4 Large Cardamom

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4.1. Introduction

India is the largest producer of large cardamom (*Amomum subulatum* Roxburgh), with an annual production of 4000 MT, followed by Nepal (2500 MT) and Bhutan (1000 MT) (Berrig *et al.*, 1993). More than 85% of the production within India is from Sikkim. An estimated 4000 t of large cardamom, valued at about Rs. 1.60 billion, is produced annually in Sikkim alone, which constitutes nearly 80% of total production from India. It is also called greater Indian or Nepal cardamom, which is a native of the Eastern Himalayan region. Large cardamom is the most important perennial cash crop of the region and is widely cultivated with Himalayan alder (*Alnus nepalensis*) as a shade tree (Sharma *et al.*, 2002).

Large cardamom is a shade-loving crop. It grows under dense (60–70% of full daylight interception) to light shade (26% full daylight interception) conditions. The daylight intensity required for optimum growth of cardamom is 5000–20,000 lux. Therefore, it is necessary to clear the undergrowth in virgin forest and regulation of overhead shade is essential, in such a way that at least 50% shade is maintained in the area. About 30 important tree species are used to provide shade to the cardamom plants. *A. nepalensis*, a deciduous, nitrogen-fixing and fast-growing tree, is the species most commonly underplanted with cardamom.

Being the largest producer and exporter of large cardamom, India enjoys near monopoly of this spice. The main production centres are the sub-Himalayan ranges spread across the Sikkim and Darjeeling districts of West Bengal. Several species of the genus *Amomum* are distributed all over the mountainous area from the Himalayas to southern China. Other species include *A. subulatum*, or large cardamom, grown in northern India and Nepal; *A. aromaticum*, or Bengal cardamom, grown in southeastern India; *A. krervanh*, or Siam or Cambodian cardamom, growing wild under forest cover in Thailand, Cambodia, Lao PDR and Vietnam; *A. globosum*, or Chinese cardamom, grown in southern China; and *A. xanthiodes*, or bastard cardamom, growing wild under forest cover in Thailand (Subba, 1984; Rao *et al.*, 1993b; Singh and Singh, 1996). Figures for the export of large cardamom from India for the past 10 years are given in Table 4.1.

Large cardamom is also known as 'black cardamom'. The pods are used as a spice, in a manner similar to the green Indian cardamom pods, but it has a drastically different flavour, so it cannot be substituted in the same recipes, unless a different flavour

Table 4.1. Export of large cardamom from India.

Year	Quantity (t)	Value (US$)
1995/96	1677	291.42
1996/97	1628	288.09
1997/98	1648	300.95
1998/99	1288	302.14
1999/2000	1185	419.52
2000/01	1506	583.57
2001/02	1577	569.52
2002/03	1450	489.76
2003/04	924	293.81
2004/05	950	270.00
2005/06	1025	252.38

Source: Spices Board, Cochin, India.

is acceptable. Unlike green cardamom, this spice is used rarely in sweet dishes. Its strong, smoky flavour and aroma are derived from the traditional drying procedure, which involves drying over open flames. North-east Indian and South-east Asian countries are dominated by the *Amomum* species, while *Aframomum* species are prevalent in the African regions of Sierra Leone, Guinea Coast, Madagascar and Tanzania. The fruits are much larger in size in comparison with *Elettaria cardamomum* (small cardamom), but the seed size and anatomy are similar in all three genera.

Large cardamom, a perennial cash crop grown beneath the forest cover on the marginal lands of Sikkim Himalaya, has been a boon to the mountain people of the area (Sharma *et al.*, 2002). It is cultivated in an area of about 23,500 ha in Sikkim. Being a shade-loving plant, the hills of Sikkim provide an ideal environment. The plant grows at altitudes between 600 and 2000 m, where rainfall is between 1500 and 3500 mm and the temperature varies from 6°C (min) to 33°C (max) (Anon., 1991). Frost and hailstorms are injurious to the plants during flowering (Biswas *et al.*, 1988).

