



CINNAMON

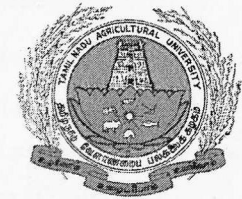
THE SWEET WOOD



Dr. J. D. NIRMALATHA
Dr. K. R. MANIKANDAN
Dr. J. PREM JOSHUA
Dr. C. GAILCE LEO JUSTIN
Dr. A. JAYA JASMINE

HORTICULTURAL RESEARCH STATION
TAMIL NADU AGRICULTURAL UNIVERSITY
PECHIPARAI – 629 161
KANNIYAKUMARI DISTRICT

2022



**CINNAMON
THE SWEET WOOD**

**Dr. J. D. NIRMALATHA
Dr. K. R. MANIKANDAN
Dr. J. PREM JOSHUA
Dr. C. GAILCE LEO JUSTIN
Dr. A. JAYA JASMINE**

**HORTICULTURAL RESEARCH STATION
TAMIL NADU AGRICULTURAL UNIVERSITY
PECHIPARAI – 629 161
KANNIYAKUMARI DISTRICT**

2022

CINNAMON - *Cinnamomum* spp. (Family: Lauraceae)

Cinnamon (*Cinna momum verum* Bercht. & Presi; Syn. *C. zeylonicum* Blume) is an important tree spice, valued for its aromatic bark. The dried bark of *C. verum* is the true cinnamon and cassia is obtained from various sources like Chinese cassia *C. cassia* Bercht. & Presl. (Syn. *C. aromaticum* Nees), Indonesian cassia – *C. burmanii* Th. Nees, Indian Cassia – *C. tamala* Th. Nees & Eberm, *C. bejolghota* Buch. Ham. and *C. impressivervium* Meissn

Cinnamon is mainly cultivated in Kannore (Kerala), South Kanara (Karnataka). Nilgiris, Lower Pulneys, Courtallam and Kanyakumari (Tamil Nadu) in India. The domestic production is about 200t of bark per year and about 60t is imported annually. The genus is native of South Western tropical India and Sri Lanka; consist of more than 250 species distributed in South East Asia, China, Australia etc. Sri Lanka is the leader in cinnamon production Seychellus and Malagay Republic are the other major producing countries.



Cinnamon of commerce is the dried inner bark of *Cinnamomun verum*. The bark, oil and oleoresion are the economically important products. Bark either as small piece or as powder is extensive used as spice all over the world. Increasing popularity of the preserved food products has ensured considerable

growth of this spice. Cinnamon bark is used for domestic culinary flavouring and for industrially manufactured sauces, candy, pickles and some beverages. According to the indigenous medicinal preparations, cinnamon bark is said to have carminative astringent, stimulative and antiseptic properties. It is more powerful as a local than as a general stimulant. It is prescribed as powder and as infusion but usually combined with other medicines. It checks vomiting and relieves flatulence.

Growth Habit

Cinnamon is a highly polymorphic, moderate sized, 25-35 feet high, evergreen, aromatic tree having a tendency to branch profusely at low level with strongly aromatic bark and leaves. Branchlets are slender and give the bushy nature. Bark smooth brown, inside creamish white, turning pinkish-brown on exposure, with a strong spicy smell, having pleasant, pungent and warm taste, up to 12mm thick. Leaf buds with small scales, finely silky leaf alternate, aromatic; glabrous, dark green and variable in size (2.5-7.5 x 5-16 cm). Panicles are terminal to sub-terminal or axillary, exceeding the leaves or slightly shorter than, up to 22 cm long and pale yellowish green in colour.

