2.1 *Piper longum*

![Photograph 2.1 Piper longum](image)

**Scientific classification**
- **Kingdom**: Plantae
- **Division**: Angiosperms
- **Class**: Magnoliids
- **Order**: Piperales
- **Family**: Piperaceae
- **Genus**: *Piper*
- **Species**: *longum*

**Vernacular names**
- **Sanskrit**: Magadhi, Granthika, Pappalika
- **Bengali**: Pipulmul
- **English**: Piper fruit
- **Gujarati**: Gantoda, Ganthoda
- **Hindi**: Piparamula
- **Kannada**: Modikaddi, Hippali, Tippali, Modi
- **Malayali**: Kattuthippaliver, Tippaliveru
- **Marathi**: Pimplimula
- **Punjabi**: Pippalimula, Magha
- **Tamil**: Kanda Tippili, Ambinadi Desavaram
- **Telugu**: Modi, Madikatta
- **Urdu**: Filfil Daraz
2.1.1 Description

Long pepper (*Piper longum*) sometimes called Javanese, Indian or Indonesian Long pepper, is a flowering vine of family Piperaceae, cultivated for its fruits, which is usually dried and used as a spice and seasoning. Long pepper is a close relative of *Piper nigrum* and has a similar, though generally hotter, taste. The Aryans were the first exporters of both kinds of pepper from the tropical forests of South Asia. The fruits of the pepper consist of many minuscule fruits each about the size of a poppy seed embedded in the surface of a flower spike that closely resembles a hazel tree catkin. The fruits contain the alkaloid piperine, which contributes to their pungency. Another species of long pepper, *Piper retrofractum* is native to Java and Indonesia.

**Macroscopy:** Fruits are small, ovoid, completely sunken and embedded in solid fleshy spike, 2.5 - 4.0 cm long. They are light green to olive green when immature which on ripening changes to shining blackish green colour.

**Microscopy:** Transverse section of the aggregate fruit shows 5 - 7 rows of fruitlets, which are spiral or vertical on a central axis. Outer epidermal cells of the fruitlets contain brown contents; the cells of which are irregular in shape. Mesocarp consists of large parenchymatous cells, filled with starch grains, traversed with a number of stone cells either solitary or in groups. Endocarp and seed coat fuses to form a deep zone, round to oval measuring 3 to 8 µ in diameter. The central axis is parenchymatous, 5 to 8 collateral vascular bundles arranged in a ring. Second layer contains tangential cells with orange red pigment. The outer most layer of kernel consisting of hexagonal or irregular cells filled with starch grains.

**Powder:** The powder of the fruits is dark brown in colour, pungent and heating in taste. The microscopical study of powder shows large polygonal perisperm cells, isolated or in group of 2 or 3, packed with simple and compound starch grains measuring 2 to 5 µ in diameter; stone cells measuring 130 to 190 µ in diameter with broad lumen in
groups of 2 to 8, stone cells, thin walled fragments of parenchymatous
cells from mesocarp.

2.1.2 Chemical profile

*Piper longum* mainly consists of alkaloids as piperine, 
piperlongumine, piperlonguminine, pipernonaline, methylpiperate,
guineensine, piperoctadecalidine and piperlongumine etc (Chatterjee 
and Dutta, 1963). The plant contains essential oil consisting of long 
chain hydrocarbons, mono and sesquiterpenes, caryophyllene being 
main component. Other chemical constituents are sabinene, chavicol, 
phellandrene, pentadecane, beta-bisabolene, linalool and limonene 
(Chauhan et al., 2011).

2.1.3 Properties and actions

Rasa : Katu  
Guna : Ruksa, Laghu  
Virya : Usna  
Vipaka : Katu  
Karma : Vatahara, Kaphahara, Dipana, Pacana, Vatanulomana, 
Vulaprasamana, Rucya

2.1.4 Important formulations

Formulations containing *P. longum* are Pancakola Curna, Dasamula 
Taila, Dasamulapancakoladi Kvatha Curna and Dasamulasatpalaka 
Ghrta (Ayurvedic Pharmacopoeia of India, 2005).