There are three popular varieties (cultivars) of large cardamom in Sikkim, e.g. Ramsey, Golsey and Sawney. The varietal differences are described by Gyatso *et al.* (1980), Subba (1984) and Rao *et al.* (1993a) (Table 4.2). In addition to these popular varieties, there are several other varieties, such as Ramla, Chivey Ramsey, Garday Seto Ramsey, Ramnag, Madhusay, Seto Golsey, Slant Golsey, Red Sawney, Green Sawney and

Table 4.2. Characteristics of different varieties of large cardamom.

Character/variety	Ramsey	Golsey	Sawney
Altitude	High	Low to middle	Middle
Extent of cultivation (%)	60	30	7
Status	Tall, vigorous wide clump growth	Less vigorous with erect leafy stem bearing stout upright leaves, clumps medium	Tall, vigorous, bent downwards
Stem colour	Maroonish with dense foliage	Greenish to maroonish	Pinkish with dark green foliage
Flowers	Yellowish and small, corolla tip with pink tinge at base	Yellowish-orange	Yellowish with pink tinge at base of corolla
Capsules	Smaller (16–30 seeds)	Bold to round (40–50 seeds)	Medium bold (30–40 seeds)
Essential oil (%)	1–8	2.3–5.0	1.8–2.5
Shade requirement	Deep shade	Less shade	Moderate to deep shade
Susceptibility to diseases	Susceptible to Chirkey and Foorkey at lower altitudes	Tolerant to Chirkey and Foorkey but susceptible to leaf spots	Susceptible to viral diseases

Source: Rao *et al.* (1993a).

Mingney. Rao *et al.* (1993b) reported a promising variety, Barlanga, from higher altitudes with desirable high-yielding characteristics, such as maximum ratio of mature tillers to productive spikes (1:3.6) and bold-size capsules (with 50–80 seeds). Surveys carried out by Biswas *et al.* (1986) revealed that Ramsey and Ramla were well suited to higher altitudes, Golsey to lower altitudes and Sawney was widely adaptable to different elevations.

Since *A. subulatum* Roxburgh is cultivated to a larger extent, and also has significant potential for trade, this chapter, unless otherwise specified, deals mostly with this variety.

4.2. Botany and Uses

Botany

Cultivation is carried out mainly in swampy places along the sides of mountain streams in Nepal, Bengal, Sikkim and Assam (eastern Himalayas). Usually, the plants are grown at an elevation of 765–1675 m above mean sea level, along small springs, on the moist and shady sides of mountain streams and along hilly slopes. The plant is a perennial herb having subterranean rhizomes, which give rise to leafy shoots and spikes. It matures during the third year of growth and its height ranges from 1.5 to 3.0 m. Leafy shoots are formed by long, sheath-like stalks encircling one another. The leaves are green or dark green, glabrous on both surfaces, with acuminate apex. Inflorescence is a dense spike on a short peduncle bearing 40–50 flower buds in an acropetal sequence. Flowering of cardamom commences in the third year after planting. Flowers appear during April and May and the capsules mature in September and October.

The fruit is a trilocular many-seeded capsule. The capsule wall is echinated and is reddish-brown to dark pink (Rao *et al.*, 1993a). The capsule morphology has been studied in detail by Gupta (1986). Harvesting is usually carried out during August to October.

Dried large cardamom capsules are, on average, 25 mm long, oval to blobose, greyish-brown to dark reddish-brown. The fruit contains 40–50 seeds, held together by a viscous sugary pulp. Though the fruits are clearly identifiable by their larger size and differences in shapes compared with small cardamom, the seeds are of nearly the same size as those of true cardamom. Histological features, sizes and orientation of cells in different layers of husk and seed have been described by Berger (1965).