The flowers are borne in axillary and terminal panicles on the ends of the twigs. The individual flowers are very small, about 3mm in diameter, pale yellow in colour, with a foetid smell, and each subtended by a small ovate hairy bract. The calyx is campanulate and pubescent. The corolla is absent. Stamen has short, hairy filament with two small glands present at its base and a four-celled another opening by 4 small flap-shaped valves. The ovary is superior, unilocular with a single ovule, tapering to a short style. The fruits are usually

eaten by birds and so it is necessary to net the trees if seeds are required for planting. The fruit is a fleshy ovoid drupe, black and 1.5-2.0 cm long when ripe, with the enlarged calyx at the base.

Floral Biology

Flowering is from November to March. On an average, 13.83 days are required for the flower bud development from the stage of its visible initiation. The peak anthesis is from 11 am to 12 noon. Stigma receptivity is higher on the day of anthesis. The method of pollination does not appear to be known with certainty, but it is probably pollinated by insects, especially flies. Every flower opens twice in two stages. In stage one on the first day, when a flower opens, its stigma is receptive, and there is no dehiscence of anthers, and the stamens of the first whorl and those of the third whorl appear fused. The flower closes in the afternoon. In stage two, the next day, the anthers dehisce 30-60 minutes after the flower opening. After about five hours the flower closes and will not open again.



Crop Improvement

Genetic Resources

The introduction of *C. verum* from Sri Lanka and *C. cassia* from China to India in due course enhanced cinnamon production in India. The conservation of available variability of cinnamon in India and from exotic sources is carried out at the Indian Institute of Spices Research, Kozhikode; Regional Research Laboratory, Bhubaneswar; Kerala Agricultural University and Tamil Nadu Agricultural University. The IISR germplasm include 166 cultivated types, 35 related/wild types and 14 exotic accessions. The genus *Cinnamomum* has two centres of diversity in India, the North East region and the Western Ghats of South India. The species occurring in India, their distribution and description are presented in Table.1.

Table 1: Cinnamon (*Cinnamomum*) species occurring in South India, their distribution and description

Species	Common Name	Place of distribution	Features
<i>C. fillipedicellatum</i> Kostem	Wild cinnamon	South India, Western Ghats, Anamalais, Nilgiris, North western Ghats	Small tree, leaves opposite, with young leaves glabrous, tomentous underneath, pedicles filiform, 5-15mm long

Species	Common Name	Place of distribution	Features
<i>C. goanese</i> Kostem	Wild cinnamon	North Western Ghats	Leaves opposite with the basal lateral nerves reaching the leaf tip; lower leaf surface glabrous or with microscopical sparse, appressed hairs; fruits ellipsoid with the persistent utmost basal parts of the tepals on the rim of the deep fruits cup
* <i>C. macrocarpum</i> Gamble	Wild cinnamon	South India (Nilgris Anamalai)	Tree, bark and leaves giving faint smell of clove and aniseed; berries large up to 1" length, globose oblong, supported by a large thickened cub and pedicel. Rare
* <i>C. malabatrum</i>	Wild cinnamon	South India, Western Ghats	Leaves with minute hairs mainly on their lower surface, bark pale brown whitish inside; fruit cup shallow, crowned by the completed persistent tepals.
* <i>C. nicolsonianum</i> Manilal & Shylaja	Wild cinnamon	South India	Medium tree, large leaves, very smell panicles with very few flowers. Extremely rare.
* <i>C. perrottetii</i> Meiss	Wild cinnamon	South India, Western Ghats	A mountain species with ovate leaves, very densely hairy on both the surface the young emerging ones highly tomentose, more than older ones; bark tasteless

