The upright shoots sprout from the rhizome at the base of the plant.



Image: Ginger plant

Rhizomes - knobbly and fleshy, covered in ring-like scars. This is the important part for food and medicine. Although the rhizomes grow underground, they are swollen stems, not roots. This is why fresh ginger is often referred to as 'stem ginger'.

Flowers - the flowering spikes sprout directly from the rhizomes and are about 30 cm long. The flowers are purple with a cream-blotched base. Fruits - red in colour. Each has three chambers containing

several small black seeds. Ginger plants that are cultivated in commercial plantations don't usually bear fruit.

Ginger - plant profile

English	Name:	Ginger
Botanical	name:	<i>Zingiber</i>
Family:	Zingiberaceae,	the ginger family.

Botanical names are often derived from their ancient names. The word *Zingiber* is a good example. It is thought to come from the Sanskrit word *singabera* which was from Arabic and Greek words meaning 'shaped like a horn'. It probably got its name because the rhizomes look like deer's antlers.

Ginger is a low-growing tropical plant which is easily grown indoors during the summer months in the UK. You can grow ginger plants from green ginger which you buy from supermarkets, although you are not likely to produce a big crop of rhizomes.

Ginger produces clusters of white and pink flower buds that bloom into yellow flowers. Because of its aesthetic appeal and the adaptation of the plant to warm climates, ginger is often used as landscaping around subtropical homes. It is a perennial reed-like plant with annual leafy stems, about a meter (3 to 4 feet) tall. Traditionally, the rhizome is gathered when the stalk withers; it is immediately scalded, or washed and scraped, to kill it and prevent sprouting. The fragrant perisperm of Zingiberaceae is used as sweetmeats by Bantu, also as a condiment and sialogogue.

Uses

Ginger produces a hot, fragrant kitchen spice. Young ginger rhizomes are juicy and fleshy with a very mild taste. They are often pickled in vinegar or sherry as a snack or just cooked as an ingredient in many dishes. They can also be steeped in boiling water to make ginger tea, to which honey is often added; sliced orange or lemon fruit may also be added. Ginger can also be made into candy, or ginger wine which has been made commercially since 1740.

Mature ginger rhizomes are fibrous and nearly dry. The juice from old ginger roots is extremely potent and is often used as a spice in Indian recipes, and is a quintessential ingredient of Chinese, Korean, Japanese and many South Asian cuisines for flavouring dishes such as seafood or goat meat and vegetarian cuisine.

Ginger acts as a useful food preservative.

Fresh ginger can be substituted for ground ginger at a ratio of 6 to 1, although the flavours of fresh and dried ginger are somewhat different. Powdered dry ginger root is typically used as a flavouring for recipes such as gingerbread, cookies, crackers and cakes, ginger ale, and ginger beer.

Candied ginger, or crystallized ginger, is the root cooked in sugar until soft, and is a type of confectionery.

Fresh ginger may be peeled before eating. For longer-term storage, the ginger can be placed in a plastic bag and refrigerated or frozen.

Regional use

In Western cuisine, ginger is traditionally used mainly in sweet foods such as ginger ale, gingerbread, ginger snaps, parkin, ginger biscuits and speculaas. A ginger-flavored liqueur called Canton is produced in Jarnac, France. Green ginger wine is a ginger-flavored wine produced in the United Kingdom, traditionally sold in a green glass bottle. Ginger is also used as a spice added to hot coffee and tea.



a) Ginger field

b) Fresh ginger rhizome.

c) Two varieties of ginger

Fresh ginger is one of the main spices used for making pulse and lentil curries and other vegetable preparations. Fresh, as well as dried, ginger is used to spice tea and coffee, especially in winter. Ginger powder is also used in certain food preparations, particularly for pregnant or nursing women, the most popular one being *katlu* which is a mixture of gum resin, ghee, nuts, and sugar. Ginger is also consumed in candied and pickled form. In Bangladesh, ginger is finely chopped or ground into a paste to use as a base for chicken and meat dishes alongside onion and garlic.