Flowering

Large cardamom is essentially a cross-pollinated crop due to the heterocyclic nature of its flowers, though they are self-fertile. Each spike bears 40–50 flowers, which open in an acropetal sequence, but only 10–15 capsules are formed per spike. The flowers remain viable for 14 h after opening (Rao *et al.*, 1993b). They are borne on shortly peduncled spikes of about 5–6 cm in diameter. The number of inflorescences produced on each clump ranges from 20 to 45, depending on the age of the clump. Each inflorescence produces 30–50 flowers. The flowers are yellowish and measure 7.03 cm in length. The most conspicuous part of the flower is the yellowish labellum/lip, which provides a platform for visiting insects. The basal parts of the petals and the labellum are fused to form a corolla tube/nectar tube (3.07 cm long). The terminally expanded part of the labellum is 3.52 cm long and 1.4 cm wide. The midrib region of the labellum is a deeper yellow and the veins are translucent. The anther is solitary, borne on a filament about 1 cm long, originating from the tip of the corolla tube, and measures 10.6 mm in length. The stamen extends beyond the anther in the form of a rolled-up leafy hood/crest. The pistil is solitary; the ovary is 5.25 mm long and contains an average of 106.8 ovules. The style is long (5.03 cm) and delicate; it passes through the groove present between the two pollen sacs. The stigma is cup-shaped (1 mm deep and 1.5 mm wide) and slightly flattened, with a row of unicellular, non-receptive hairs on its margin. Only the inner surface of the cup is receptive. The stigma cup is pointed distally and the inner wall is lined with a viscous exudate. The stigma extends 1.5–2.0 mm beyond the level of the anther and is covered with the rolled-up extension of the stamen (crest) in the form of a hood. Two yellowish nectarines (3.93 mm long) are located at the base of the style and fill the entire space in the lower part of the corolla tube (Sinu and Shivanna, 2007).

Cytology of *Ammomum* indicates that the diploid chromosome number of *A. subulatum* is 48. However, variability is also reported with 2n = 26, 34, 42 and 44 (Sharma and Bhattacharya, 1959).

Uses

Large cardamom is the dried fruit of a perennial herbaceous plant. Its quality characteristics are different from those of small cardamom. It is valued for its acceptable taste, flavour and aroma. The spice is used in rice preparations and meat dishes, besides a wide range of beverages and sweets.

Large cardamom has a fresh and spicy aroma. By virtue of the traditional drying procedure over open flames, the spice also acquires a smoky flavour. The ground seeds are an optional ingredient in mixed preparations and spice masala mixtures, and are also used as a flavouring agent in confectionary, hot or sweet pickles and in beverages.

Large cardamom also possesses curative properties in the Ayurvedic and Unani systems of medicine (Mukherjee, 1972; Singh, 1978; Nambiar *et al.*, 1994). It is also used to flavour cardamom cola, prepared by blending caramer acid and carbonating mixture.

4.3. General Composition

The chemical composition of large cardamom (Table 4.3) differs with variety, region and age. The seeds contain 3% essential oil, which is dominated by 1,8-cineole (more than 70%). Smaller and variable amounts of limonene, terpinene, terpineol, terpinyl acetate and sabinene have also been reported. Table 4.4 compares the composition of large cardamom seeds with small cardamom seeds (Singh, 1978).

Table 4.3. General composition of large cardamom.

Component	Value (%)
Moisture	8.49
Protein	6.00
Total ash	4.01
Starch	43.21
Crude fibre	22.00
Non-volatile ether extract	2.31
Volatile ether extract	3.00
Alcohol extract	7.02
Volatile extract	2.80
Water-soluble ash	2.15
Alkalinity of water-soluble ash	0.90
Ash insoluble in acid	0.42
Volatile oil	2.80

Source: Pruthi (1993).

Table 4.4. Comparison of chemical analysis of large and small cardamom seeds.

Character	Large cardamom (average %)	Small cardamom (average %)
Moisture	8.49	8.30
Volatile oil	2.80	8.30
Protein	8.00	10.30
Crude fibre	22.00	9.20
Total ether extract	43.21	45.40
Alcohol extract	7.02	–
Total ash	4.01	5.00

Source: Singh (1978).

4.4. Chemistry

Chemistry of volatiles

Volatile oil is the principal aroma-giving compound in the large cardamom. Steam distillation of the crushed seeds gives a dark brown oil (2.5%) with a cineol-like aroma. The highest volatile oil content was recorded as 3.32% in the Golsey Dwarf variety, whereas the lowest was 1.95% in the White Ramna variety (Gupta, 1986). Cineole contributes to pungency, while terpinyl acetate contributes towards the pleasant aroma (Karibasappa, 1987). Karibasappa also reported that the cultivar Ramnag, followed by Golsey, had uniform-sized capsules with maximum values for capsule weight, capsule size, seeds per capsules, oleoresin content and volatile oil content.