Species	Common Name	Place of distribution	Features
* <i>C. riparium</i> Gamble	Wild cinnamon	South India, Western Ghats	A graceful little tree, with long lanceolate narrow leaves and bright blue shining, ovoid berry 0.5" long. Rare
* <i>C. keralaness</i> Kostem	Wild cinnamon	South India, Western Ghats	Tree with light brown to reddish, odourless and tasteless bark, fruiting panicles pseudoterminal and axillary long lax fruit ellipsoid, cupula conical, slightly fleshy and not ribbed
* <i>C. tamala</i> Nees	Indian cassia	North East India	A moderated sized tree, leaves 3-10" panicles scarcely exceeding leaves perianth sparingly silk, pubescent, lobes deciduous in fruit, fruit small ellipsoid.
* <i>C. travancoricum</i> Gamble	Wild cinnamon	Western Ghats	A small tree, the leaves with basal lateral nerves not reaching the leaf tip, leaves elliptic or sub ovate elliptic, obscurely acuminate with the undersurface of the young leaves sericeous
<i>C. verum</i> Persl. (syn. <i>C. zeylanicum</i> Blume)	Cinnamon or Ceylon cinnamon	Sri Lanka	Small tree, bark aromatic, panicles medium-large and many flowers, fruit small, berry aoid, dark purple
* <i>C. wightii</i> Meissn	Wild cinnamon	Western Ghats	Bark slimy and without taste and odour; leaves opposite or spirally arranged, rigidly coriaceous, broadly elliptic; panicles very

Species	Common Name	Place of distribution	Features
			short, fruit cup conical, more or less fleshy, not ribbed. Rare
* <i>C. sulphuratum</i> Nees	Wild cinnamon	South India, Western Ghats, Nilgiris	A mountain species with lanceolate elliptic leaves, above glossy, beneath initially densely, late sparsely tomentellous
* <i>C. heynianum</i>	-	Western Ghats	Extremely rare or even extinct
<i>C. gracile</i> Hook. f.	-	Western Ghats	Small, shrubby species with small leaf and flower, very rare
<i>C. chemungianum</i>	-	Western Ghats	Recently reported. Very rare
<i>C. walaiwaense</i> Kostem	-	Western Ghats	Very rare

* Species endemic to Western Ghats

Variability

The variability studies with 101 open pollinated accessions indicated that a wide range and high efficient of variability exists for number of peeler shoots per plant, plant height, plant girth and spread. The results indicated the scope for further improvement through selection.

Four promising genotypes from among 300 cinnamon collections varied significantly for most of the characters related to growth and yield. The bark yield varied from 33.35 to 84.5 g, whereas the leaf yield (fresh) ranged from 1.47 to 3.69 kg. The oil percentage bark varied between 1.88 and 3.2, cinnamaldehyde content of oil from 66.77 to 70.23 per cent and the eugenol content from 5.71 to 8.61 of per cent. The relation between colour of young

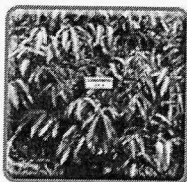
flushes and quality parameters were studied. Plants with purple coloured flushes had 29 per cent more bark oil as compared to green flush plants. The bark oleoresin and leaf oil content did not show any difference among such young leaf colours.

Varieties

A promising selection RRL (B) C-6 isolated from seedling progenies from Regional Research Laboratory, Bhubaneswar. This genotype, the best among the progenies, had stable high oil content and quality with 94 per cent eugenol in leaf oil and 83 per cent cinnamaldehyde in bark oil. Two high yielding and high quality cinnamon selections namely "Navashree" and "Nithyashree" have been developed at IISR which are selections from germplasm, the former from the collections in India and the latter from the introductions from Sri Lanka.

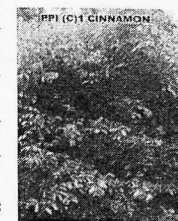
YCD-1

It is a cinnamon selection from Horticultural Research Station, Yercaud. It comes to harvest from third year onwards and can be maintained economically for 20 years. It gives a bark yield of 359.75 kg quills and 3800 kg of dried leaves/ha with high bark recovery of 35.3 per cent. It also has 2.8 and 3.0 per cent volatile oil in quills and leaves, respectively, and the regeneration capacity is moderately high with 19.2 harvestable shoots. Quills are sweet and light pungent in taste.