In Burma, ginger is widely used in cooking and as a main ingredient in traditional medicines. It is also consumed as a salad dish called *gyin-thot*, which consists of shredded ginger preserved in oil, and a variety of nuts and seeds. In Indonesia, a beverage called *wedang jahe* is made from ginger and palm sugar. Indonesians also use ground ginger root, called *jahe*, as a common ingredient in local recipes. In Malaysia, ginger is called *halia* and used in many kinds of dishes, especially a soup. In the Philippines it is brewed into a tea called *salabat*. In Vietnam, the fresh leaves, finely chopped, can also be added to shrimp-and-yam soup as a top garnish and spice to add a much subtler flavour of ginger than the chopped root.

In China, sliced or whole ginger root is often paired with savory dishes such as fish, and chopped ginger root is commonly paired with meat, when it is cooked. However, candied ginger is sometimes a component of Chinese candy boxes, and a tisane can also be prepared from ginger.

In Japan, ginger is pickled to make Beni shoga and gari or grated and used raw on tofu or noodles. It is also made into a candy called *shoga no sato zuke*. In the traditional Korean kimchi, ginger is either finely minced or just juiced in order to avoid the fibrous texture and added to the ingredients of the spicy paste just before the fermenting process.

In the Caribbean, ginger is a popular spice for cooking, and making drinks such as *sorrel*, a seasonal drink made during the Christmas season. Jamaicans make ginger beer both as a carbonated beverage and

also fresh in their homes. Ginger tea is often made from fresh ginger, as well as the famous regional specialty Jamaican ginger cake.

On the island of Corfu, Greece, a traditional drink, a type of ginger beer, is made. The people of Corfu and the rest of the Ionian Islands adopted the drink from the British, during the period of the United States of the Ionian Islands.

Preliminary research

Preliminary research indicates that nine compounds found in ginger may bind to human serotonin receptors which may influence gastrointestinal function.

In a 2010 study, daily consumption of ginger was shown to help ease muscle pain associated with exercise by 25%.

Ginger root supplement has been identified in one study to help reduce colon inflammation markers such as PGE2, thus indicating a measure that might affect colon cancer.

In limited studies, ginger was found to be more effective than placebo for treating nausea caused by seasickness, morning sickness and chemotherapy, although ginger was not found superior to placebo for pre-emptively treating post-operative nausea. Some studies advise against taking Ginger during pregnancy, this precautionary measure is based on studies suggesting that ginger is mutagenic, though some other studies have reported anti-mutagenic effects. Other preliminary studies showed that ginger may affect arthritis pain or have blood thinning and cholesterol lowering properties, but these effects remain unconfirmed.

Advanced glycation end-products are possibly associated in the development of diabetic cataract for which ginger was effective in preliminary studies, apparently by acting through antiglycating mechanisms.

Zingerone may have activity against enterotoxigenic *Escherichia coli* in enterotoxin-induced diarrhea.

- In Nepal, ginger is called *aduwa* and is widely grown and used throughout the country as a spice for vegetables, used medically to treat cold and also sometimes used to flavour tea.
- In the Philippines, ginger is known as *luya* is used as a throat lozenge in traditional medicine to relieve sore throat. It is also brewed into a tea known as *salabat*.
- In the United States, ginger is used to prevent motion and morning sickness. It is recognized as safe by the Food and Drug Administration and is sold as an unregulated dietary supplement. Ginger water is also used to avoid heat cramps.
- In Peru, ginger is sliced in hot water as an infusion for stomach aches as *infusión de Kión*.
- In Japan it is purported to aid blood circulation.^[38] Scientific studies investigating these effects have been inconclusive.

Cultivation

Ginger is usually cultivated vegetatively, which means pieces of rhizome are planted in the soil and each sprouts to form a new plant. Modern micro propagation is also being used where new plants are cloned from cells taken from a plant. The cloned offspring are then planted out in fields.



Propagation

Propagation: Grown from the end 'finger' pieces broken off a root or 'hand' of ginger. Existing ginger plants can be divided and the roots grown on, although they are difficult to keep alive during the UK winter because of low light levels.



Ginger - grow it

Find some fresh ginger in the shops. Choose fingers which have a shoot bud developing - this looks like a small pyramidal horn at the end of the root - and cut off at least 5cm from this bud.

Bury the finger bud upwards in a 20cm pot of loam-based compost. Keep warm and constantly moist during the growing season. Move to a larger pot as the plant grows, (ultimately you might need a 35cm diameter pot if your ginger is growing very well.)