Quantitative chromatographic analysis of the composition of distilled essential oil was reported previously by Nigam and Purohit (1960) and by Lawrence (1970). The major constituent of large cardamom essential oil is 1,8-cineole (65–80%), while the content of α-terpenyl acetate is low (traces to 5%). The monoterpene hydrocarbon content is in the range of 5–7%, of which limonene, sabinene, terpinene and pinene are significant components. The terpinols comprise approximately 5–7% of the oil. The high cineole and low terpenyl acetate probably account for the very harsh aroma of this spice in comparison with that of true cardamom (Pruthi, 1993).

Seed oil

The seed oil in *A. subulatum* has been the subject of several investigations. Nigam and Purohit (1960) obtained 2.5% oil from the seeds and fractionated the oil into different cineole-rich fractions. Lawrence (1970) separated the components of the oil by preparative gas chromatography, identified them by their IR spectra and retention data and found the major component, 1,8-cineole, in 74%. Patra *et al.* (1982) studied the oil by packed column GC and reported that its major components were sabinene (9.1%), γ-terpinene (16.2%) and 1,8-cineole (63.3%). In another study, Gupta *et al.* (1984) analysed oils derived from different strains of *A. subulatum* growing wild in Sikkim and found the 1,8-cineole content varied from 77 to 89%. The oil and volatile concentrate produced by liquid carbon dioxide extraction of *A. subulatum* were compared by Kaur *et al.* (1993).

Analysis of the steam-distilled volatile oil of the seeds of the large cardamom grown in Sikkim, India, using GC-MS, identified 25 components, of which 16.3% was monoterpene hydrocarbons and 75.3% was oxygenated monoterpenes, with 1,8-cineole [eucalyptol] (61.3%) being the major component. α-Terpineol, α- and β-pinene and allo-aromadendrene were also detected (Gurudutt *et al.*, 1996).

The large cardamom pericarp (husk) yielded 0.18% volatile oil by the Clevenger hydrodistillation method. This oil was analysed for physical parameters, e.g. specific gravity (0.9148), refractive index (1.4733) and optical rotation (−7.700). The volatile oil was subjected to GC-MS analysis and 37 compounds were identified, constituting > 98% of the total oil. The major compounds characterized were 1,8-cineole (38.7%), β-pinene (13.6%), α-terpineol (12.6%), spathulenol (8.3%), 4-terpineol (4.5%), germacrene D (3.0%), α-pinene (2.8%) and β-selinene (2.7%). GC and GC-MS data revealed that 1,8-cineole content was less than 50% when compared with the seed oil. Table 4.5 shows the major constituents separated by GC-MS (Rout *et al.*, 2003). Figure 4.1 gives the structures of the major chemical components in the volatile oil from seeds.

Steam distillation of the crushed seeds of large cardamom yielded 2.5% dark brown-coloured liquid with the following physical constants: specific gravity (29°C), 0.9142; refractive index (29°C), 1.460; optical rotation in chloroform, 18°C.

The physical and chemical quality attributes of large cardamom (*A. subulatum*) cultivars obtained from the north (Zongu Golsai, Ramsey and Golsai), south (Sawney and Golsai), east (Barlangey) and west (Zongu Golsai, Ramsey and Barlangey) regions of Sikkim, India, Bhutan (Bhutan large cardamom) and Nepal (Tedey K. cut) were evaluated (Naik *et al.*, 2006). GC analysis of the volatile oils showed that there was considerable variation among the cultivars with respect to α-pinene (3.2–4.5%), β-pinene (6.7–8.5%), 1,8-cineol (80.4–84.6%), 4-terpineol (0.60–1.30%) and α-terpineol (3.3–4.3%). Analysis for metals by AAS showed that the seeds contained cadmium (0.06, 0.07 and 0.07 ppm, respectively), lead (0.12, 0.37 and 0.24 ppm, respectively), copper (5.14, 9.68 and 6.33 ppm, respectively) and iron (28.51, 111.19 and 55.28 ppm, respectively). Analysis of the seed and capsules for heavy metals showed that there was considerable variation among regional cultivars with respect to iron content, whereas the cadmium,

Table 4.5. Percentage composition of oils from the seeds of *Amomum subulatum* growing in Sikkim.