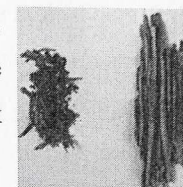


PPI 1

It is a selection from OP seedlings progeny introduced from Sri Lankan types, and released from Horticultural Research Station, Pechiparai. It has higher oil recovery from bark (2.9 percent) and leaf (3.3 percent). The bark recovery is 34.22 percent. It yields 980 kg fresh bark/ha and can be cultivated upto 100-500MSL.



Konkan Tej was developed by clonal selection at KKV, Dapoli which has got high bark oil (3.2%), cinnamaldehyde (70.23%) and eugenol (6.93%), yield 789.75g fresh bark 3.56 leaf per plant



"Sugandhini" is selection from Aromatic Medicinal Plant Research Station, Odakkali, KAU. It is recommended for cultivation in the midlands and highlands Kerala both in open and as intercrop in coconut gardens for the production of cinnamon leaf oil. Average leaf yield is 18 kg/tree/year and average bark yield is 1.2 kg/tree/ year. Leaf oil yield is 295 ml/tree/year or 125kg/ha and the eugenol content of the leaf oil is 94 per cent.

Crop Production

Soil and Climate

Cinnamon is a hardy plant, which tolerates a wide range of climatic conditions. The crop performs well from 300 to 350m above MSL and thrives up to 1000m above MSL. It flourishes in places with annual rainfall of 150-250cm with an average temperature of 27°C. A hot and moist climate is highly suited for cultivation of cinnamon and prolonged spells of dry weather are not

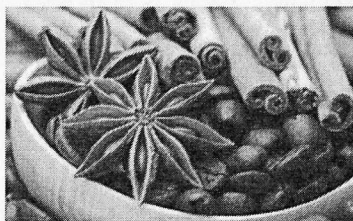
conducive for its growth. Infact the finest quality cinnamon from Sri Lanka is grown in the sandy soil of the coastal area in the Island. Cinnamon is a hardy plant, which tolerates a wide range of climatic conditions.

Cinnamon flourishes well in a wide range of soils including marginal soils with poor nutrient status. The quality the bark greatly influenced by the soil. Sandy loam rich in organic matter is best for cinnamon. In Sri Lanka cinnamon bark of the first quality obtained in white sandy soil. In the west cost of India cinnamon is cultivated in lateritic and sandy soils which are poor in nutrient status. Water logged and marshy areas may be avoided as they yield an undesirable produce.

Propagation

Seed

The common method of propagation is by seed. Cinnamon flowers in December-January and seed ripens in May-June. At higher elevations, it is one month late. The fruits are picked when the outer pulp



turns black. Seeds gathered, dried and heaped up in shady place till the pulp turns black. To free the pulp, the whole mass of seeds is trampled and then washed. After separation of the pulpy mass, the seeds are separated. The seeds are then dried in air taking care not to expose them under sun. If they are exposed to sun, seed coat will crack and the seeds get damaged. The seeds are sown in situ or in raised nursery bed or polythene bags containing a mixture of sand, well rotten cattle manure and soil (2:11). Seeds are sown in July-August

in the nursery and the seedlings are ready in December for planting. They may also be transplanted in April May before the monsoon sets in. Seeds are sown in the nursery beds at 10 x 20 cm apart and covered with soil for 3 cm and watered on alternate days, till a pair of leaves develops. They take about 2-3 weeks for germination. When they are 7 to 8 months old, they are potted and then planted in the field cleared of weeds.

Vegetative propagation

Propagation by cuttings is said to be useful. Older shoots failed to strike roots when compared to the young ones. Trials conducted at Tamil Nadu Agricultural University with hardwood and semihard wood cuttings treated with growth regulators like IAA, 2,4-D, IBA and NAA indicated that vegetative propagation in cinnamon is successful by using hardwood/semi hard wood cuttings treated with IBA 2500 ppm.