Once the ginger has started to grow, feed every two to three weeks with a general pot-plant feed. In the autumn, reduce the watering and let the pots dry out, which will encourage the plants to form rhizomes. Lift the rhizomes carefully and use in cooking.

Planting

In northern India, planting of Ginger is done on the onset of monsoon. In Eastern India planting is done in the month of march. The method of land preparation depends on the soil and climatic conditions.

Usually beds of 1.0 m, width, 15 cm height, and 6-7 metre in length with 30 cm wide channels between beds are made. Ginger is universally propagated from cutting of Rhizome known as bits. A direct relationship has been established between size of planting material and final yield. Bits should be 3-5cm in the length, 15- 20gm in weight and at least one sound bud.

A seed rate of 15-20 Quintals per hectare is considered to be optimum for planting. Before planting bits should be treated with fungicide like carbendazim and mancozeb by dissolving the 30 gm of powder in 15 litres of water as a safeguard against soft rot and to induce early sprouting. The spacing for planting of the ginger should be kept 25-45 cm between rows and 15-20 cm between plants.

Ideal Land Preparation Planting

1. Select Your Site

- (a) Newly cleared virgin and is best.
- (b) If not, grow ginger on land once in three or four years, rotating with cassava and taro.
- (c) Do not grow ginger on land previously cropped with bele, yam, banana, turmeric or tomatoes because of the root-knot nematodes (eelworms) which is the common disease for these crops so it can also affect ginger.

(d) Avoid steep slopes and low wet areas. Steep slopes because of continuously cropping of ginger; soil erosion is resulted in all the rich top soil being washed away.

- On hilly lands, the fertilizer application is a major cost because fertilizer is very easily leached
- Cost of production on hilly lands is comparatively higher than on flats eg. Labour, land preparation.

2. Land Preparation

(a) Weed, clear and burn all rubbish, because some weed species are susceptible to root-knot nematodes.

(b) Apply poultry manure 10 tonnes/ha.

(c) Using digging fork, turn soil, bury remaining rubbish and mix soil well with poultry manure. Leave for 2 weeks for the manure to decompose properly.

(d) Before planting prepare soil well, making it loose and fine.

(e) Sub-divide plots with well arranged drained and form raised beds 1.8m wide and about 30-40cm high when good soil tilted is obtained.

Seedbeds Should be placed where susceptible crops have not been planted for several years. Preparation of the beds by turning the soil several times kills nematodes by leaving them to get hot and dry on the soil surface.

Soil fumigation maybe possible and will kill nematodes as well as control some diseases and weeds.

3. Planting ginger

- Generally the best time to plant is September.
- Spread poultry manure at the rate of 10t/ha and mix well with soil 2 weeks before planting.
- Open furrows about 10cm in depth and 90cm apart.
- Apply basal P&K at planting and lightly cover with soil.
- Place rhizome 15cm apart in furrows if for immature ginger and 20cm apart for mature ginger.
- Cover rhizomes with soil to a depth of about 10-15cm.

4. Manures and Fertilizers

Well rotten FYM or compost at the rate of 25-30 ton/hectare should be applied at the time of planting.

The amount of inorganic fertilizer depends upon the fertility of the soil and organic manure used. It ranges between 100-120 kg nitrogen, 75-80 kg of phosphorus and 100 -120 kg of Murat of potash. It is advisable to add 20-25 kg of elemental sulphur at the time of land preparation to correct the deficiency of sulphur which is increasing in Indian soils.

Half of nitrogen and entire quantity of phosphorus and Murat of potash should be given as basal. Rest of the nitrogen should be split in two doses as top dressing at the 45 and 90 days after planting.

5. Shade and mulching

One row of maize in every inter row space of ginger with maintenance of 100% maize population

and application of additional fertilizer to maize additional yield of ginger can be obtained. Mulching is essential as it enhances sprouting, increase infiltration and organic matter. First mulching should be done at the time of planting with quick rotting green leaves at the rate of 10-12 t/hectare or with dry leaves at the rate 5-6 t/hectare.