Compound	Retention index calculated	RI literature	Fresh seed oil	Laboratory-dried seed oil
α-Thujene	934	931	0.1	0.1
α-Pinene	941	939	1.7	2.3
Camphene	953	953	0.1	0.1
β-Pinene	976	980	3.2	3.4
Myrcene	991	991	0.7	1.4
α-Phellandrene	1002	1005	t	t
δ-3-Carone	1014	1011	0.1	0.1
p-Cymene	1023	1026	t	t
1,8-Cineole	1033	1033	84.5	86.0
(*Z*)-β-Ocimene	1040	1040	t	t
(*E*)-β-Ocimene	1050	1050	t	0.6
γ-Terpinene	1057	1062	0.2	0.5
cis-Sabinene hydrate	1067	1067	t	t
Terpinolene	1084	1088	0.1	0.2
trans-Sabinene hydrate	1096	1097	t	t
Linalool	1101	1098	0.1	0.1
α-Fenchol	1110	1112	t	t
cis-p-Menth-2-en-1-ol	1118	1121	0.1	0.1
cis-Pincarveol	1133	1139	t	t
trans-p-Menth-2-en-1-ol	1137	1140	t	t
Isobomeol	1159	1156	t	t
cis-β-Terpineol	1163	1163	0.6	0.4
Terpinen-4-ol	1172	1177	1.4	1.1
α-Terpineol	1188	1189	4.6	2.9
trans-Piperitol	1205	1205	t	t
α-Terpinyl acetate	1350	1350	0.3	t
Germacrene D	1472	1480	0.1	0.1
γ-Cadinene	1508	1513	t	t
δ-Cadinene	1524	1524	t	t
(*E*)-Nerolidol	1570	1564	1.0	0.2
Spathulenol	1581	1576	0.1	t
T-Cadinol	1644	1640	0.1	t
α-Muurolol	1656	1670	t	t

t = trace.
Source: Rout *et al.* (2003).

lead and copper levels were of close range (Table 4.6).

Husk oil

The pericarp (husk) of large cardamom yielded 0.18% volatile oil by the Clevenger hydrodistillation method. This oil was analysed for physical parameters, *e.g.* specific gravity (0.9148), refractive index (1.4733) and optical rotation (−7.700).

The volatile oil was subjected to GC-MS analysis and 37 compounds were identified, constituting > 98% of the total oil. The major compounds characterized were 1,8-cineole (38.7%), β-pinene (13.6%), α-terpineol (12.6%), spathulenol (8.3%), 4-terpineol (4.5%), germacrene D (3.0%), α-pinene (2.8%) and β-selinene (2.7%). GC and GC-MS data revealed that the 1,8-cineole content was less than 50% when compared with the seed oil (Naik *et al.*, 2004).