Layering is possible Between “Tongue” and ‘ring’ methods, the ring method of layering was more successful. The growth regulators Indole Acetic Acid and Indole Butyric Acid (50 ppm) are found to promote rooting of layers

Propagation by old stumps is also practiced and is believed to give quicker results. Extreme care is necessary to select old stumps from healthy trees of known performance. Plantations established through old stumps are very often susceptible to root injuries and even a slight injury to roots causes heavy casualties. Before the stumps are removed, the trees are sheared 15 cm away from the main projections and the stumps are removed by one stroke to avoid splitting of the bark. After removal of cuttings, the cut ends are smeared with cowdung.

Field Preparation and Planting

Ten to twelve-month old seedlings are suitable for planting. A spacing of 3-5 m between plants is recommended. Shade and irrigation are essential immediately after planting. Weeding and mulching reduce weed growth.

After care

It is essential to clear off all weeds from the planted area. Climbing plants, which will arrest the proper growth of the cinnamon plants, also should be removed. Three to four weedings are required a year for 2-3 years. Weeds should be burnt away from the plants. Cinnamon can be intercropped with coconut, pepper, cocoa and pineapple. The young plants are cut close to the ground level in order to facilitate the growth of side shoots. This is done until the whole tree assumes the shape of a low bush with the side shoots springing forth in profusion. The plants are coppiced after two years, the stems being cut within 10-15 cm from the ground and covered with earth. This encourages the formation of shoots, of which four to six vigorous ones are allowed to grow for further two years before harvesting. The stems which are kept straight by pruning are cut when they are 2-3m height and 1.2-5.0 cm in diameter. After cutting, the plants are pruned of all un-wanted or distorted shoots and stumps, and more soil is drawn up around them. The number of shoots in the young stools normally increase each year and reach a maximum after about eight years.

Manuring

Systematic manuring is rarely practiced in India for this crop. The Kerala Agricultural University (KAU, 1993) has recommended a fertilizer schedule

of 20:20:25 g of NPK per plant along with 20 kg of compost per year during the first year of planting which is to be gradually increased to 200:180:200g NPK and 50 kg of compost per year from 15th year onwards. Fertilizers may be applied in two splits during May-June and September-October.

Crop protection

Pests

The important pests affecting cinnamon trees viz, (1) cinnamon butterfly, (1) pink hopper and (ii) leaf eating caterpillars. Which have the common management practices are presented below.

Cinnamon butterfly: *Chilasa clytia*

This is the most destructive pest of cinnamon especially in younger plantation and in the nursery and is generally seen during the post monsoon period. This butterfly is widely distributed in the cinnamon growing tracts of Sri Lanka and South India. The first instar larva starts feeding on the lamina of the freshly emerged leaves while the subsequent instars feed on the tender leaves voraciously leaving only the mid ribs with portion of veins. Infestation by this pest may adversely affect the normal growth of the plant. The larvae feed on the tender leaves in the main field as well as in the nursery and cause severe loss.

Shoot and leaf webber: *Sorolopha archimedi* Meyr.

This is another destructive pest of cinnamon. The pest is abundant in the field during August. In severe cases of infestation, most of the leaves are rolled

up and eaten by the caterpillars. The continuous infestation of this pest on young plants reduces normal growth of plants.

Leaf webber: *Orthaga vitalis* Walk

The caterpillar webs up the leaves into cluster. The webbed leaves gradually dry up and are held together by the web. A severely infested plant show many such clusters on it and presents a sickly appearance.

Tussock moth: *Dasychira mendosa* Hbn.

The larvae feed on foliage of cinnamon. This is a polyphagous pest.

Leaf caterpillar: *Euproctis fraterna*

The larvae feed on the leaves and destroy the tender leaves during flushing season (August-December) and cause extensive damage.

Leaf miner: *Acrocercops* sp. Near *telestis* Mayr.

The young caterpillars mine into the tender leaves. They make linear and tortuous mines which end in blotches. The infested leaves present a sort of crinkled or distorted appearance. The infested leaf shows a peculiar type of blisters of irregular shape and size harbouring tiny caterpillars. Finally, the affected portions of the leaves get dried up and holes and formed in the lamina.