6. Water management

The crop raised in the month of April-May needs 2-4 initial watering at an interval of 7 days depending upon the soil types. After this the crop receives monsoon rain and comes up well till end of September. Subsequently the crop has to be given watering commencing from middle of October and the end of December at 15 days intervals. In ginger cultivation sprouting, rhizome initiation and rhizome development are critical stages of irrigation.

7. Plant Protection

A) Weed management

Two weeding are generally given to the ginger crop. First weeding should be done just before the second mulching. It is repeated depending on the intensity of the weed growth or at an interval of 45-60 days. During hoeing, every care should be taken so that the rhizomes should not be disturbed, injured or exposed.

Weeds grow and usually compete with ginger for nutrients, water and light resulting in ginger reduction.

Apart from this, they also seem to have a direct effect on the plant rhizome e.g the nut grass/ sedge where its root penetrating inside the ginger rhizome resulting in low yield gain and forming entrance to the pathogenic organism.

Control

If proper weed control is done before planting there should be fewer weeds after planting. One way of preventing is good land preparation.

However, soon after planting apply:- Atrazine as a pre-emergence weed control rate of 56g in 14 litres of water. If applied at the right time and in right amount this should keep the weeds under control for about 8 weeks.

After this manual weeding/weed wiper can follow up if need arises.

b) Pests and Diseases

The four main pest diseases and pest of ginger in Fiji is rhizome rot, soft rot, root rot nematode and rhizome scale.

i) Rhizome Rot

- It is a partly/completely decomposition of rhizome tissue; a root may dry, wet, hard, soft or slimy where the colour of it normally brown to black. This rot is caused by the fungus (*Fusarium Oxysporum*) which is a problem in the field and also during post-harvesting when ginger is washed dirty (recycled) water, poor aeration and storage in contaminated sheds where rotten piles of reject ginger is allowed to accumulate.

Soft Rot

- Disease which appeared in 1991, in ginger grown at Veikoba is soft rot – the ginger outside looks using fresh and shiny but the pot is in the inside of it. When touched, it is a bit spongy compared to the good quality one. The soft rot is caused by the fungus *pythium gracile*, either alone or in combination with a bacterium *Erwinia* sp. The fungus *pythium* is a water-mould and develops maximally in moist conditions, and when temperatures are favourable. Prolonged wet weather, therefore, creates ideal condition for development of soft-rot disease in ginger.

Root knot Nematode

- Is a disease caused by the nematode (*Meloidogyne In cognita*) which attacks both the root and the rhizome of the ginger, resulting in warty overgrowth on them. This nematode normally burrows themselves into the soil and form knots on the roots and rhizome. In this way, they attack the plant by feeding on the food and nutrients which should be used by the plant for growth and production. Therefore, because of less/starved with nutrients and food, the plant dies

Pests

Rhizome Scale

Description – The size and shape of this scale insect is about 0.5mm to 2mm in diameter and usually circular in shape. They normally have a shell colour brown on top which act as a coverage and protection.

- The true colour of the insect underneath
- Yellowish in colour.

Damage

- It attacks the Rhizome of the plant by sucking out the juice from it.
- Later, wilting of the plant and therefore it dies. * It is hard or difficult to treat this pest (using insect ides or even hot-water treatment because of the shell forming on top which protects the insect from dying.

Apart from these major pest and diseases, other include;

Fungi & Bacteria

- Thread Blight – *Ceratobasidium* sp; *Corticium* sp
- Stem Rot – *Athelia rolfsii*
- Leaf Spot – *Magnaporthe Grisea*

Nematodes

- a) Burrowing Nematode – *Radopholus similis* (associated with rhizome rot)
- b) Reniform Nematode – *Rotylenchulus reniformis* (yellowing leaf drying and stunting)

Pin Nematode – *Criconemoides Onoensis* Control

The most recommended method used to control these Pest and diseases is the use of Hot Water Treatment. Hot-Water Treatment Operation

1. Place the tank on level ground in a shaded area.
2. Fill the tank with water to about 15cm (6”) from the top.
3. Heat the water (using gas burner) to 51°C.

At full blow the water should reach this temperature in about 45 min or depends.

Adjust the burner to maintain this temperature.

4. Fill the first basket with ginger seed, and immerse it on the right hand side of the tank (facing the burner).

Adjust (increase) burner to bring temperature back to 51°C and maintain.