2.1.5 Medicinal uses

*Piper longum* has been used in the treatment of respiratory tract 
problems such as cough, bronchitis, tuberculosis and asthma. It is good 
remedy for treating gonorrhoea, menstrual pain, sleeping problems, 
chronic gut related pain and arthritic conditions, malarial fever, 
diarrhoea and jaundice (Ghoshal et al., 1996; Umadevi et al., 2009).

Other beneficial effects of *Piper longum* include its analgesic and diuretic 
effects, relaxation of muscle tension and alleviation of anxiety 
(Vedhanayaki, 2003).
2.2 *Piper nigrum*

**Photograph 2.2 *Piper nigrum***

(A) Aerial part  
(B) Fruits

**Scientific classification**

- **Kingdom**: Plantae
- **Division**: Angiosperma
- **Class**: Dicotyledonae
- **Order**: Piperales
- **Family**: Piperaceae
- **Genus**: *Piper*
- **Species**: *nigrum*

**Vernacular names**

- **Sanskrit**: Maricha, Ushana
- **Hindi**: Kali mirch
- **Kannada**: Karemenasu
- **Marathi**: Kali mirch
- **Gujarati**: Kalamari
- **English**: Black pepper
- **Bengali**: Kalamorichi
- **Telugu**: Miriyala
2.2.1 Description

*P. nigrum* is widely cultivated in India, Ceylon and other tropical countries. The climbing perennial shrub grows in hot and moist places. Its branches are stout, trailing and rooting at the node. Leaves entire, variable in breadth, 12.5 -17.5 cm by 5.0 -12.5 cm. Flowers are minute in spikes, usually dioecious, often female, bears 2 anthers and the male, a pistillode. Fruiting spikes are variable in length. Fruits are globose and bright red when ripe and seeds are usually globose.

**Macroscopy:** The entire fruit is almost globular about 4-6.5 mm diameter, brownish to black in colour, the surface is uneven, seeds almost white, aromatic with a pungent taste.

**Microscopy:** Epicarp shows an outer layer of polygonal cells having a distinct cuticle and containing a dark brown to blackish contents, followed by 2-3 layers of thin walled parenchyma cells intermingled with greatly thickened isodiametric to radically elongated stone cells. Mesocarp is a comparatively broad zone constituting the greater area of the pericarp. The outer 7-8 layers of cells are parenchymatous and certain small starch grains and scattered among these cells will be noted larger secretion sacs with suberized walls and oil/resin contents. The next several layers of cells are compressed and fibrovascular bundles in these regions. Beneath the compressed cells a layer of larger oil cells having suberized walls and then a zone of two layers of small parenchyma cells are present. Endocarps consisting of single layer of stone cells whose radius and inner walls are more strongly signified than outer layer. A test consisting of 2-3 layers of compressed elongated cells beneath which is a pigment layer containing a dark-brown tannin substance. Inner zone of perisperm cells are radically elongated which embeds largely oleo-resins besides starch and proteins substance. Tracheids are pitted, some of them show helical thickenings on their secondary wall.

**Powder:** The powder of fruits of *P. nigrum* is brownish black, pungent, heating with aromatic taste. The microscopical study of powder shows
large polygonal cells having a distinct cuticle followed by thin walled parenchyma cells. Starch grains scattered measuring 2 to 4 µ in diameter; fibrovascular bundles measuring 110 to 170 µ in diameter from mesocarp. Endocarps consisting of layer of stone cells whose radius 2 to 5 µ and dark-brown tannin substance. Perisperm cells are radically elongated which embeds largely oleo-resins besides starch and proteins.

2.2.2 Chemical profile

Black pepper contains volatile oil, crystalline alkaloids - piperine, piperidine and resin (Parmar et al., 1997). The minor alkaloids present are piperitine, piperolein A, piperolein B, piperanine, trichostachine. The volatile oil contains large amounts of terpenes, phellandrene, dipentene and sesquiterpenes (Seung et al., 2006).