Citrus leaf miners: *Phylloenistis citrella* Staint

The larvae only younger tender serpentine mines in them. The larvae feed on the epidermal cells of the leaf leaving behind remaining leaf tissue quite intact the overlapping layer of leaf tissue, protecting the larva, is

comprised of smooth waxy cuticle of the tissue. Larvae feed in zig-zag lines and severely infested leaves get distorted in shape.

Red borer: *Zeuzera coffeae*

Red caterpillar bores into the stem branches and cause damage. In early stages of attack, young plants/branches usually show signs wilting. The infested usually one or two holes through which the excreta of the larva hangsout and accumulate at the of the plant. In severe cases, the branch or whole plant dries up.

Plant louse or jumping bag: *Paurapsylla depressa*

The jumping plant louse associated with foliage. Feeding of the nymphs stimulates development pale green yellowish galls on leaf surface. The galls are mostly epiphyllous, ovoid or conical and unilocular and are located on the leaf blade and on the terminal buds. Formation galls results in major crop loss.

Wax scale: *Ceroplastes rubens* Mask

The scales are usually seen on midribs, though sometimes, they are observed on the entire lamina. They suck the sap from leaves and the leaves become black due to the development of sooty mould.

Pink leaf hopper: *Bothrogonia* sp

This is a seasonal pest. The nymphs and adults are found at the leaf base during the rainy months causing direct damage by piercing tissue and sucking sap from the veins of young leaves causing chlorosis. The adults is a medium

sized elongate, pinkish bug with black spots on the head and thorax; hind wings are membranous and smoky. This disappears from October onwards.

Management

- Whenever, the caterpillar pest occurs the pest problem can be minimised by way mechanical destruction.
- If required, spraying of contact insecticides like methyl parathion, phosalone, quinalphos, fenthion etc. at 0.05 percent could be done to minimise the attack.
- Whenever, the leaf miner attack is heavy, spraying of monocrotophos or phosalone or imidacloprid at 0.05 percent will give substantial control.
- Psyllid bugs are not found to occur as regular pest. Leaf hoppers are also very minor important pests at present. However, if these insects are noticed in pests from, application systemic insecticides, like monocrotophos, methyl demeton, dimethoate etc. at 0.05 per cent will control these pests.
- The larvae of the red borer could be killed by plugging the bore hole after applying a tablet of celphos. Alternatively the bore hole can be plugged with cotton wool soaked in monocrotophos 0.2 per cent.
- Monocrotophos can also be injected @ 0.5ml of formulation 36 WSC undiluted per plant. The efficiency of monocrotophos injection could be improved by drilling a fresh artificial hole for this purpose.

Leaf miner (*Gonopomorpha civica*, *Phyllocnistis chrysophthalma*)

Infestation by the leaf miner (*Conopomorpha civica*) is more common during the monsoon period and generally nursery seedlings are seriously affected. The adult is a minute silvery grey moth. The larvae are pale grey initially and become pink later measuring about 10 mm in length. They feed on the tissues between the upper and lower epidermis of tender leaves resulting in linear mines that end in blister like patches. The infested leaves become crinkled and the mined areas dry up leaving large holes on the leaves. Spraying quinalphos 0.05% during emergence of new flushes is effective in preventing the pest infestation. Many other leaf feeding caterpillars and beetles also occur sporadically on cinnamon feeding on tender flushes. Application of quinalphos 0.05% would keep them under check.

Symptoms

Larvae of leaf miners mine the leaves and eat the chlorophyll. The affected leaves become dried.

Management

It can controlled spraying monocrotophos (0.05%).

Leaf and shoot webber (*Sorolopha archmedias*)

Symptoms

The larvae web the tender leaves and feed on them. It affects the growth of the young trees.

Management

The pest can be controlled effectively by spraying of monocrotophos or methyl demetan or dimethoate 0.2 per cent.