5. Move the first basket to the left after 5 minutes and immerse the second basket to the right hand side.
6. Remove the first basket from the tank after 10 minutes.

Usually healthy, although red spider mite can be an occasional problem. Increasing the humidity by misting plants twice daily with warm water helps discourage these pests.

To control shoot borer and leaf roller, the spray of indoxacarb of 10 ml per 15 litre of water or novaluron of 10 ml per 15 litre of water is very effective if sprayed at 15 days interval.

Rhizome scale insects destroys rhizome and it can be controlled by dipping the seed rhizome in quinalphos by dissolving 1 ml in 1 litre of water.

To avoid rhizome rot, good drainage and treatment of the seed rhizome with dissolving 3 gm of combination of carbendazim and mancozeb (readily available in the market) in 1 litre of water for nearly 30 minutes, before storage should be done. Bacterial wilt which causes milky ooze as gentle pressing of rhizomes and can be effectively controlled by treating the seed rhizome with dissolving 2 gm of streptocycln in 1 litre of water for 30 minutes.

Harvesting and yield

Rhizomes are harvested at different times, depending on their intended use. Fresh ginger might be harvested about 5 months after planting. For preserved ginger, they are usually dug up 5 to 7 months after planting, before they are fully mature but while they are still tender and mild. For dried ginger, mature rhizomes with a full aroma, flavour and pungency are harvested 8 to 9 months after planting. The essential oil content within rhizomes increases with age, so plants used for this might be harvested even later. They are harvested either by hand or by mechanical diggers and are graded according to local preference or end-use. They are sold fresh, dried or ground, or are processed into oil and oleoresin.

For fresh Ginger, the crop should be harvested before attaining the full maturity means when rhizomes are still tender, low in pungency and fiber content, usually from fifth month onwards after planting. Harvesting for the preserved ginger should be done after 5-7 months of planting while harvest for dried spices and oil is best at full maturity. i.e between 8-9 months after planting when leaves start yellowing. Rhizomes to be used for planting material should be harvested until the leaves become completely dry. After digging the rhizomes should be treated with fungicide like mancozeb @3-4 gm per litre of water, dried in shade, and stored in pits covered with 20 cm layer of sand alternating every 30 cm layer of rhizomes. These pits should be dug under a thatched roof to protect the rhizomes from rain, water and direct sun. Average yield varies from 12-15 tons per hectare. However recovery of dry ginger varies from 20-22%.

Washing and drying

After harvest, the fibrous roots attached to the rhizome should be trimmed off and soil is removed

by washing. Rhizomes should be soaked in water overnight and then cleaned. The skin can be removed by scrapping with the correct instrument. Peeling or scraping reduces, drying time, thus minimizes mold growth and fermentation. However scraping process tends to remove some of the oils constituents which are more concentrated in the peel. By removing the outside Corky skin the fiber content also decreases. After scrapping, the rhizomes should be sun dried for a week with frequent turning and well rubbed by hand to remove the outer skin. This is called as the unbleached ginger. The peeled rhizomes should be repeatedly immersed in 2% lime solution for 6 hours and allowed to dry in the sun for 10 days while rhizome receive a uniform coating of lime and moisture content should be 8-10%. This is called as bleached ginger which has improved appearance with light bright colour.

Ginger - food

Ginger is a popular spice worldwide. In Asia, it is mainly used in the form of fresh rhizomes, peeled then grated or chopped. Its aroma has been described as "rich and warm, with a refreshing, woody note and sweet, citrus undertones". It is a versatile spice that works well in savoury and sweet dishes in many culinary traditions.

Flavouring and food

Often paired with garlic, fresh ginger is a key ingredient in many South Asian savoury dishes. In the north of India, garlic, ginger and onion are often pounded together to make a paste which is then fried to form the basis of vegetable and meat dishes. In southern India, chillies and turmeric replace the onion.

Preserved ginger - pieces of ginger rhizome in sugar syrup - is a popular ingredient in sweet dishes in South Asia. Fresh ginger is often pickled in vinegar in Southeast Asia. In Japan pickled ginger is known as 'gari' and 'beni-shoga' and eaten with sushi. Ginger beer is a non-alcoholic soft drink, popular in the West Indies and in Britain. It can be made with fresh or powdered ginger. Home-made ginger beer is a refreshing drink in summer.