2.2.3 Properties and actions

Guna : Usna, Ruksa, Tikshna
Virya : Usna
Vipaka : Madhura
Karma : Tridosahara, Rasayana

2.2.4 Important formulations

Formulations containing P. nigrum are Maricyadi taila, Trikatu, Maricyadi gutika, Caturusana, Pancakola, Sadusana and Sodasa vati (Ayurvedic Pharmacopoeia of India, 2005).

2.2.5 Medicinal uses

P. nigrum cures illness such as lung diseases, liver problems and heart diseases. It is much employed as an stimulant, in cholera weakness following fevers, vertigo, coma etc., as a stomachic in dyspepsia and flatulence and as an antiperiodic in malarial fever (Mun-Chual et al., 2007). It is also used as an alterative in paraplegia, psoriasis, allergy, and atherosclerosis and arthritic diseases. Externally, it is valued for rubefacient and as a local application for relaxed sore throat, piles and some skin diseases (Lee et al., 2008).
2.3 *Aconitum ferox*

![Photograph 2.3 Aconitum ferox](image)

(A) Aerial part  
(B) Roots

**Scientific classification**

- **Kingdom**: Plantae
- **Division**: Magnoliophyta
- **Class**: Magnoliopsida
- **Order**: Ranunculales
- **Family**: Ranunculaceae
- **Genus**: *Aconitum*
- **Species**: *ferox*

**Vernacular names**

- **Sankrit**: Visa vajranaga, Amrta, Vatsanagaka
- **Assam**: Bish, Mithavish
- **Bengali**: Kathavish
- **English**: Aconite
- **Gujarati**: Vachhanaag, Basanaag
- **Hindi**: Bisa, Meethabisha, Bachhnaag
- **Kannada**: Basanalli, Vatsanaha, Vatsanahi
- **Malayali**: Vatsanabhi
- **Marathi**: Bachnaga
- **Punjabi**: Mitha visha
- **Tamil**: Vasanaavi, Nabhi, Vasanabhi
- **Telugu**: Vatsanaabhi, Naahi
- **Urdu**: Bachnak, Beesh
2.3.1 Description

*Aconitum ferox* also known as *Aconitum virorum* is a species of monkshood of family Ranunculaceae. It is also known as the Indian Aconite. A deciduous perennial that grows to 1.0 m tall by 0.5 m wide in Darjeeling (West Bengal) and prefers many types of soil. Erect tall stems being crowned by racemes of large and eye-catching blue, purple, white, yellow or pink zygomorphic flowers with numerous stamens. They are distinguished by having one of the five petaloid sepals (the posterior one), called the galea, in the form of a cylindrical helmet; hence the English name monkshood. There are 2-10 petals, in the form of nectaries. The two upper large petals are placed under the hood of the calyx and are supported on long stalks. *A. ferox* contains large quantity of alkaloid pseudoaconitine, which is deadly poisonous. It was used in European witchcraft ointments. Overall it is considered as one of the most poisonous plant in the world.

**Macroscopy:** Roots paired, occasionally separated due to breakage, ovoid, conical, small portion of stem sometimes attached, tapering downwards to a point, 2 - 4.5 cm, rarely 5 cm long, 0.4 -1.8 cm thick, gradually decrease in thickness towards tapering end; wrinkled longitudinally and transversely, rough due to root scars; dark brown to blackish-brown; fracture, cartilaginous, hard and white within the cambium ring and brownish outside cambium; odour indistinct, taste, slightly bitter followed by a strong tingling sensation and poisonous.