They can be controlled by dusting with carbaryl. Leaf feeding caterpillars on older seedlings could be controlled by spraying 0.05 per cent quinalphos.

Diseases

Cinnamon suffers comparatively from a few diseases.

Stripe canker (*Phytophthora cinnamomi*)

Symptoms

In the affected plants, canker is found on the trunk and branches particularly, on young trees of various *Cinnamomum* species under poor drainage conditions. Vertical stripes of dead bark occur near the ground level.

Management

Maintain proper drainage during rainy season.

Red Leaf spot: *Colletotrichum capsici*

Symptoms

The infection appeared as small red circular spots near the margin of the leaves, which later extends and cause reddish elongated spots with dark red margins. In severe cases, the symptom can be seen on the entire leaf lamina, leading to drying and defoliation. Shot hole symptoms were also observed. In the centre portion of the spots, several black dots representing the fructification of the fungus.

Management

Spray any copper fungicides (0.1 per cent).

Leaf spot and Die back (*Collectotrichum gleosporioides*)

Symptoms

The fungus causes dark brown spots in the leaf surface initially and later stages cause drying of leaves and twigs.

Management

The disease can be controlled by spraying 1 per cent Bordeaux mixture.

Pink disease (*Corticium javanicum*, *Corticium salmonicolor*)

Symptoms The fungus attacks cinnamon plants during rainy season. It develops a pale pinkish white crust on stems, destroying cambium layer and causing death of the shoot or twig.

Management

Spraying 1 per cent Bordeaux mixture also can control this disease.

Damping off (*Diplodia* sp.) and rot

Symptoms

Various rots are reported on cinnamon viz, root-rot (*Rosellinia* spp.), brown-rot (*Phellinus lamaensis*) and white rot (*Leptoporus lignosus*). The pathogen produces brown spots in the stem or root portion and cause death of the plants.

Management

Against the rot and twig blight, spraying of 1 per cent Bordeaux mixture at interval of 1-2 months has been suggested as preventive method.

Gray blight disease (*Pestalotiopsis palmarum*)

Symptoms

The fungus produces brown spots in the leaves and cause drying of leaves.

Management

Spraying of benomyl at 500 ppm and captafol at 100 ppm can control the leaf blight.

Harvest and Yield

Coppicing is practiced from second or third year onwards. Stems are cut during rains to facilitate peeling. Best time for peeling is when new flushes and leaves are hardened after a rainy season. Plants are coppiced to a height of 12 cm from the ground level. The subsequent harvest is made between 12-18 months after. The side shoots are also cut so that the plant assumes the shape of a low bush and a bunch of canes suitable for peeling are available subsequently. The regular peeling operations are commenced from fourth or fifth year depending on the extent of peeler shoots available. The best quality is obtained from the thin bark of shoots in the centre from the middle portion of shoots. Fully developed cinnamon shoots of 1.5-3.0 cm diameter harvested during rainy season gives good quality bark and high yield. The cut stems are collected, tied and bundled and carried to the peeling shed. The cut stems are

subjected to scraping and peeling operations. After scraping the outer skin, the peeling of the bark is done carefully using specially made knife.

Post harvest handling and Processing

Preparation and curing of bark require sufficient expertise. The various steps involved are (i) cutting of branches of the right size and shape in the right season at the right stage of maturity; (ii) scraping of outer rough corky layer, (iii) peeling and skillfully removing the bark from the inner wood and (iv) piping and preparation of quills, quillings, featherings and chips.

Curing of Barks

The peels are gathered and kept overnight under shade for what is called fermentation or curing. However, while no real fermentation process develops during the course of a night, a little softening of the bark does occur with the result peel become pliable for the ensuing piping operation.

Cutting and Peeling

Cutting is followed by scraping and peeling operations. The peeling is a specialized operation peculiar to this industry which requires some skill and considerable experience. It is done by using a specially-made knife which has a small round end with a projection for scraping the outer skin. First make a longitudinal slit from one end to the other. Then by working the knife between the bark and the wood, the bark is ripped quickly. If there is any difficulty in peeling the shoots are rubbed between wooden blocks to loosen the bark. This operation renders peeling easier. The shoots cut in the morning are peeled on the same day.