With the increasing popularity of Asian cooking, fresh ginger is now widely available. If frozen after peeling and grating, fresh ginger can conveniently stored for home use.

Processing

The most familiar form in Europe is dried ginger. Its preparation involves killing the rhizomes in boiling water, or by peeling, scraping or slicing, and drying. Rhizomes that have been peeled are known as 'uncoated' or 'white' ginger. Those with the peel still on are known as or 'black' or 'coated' ginger. Both are usually sun dried for several days. Dried rhizomes can be pulverised to produce ground ginger.

Ginger oil and oleoresin can be obtained from fresh or dried rhizomes. Ginger oil is obtained by steam distillation, and oleoresin is extracted with organic solvents. Black ginger is preferred for these extractions. India is one of the top producers of ginger oil, and exports mainly to America and Europe.

Chemistry of Ginger

The characteristic odour and flavour of ginger is caused by a mixture of zingerone, shogaols and gingerols, volatile oils that compose one to three percent of the weight of fresh ginger. In laboratory animals, the gingerols increase the motility of the gastrointestinal tract and have analgesic, sedative, antipyretic and antibacterial properties.

Ginger oil has been shown to prevent skin cancer in mice and a study at the University of Michigan demonstrated that gingerols can kill ovarian cancer cells. [6-gingerol (1- 4'-hydroxy-3'methoxyphenyl]-5-hydroxy-3-decanone) is the major pungent principle of ginger. The chemo-preventive potentials of [6]-gingerol present a promising future alternative to expensive and toxic chemotherapeutic agents.^[28]

Ginger contains up to three percent of a fragrant essential oil whose main constituents are sesquiterpenoids, with (-)-zingiberene as the main component. Smaller amounts of other sesquiterpenoids (β -sesquiphellandrene, bisabolene and farnesene) and a small monoterpene fraction (β -phellandrene, cineol, and citral) have also been identified.

The pungent taste of ginger is due to non-volatile phenylpropanoid-derived compounds, particularly gingerols and shogaols, which form from gingerols when ginger is dried or cooked. Zingerone is also produced from gingerols during this process; this compound is less pungent and has a spicy-sweet aroma.^[29] Ginger is also a minor chemical irritant, and because of this was used as a horse suppository by pre-World War I mounted regiments for feaguing.

Ginger has a sialagogue action, stimulating the production of saliva, which makes swallowing easier.

The traditional medical form of ginger historically was called *Jamaica ginger*; it was classified as a stimulant and carminative and used frequently for dyspepsia, gastroparesis, slow motility symptoms, constipation, and colic. It was also frequently employed to disguise the taste of medicines.

Some studies indicate ginger may provide short-term relief of pregnancy-related nausea and vomiting. Studies are inconclusive about effects for other forms of nausea or in treating pain from rheumatoid arthritis, osteoarthritis, or joint and muscle injury. Side effects, mostly associated with powdered ginger, are gas, bloating, heartburn, and nausea.

Tea brewed from ginger is a common folk remedy for colds. Ginger ale and ginger beer are also drunk as *stomach settlers* in countries where the beverages are made.

- In Burma, ginger and a local sweetener made from palm tree juice (*htan nyat*) are boiled together and taken to prevent the flu.
- In China, ginger is included in several traditional preparations. A drink made with sliced ginger cooked in water with brown sugar or a cola is used as a folk medicine for the common cold. "Ginger eggs" (scrambled eggs with finely diced ginger root) is a common home remedy for coughing. The Chinese also make a kind of dried ginger candy that is fermented in plum juice

and sugared, which is also commonly consumed to suppress coughing. Ginger has also been historically used to treat inflammation, which several scientific studies support, though one arthritis trial showed ginger to be no better than a placebo or ibuprofen for treatment of osteoarthritis.

- In Congo, ginger is crushed and mixed with mango tree sap to make tangawisi juice, which is considered a panacea.
- In India, ginger is applied as a paste to the temples to relieve headache, and consumed when suffering from the common cold. Ginger with lemon and black salt is also used for nausea.
- In Indonesia, ginger (*jahe* in Indonesian) is used as a herbal preparation to reduce fatigue, reducing "winds" in the blood, prevent and cure rheumatism and control poor dietary habits.