Non-volatiles

Pigments

Extraction of fresh large cardamom pod husks with methanolic HCl yielded a

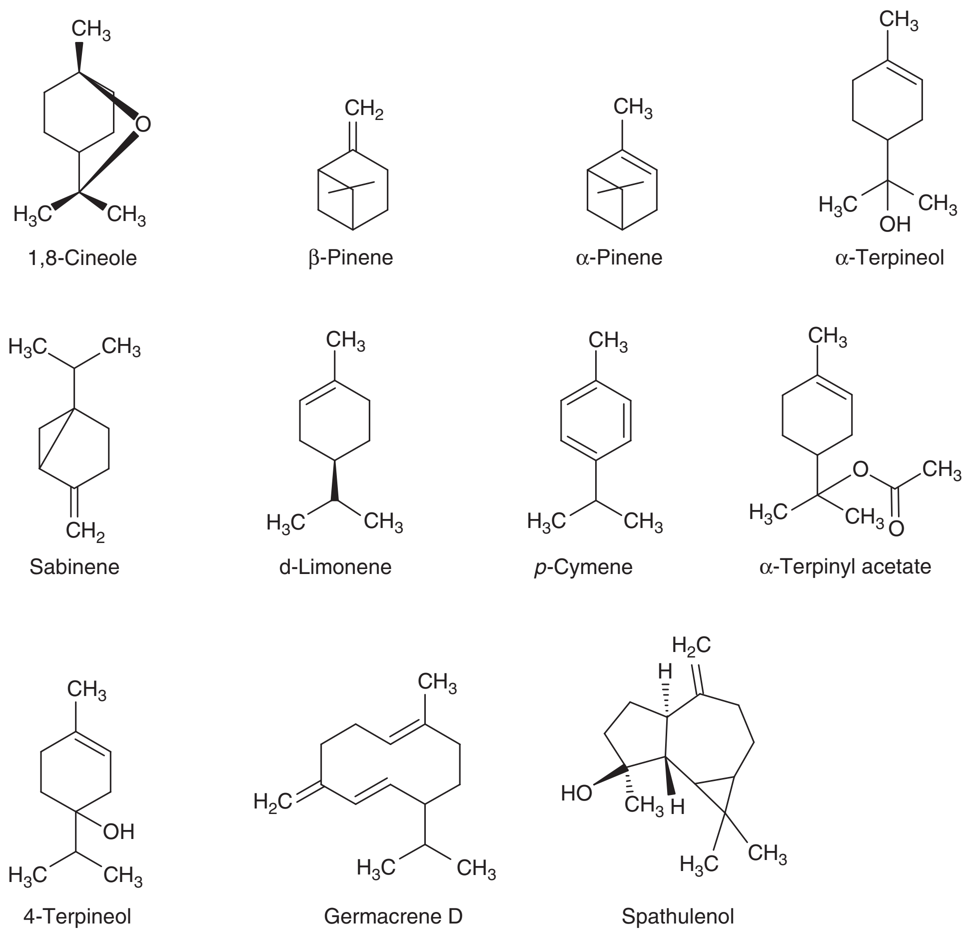

Fig. 4.1. Major essential oil components in large cardamom.

Table 4.6. Range of variation in the physical and chemical quality attributes of *Amomum subulatum* from the western regions of Sikkim, India.

Character	Minimum	Maximum	Mean
Moisture content (%)	7.2	14.9	10.5
Bulk density (g/l)	302.0	374.8	344.8
Husk to seed ratio	1:1.7	1:1.25	1:2.2
Anthocyanins (mg/100 g)	46.2	222.3	98.4
Volatile oil (%)	2.6	4.2	3.4
Total ash (%)	3.6	4.3	3.9
NVEE (%)	2.8	3.0	2.9
Cadmium (ppm)	0.06	0.07	0.07
Lead (ppm)	0.12	0.37	0.24
Copper (ppm)	5.14	9.68	6.33
Iron (ppm)	28.5	111.2	55.3

Note: NVEE - non-volatile ether extract.
Source: Naik *et al*. (2006).

mixture of two (deep pinkish-red) pigments. The pigments, present in the ratio of 1:2, were separated by paper chromatography, characterized as cyanidin 3-glucoside and cyanidin 3.5-diglucoside by chemical and spectroscopic analysis and confirmed by comparison with authentic samples (Naik *et al.*, 2004).

4.5. Medicinal and Pharmacological Uses

Large cardamom possesses the following medicinal properties: antiseptic (pulmonary), antispasmodic (neuromuscular), aphrodisiac, expectorant, anthelminthic, antibacterial (variable), cephalic, cardiotonic, diuretic, emmenagogue, sialogogue and stomachic.

Table 4.7. Distribution and diversified uses of different species of *Amomum*.

Species	Common name	Country	Use
A. aromaticum Roxb.	Bengal cardamom or Nepal cardamom	Eastern India, Pakistan	Rhizomes are used as condiment and flowering shoots are used in curries
A. A. compactum Soland	Round cardamom	Malaysia, Java	Fruits are used as condiment and spices
A. A. globosum Cour Cour	Round Chinese cardamom	China	Seeds are used as cardamom
A. Krervanw Pierre	–	Cambodia, Indo-China	Fruits are used as condiment and to flavour curries, sausages and cordials
A. maximum Roxb.	Java cardamom	Malaysia	Condiment
A. xanthioides Wall	Wild bastard Siamese cardamom	Burma, India	Condiment

Source: Arora (1985).

Table 4.7 summarizes the distribution and uses of the different species of *Amomum*.

Anti-inflammatory

In India, the spice is used broadly to treat infections in teeth and gums, to prevent and treat throat troubles, congestion of the lungs and pulmonary tuberculosis, inflammation of eyelids and also digestive disorders.