**Microscopy:** Root shows epidermis 1-3 layered, suberised, papillose on outside, primary cortex consisting of 8-10 layers of oval to tangentially elongated, thin-walled, parenchymatous cells, without or with a few intercellular spaces, a few rectangular or triangular stone cells in singles found scattered in this zone; primary cortex separated by distinct endodermis, inner bark parenchymatous, consisting of round to oval cells, containing a few groups of phloem strands, occupying more than half the radius; cambium having 6-10 angles; xylem vessels arranged almost in a ring, some scattered, often forming V shaped ring, closing xylem parenchyma in older portions; bundles compact often wedge-
shaped having acute apex; xylem exarch, metaxylem vessels met in centre; starch grains simple measuring 6-18 μ diameter. And compound grains consisting of 2 -5 components with hilum in centre, present in cortical cells, phloem parenchyma and xylem parenchyma.

**Powder.** The powder of aconite is light grey, shows vessels, a few aseptate fibres, numerous simple and compound starch grains having hilum in the centre, single grain measuring 6-18 μ diameter.

### 2.3.2 Chemical profile

*A. ferox* contains diterpenoid alkaloids: aconitine, napelline, aconine. Pseudaconitine is the major constituent and the other three minor alkaloids are identified as bikhaconitine, veratroyl pseudaconine and diacetyl pseudaconitine (*Purushothaman and Chandrasekharan, 1974*). Root tubers yields diterpenoid alkaloid vakognavine and nine known norditerpenoid alkaloids, chasmaconitine, crassicauline-A, falconericine, bikhaeonine, pseudaconine, neoline, senbusine-A, isotalatizidine and columbianine (*Jampani and Alfred, 1994*).

### 2.3.3 Properties and actions

<table>
<thead>
<tr>
<th>Rasa</th>
<th>Madhura</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guna</td>
<td>Usna, Ruksa, Tiksna, Laghu, Vikasi Vyavayi, Yogavahi.</td>
</tr>
<tr>
<td>Virya</td>
<td>Usna</td>
</tr>
<tr>
<td>Vipaka</td>
<td>Madhura</td>
</tr>
<tr>
<td>Karma</td>
<td>Tridosahara, Rasayana, Svedala, Pittasantapakaraka.</td>
</tr>
</tbody>
</table>

### 2.3.4 Important formulations

Formulations containing *A. ferox* are Tribhuwanakirti Rasa, Sutasekhara Rasa, Anandabhairava Rasa, Vatavidhwansana Rasa and Mahavisagabha Taila (*Ayurvedic Pharmacopoeia of India, 2005*).

### 2.3.5 Medicinal uses

*A. ferox* has antileprosy, anti-rheumatic, cardiac stimulant, anti-inflammatory, expectorant, diuretic and antidiabetic properties. It paralyses the respiratory center and used in the treatment of asthma, gout, skin diseases and neuralgia (*Sunil et al., 2000; Alok et al., 2008*).
2.4 *Zingiber officinale*

(A) Whole plant  
(B) Rhizomes

**Photograph 2.4 Zingiber officinale**

**Scientific classification**
- **Kingdom**: Plantae
- **Division**: Magnoliophyta
- **Class**: Commelinids
- **Order**: Zingiberales
- **Family**: Zingiberaceae
- **Genus**: Zingiber
- **Species**: officinale

**Vernacular names**
- **Sanskrit**: Katubhadra
- **Bengali**: Ada
- **English**: Ginger
- **Gujarati**: Adu
- **Hindi**: Adarakha
- **Kannada**: Alla, Hasishunti
- **Malayali**: Inchi
- **Marathi**: Ardrak, ale
- **Punjabi**: Adi, Adrak
2.4.1 Description

*Z. officinale* lends its name to its genus and family (Zingiberaceae). Ginger cultivation began in Asia and is now grown abantly in India, West Africa and the Caribbean. According to Floridata, *Z. officinale* is usually about four feet tall, with long, narrow leaves that measure around seven inches long. The plant flowers, it produces small yellow-green flowers. The word "zingiber" is a distant relative of the Sanskrit word "shringavera," which means "shaped like a deer's antlers" (referring to the shape of the plants leaves).