Species in the genus *Amomum* are also used in traditional Indian medicine. Among other species, varieties and cultivars, *A. villosum* is used in traditional Chinese medicine to treat stomach aches, constipation, dysentery and other digestive problems.

Antidote to snake venom

Reportedly, the spice is also used as an antidote for both snake and scorpion venom.

Hepatoprotective

The components in the volatile oil, e.g. 1,8-cineole, terpinene, terpiniol, sabinine, α-pinene and limonene, act as a tonic for the heart and liver, an appetizer, promote the elimination of bile and help reduce congestion of the liver. The oil is also useful in treating gonorrhoea.

Anti-ulcerogenic

Large cardamom fruit, commonly known as ‘Heel kalan’ or ‘Bari Ilaichi’, is used in the Unani system of medicine to treat gastrointestinal disorders. A crude methanolic extract and its different fractions, e.g. essential oil, petroleum ether (60–80°C), ethyl acetate and methanol fractions, were studied in rats for their ability to inhibit gastric lesions induced by aspirin, ethanol and pylorus ligature. A direct protective effect of ethyl acetate fraction on the gastric mucosal barrier was seen. The decrease observed in gastric motility brought about by essential oil and petroleum ether fractions suggests the gastroprotective action of the spice. These investigations validate the use of large cardamom in gastrointestinal disorders by Unani physicians (Jafri *et al.*, 2001).

Other uses

In medicine, cardamoms are fragrant adjuncts to other stimulants, bitters and purgatives. They are used in conditions like indigestion, vomiting, enlarged spleen, abdominal pains, rectal disease and mouth infections. The seed extract acts as a tonic for the heart and liver, is a bowel astringent and has hypnotic and appetizing properties. Cardamom skin is used for headaches, tooth ailments and stomatitis and its oil, applied to the eyelids, allays inflammation.

Large cardamom can also be put to a variety of industrial uses (Gupta *et al.*, 1984). The globous fruit stalks, usually discarded by farmers, can be used as a base of agarbathis (Pruthi, 1977; Chandrasekhar, 1987).

4.6. Specifications

The quality of large cardamom is based mainly on:

- External appearance, which provides the visual perception of quality; in particular, colour, uniformity of size, shape, consistency and texture.
- Flavour, influenced by the aromatic compounds.

The Spices Board of India has prepared a draft ISO with CFTRI, Mysore, which has been submitted to the Bureau of Indian Standards. The details are shown below:

Capsules	
1. Extraneous matter	Not more than 5% by weight.
2. Insect-damaged capsules	Not more than 5% by weight.
3. Moisture	Not more than 14% by weight.
4. Volatile oil % (ml/100 g)	Not less than 1.5% by weight.
5. Colour should be natural and capsules free from added colours.	
Seeds	
1. Moisture	Not more than 13% by weight.
2. Volatile oil	Not more than 2% by weight.
3. Total ash	Not more than 5% by weight.
4. Acid-insoluble ash	Not more than 2% by weight.
5. Extraneous matter	Not more than 2% by weight.
6. The seeds should be free from moulds and insects.	
7. Insect-damaged seeds	Not more than 2% by weight.
8. Colour and flavour	Should be natural and characteristic.

4.7. Conclusion

The demand for large cardamom in the export market is increasing steadily. The internal consumption of large cardamom is also increasing day by day, which is resulting in an exportable surplus. Used as a flavouring agent in various cuisines and also used in Ayurvedic medicines, India exports large cardamom to the Middle East, Japan and Russia.

Valued for its medicinal properties, this crop does not require much external input and is less labour-intensive, low-volume and non-perishable, with high economic returns. As the large cardamom grows well under shade in a humid environment, it can be cultivated under nitrogen-fixing tree species in moist wasteland along water channels, field bunds and terraces.

Large cardamom (*A. subulatum*) is the most important perennial cash crop of Sikkim, from where cultivation is spreading to the north-eastern states of India, Nepal and Bhutan. More than 85% of Indian production is from Sikkim. The spice has diversified uses in the fields of medicine and industry. Development of high-yielding superior varieties, combined with sustainable production, will definitely enhance the export value of the spice.

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