**Macroscopy:** Ginger occurs as entire rhizome or in pieces, rhizome laterally compressed bearing flattish ovate, oblique branches on upper side, each having a depressed scar at its apex, pieces 5-15 cm long, 1.5-6.5 cm wide (usually 3-4 cm) and 1-1.5 cm thick, fracture, short with projecting fibres, transversely cut surface shows a wide central stele having numerous grayish cut ends of fibres and yellow secreting cells; odour - gingery; taste - pungent.

**Microscopy:** Rhizome of *Z. officinale* show a few layered, irregularly arranged, tangentially elongated, brown cells of outer cork and 6-12 rows of thin walled, colourless, radially arranged cells of inner cork; secondary cortex consisting of hexagonal to polygonal, isodiametric, thin walled, parenchymatous cell containing numerous circular to oval starch grains with striations and hilum at one end with clear concentric striations, measuring 5-25 µ diameter, idioblasts containing large yellowish to brownish globules of oleo-resin; walls of oil cells suberised; numerous closed, conjoint, collateral, cortical fibro-vascular bundles scattered throughout cortical zone, greater number occurring in inner cortical region, larger bundles consist of 2-7 vessels, small cells of sieve tube, polygonal cells of parenchyma and group of fibres; vessels showing
reticulate, scalariform and spiral thickening; fibres separate with a few oblique pores on their walls; endodermis single layered, free from starch; pericycle single layered enclosing central stele; stele consisting of thin walled polygonal, isodiametric cells of parenchyma, filled with abundant starch grains, oleo-resin cells similar to those present in cortex; fibrovascular bundles of two types, those arranged along pericycle in a definite ring are smaller size and devoid of fibres, vessels 2-5 cm in number, larger bundles found scattered throughout stele, composed of xylem, phloem, parenchyma and sheath of sclerenchyma.

**Powder:** Ginger (*Z. officinale*) powder is light yellow, shows thin walled parenchymatous cells, septate fibres with oblique, elongated pits on their walls, reticulate and spiral vessels, oleo-resin cells abundant, single starch of varying shapes with eccentric hilum, measuring 5-25 µ in diameter.

### 2.4.2 Chemical profile

Ginger possesses volatile oil containing mainly monoterpenoids like β-phellandrene, (+)-camphene, cineole, geraniol, curcumene, citral, terpineol, borneol and sesquiterpenoids like α-zingiberene, β-sesquiphellandrene, β-bisabolene, α-farnesene, zingiberol (*Langner et al., 1998; Evans, 2002*). Other components included gingerols, shogaols, 3-dihydroshogaols, paradols, dihydroparadols, acetyl derivatives of gingerols, mono and diacetyl derivatives of gingerdiols, 1-dehydrogingerdiones and diarylheptanoids (*Jolad et al., 2004*).

### 2.4.3 Properties and actions

<table>
<thead>
<tr>
<th>Rasa</th>
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<tbody>
<tr>
<td>Guna</td>
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</tr>
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<td>Karma</td>
<td>Vatahara, Kaphahara, Rocana, Dipana, Bhedana, Svarya, Hrdya, Vrsya.</td>
</tr>
</tbody>
</table>
2.4.4 Important formulations

Formulations containing *Z. officinale* are Ardraka Khandavaleha and Saraswatarista (*Ayurvedic Pharmacopoeia of India, 2005*).

2.4.5 Medicinal uses

Ginger is stimulant and carminative, and used frequently for dyspepsia and colic. Used in treatment of catarrh, rheumatism, nervous diseases, gingivitis, toothache, asthma, stroke, constipation and diabetes (*Wang and Wang, 2005; Tapsell et al., 2006*). Ginger decreases pain from arthritis and have blood thinning and cholesterol lowering properties that make it useful for treating heart diseases. Ginger possesses antiemetic, anti-inflammatory, anticancer, anxyolitic and antithrombotic effects (*Afzal et al., 2001*).