Preparation of Quills

The bark, as it dries, contracts and assumes the shape of a pipe otherwise known as 'quill'. The smaller quills or pipes are inserted into larger ones to form compound quills. They are then arranged systematically end to end in lengths of about 90 cm.

Drying

The quills are rolled by hand when they are soft and fresh and after rolling, they are dried on mats in shade. The drying lasts for 2 to 5 days, depending upon the weather and the type of bark. When drying is complete, the bark is collected and packed in bundles of different grades for marketing. The barks, which are broken into pieces and those taken from very tender shoots, are not suitable for the preparation of quills. These are also dried in the sun and graded as quillings and featherings respectively. Yet another grade of bark is the cinnamon chips obtained by drying the thin peelable bark removed in small chips from over-matured shoots.

Grading

Cinnamon is available in the market in different grade designations in different countries, but the more common are the following 4 grades accepted by the ISO and IS1, that are graded according to their length, breadth and thickness.

Quills

They are the long compound rolls of bark upto 1 m in length, which constitute the best grade.



Quillings

During the course of grading and transportation, some breakage of quills takes place. Besides, the smaller pieces left after the preparation of quills also goes into this second quality cinnamon, known as 'quillings'. They are, of course, genuine cinnamon and are mainly used for grinding and also for the distillation of the cinnamon bark oil.

Featherings

This grade consists of the inner bark of twigs and twisted shoots, which cannot give straight quills, or quillings of normal length. Thus, they are also genuine and are used in the same way as quillings. However, they often contain small chips.

Chips

These include the bark pieces obtained from thick branches and stems, trimmings of the cut shoots before they are peeled and shavings of outer and inner barks. The chips are also obtained from small twigs by beating or hammering and odd-pieces of outer bark.

They invariably contain less inferior bark and woody material. This admixture is labelled chips, which constitute the most inferior grade of

cinnamon. However, there are no standards for cassia and cinnamon under Agmark and for cassia under ISI yet.

Composition

Moisture: 9.9%; protein: 4.6%; fat (ether extract): 22%; fibre 20.3%; carbohydrates: 59.5%; total ash: 3.5%; calcium: 1.6% phosphorus: 0.05%; iron: 0.004%; sodium: 0.01%, potassium: 0.4% vitamins (mg/100 g)- vit. B: 0.14; vit B₂: 0-21; niacin: 1.9%, vit C: 39.8%; vit. A: 175 IU per 100g; calorific value (food energy): 355 calories per 100g. Composition varies according to the quality and region

Packaging of Different Commercial Classes of Cinnamon Bark and Powder

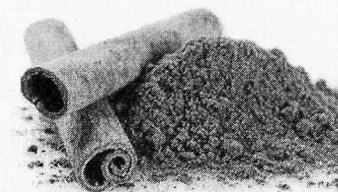
Whole Cinnamon

The different commercial classes of whole cinnamon are usually packed as follows

- i. Cinnamon, type Sri Lanka in cylindrical bales of about 45 kg each
- ii. Cinnamon, type Seychelles and type Madagascar in bales of about 50 kg each.
- iii. Cinnamon, type Seychelles quills and quillings are packed in wooden boxes of about 100 to 150 kg each.

Cinnamon Powder

Cinnamon powder shall be packed in clean, sound and dry containers made of a material which does not affect the product or its flavour. In addition, the containers shall protect the cinnamon powder against moisture and loss of volatile matter.



Packing of Cassia and Cinnamon and their Products

Cinnamon quills are exported in bundles packed in 25 kg bales covered with jute sacking and bound with metal strapping. Cinnamon destined for grinding is packed in pressed bales to reduce bulk. Cassia is also packed in 50 kg bales but is not compressed. Minimum quantities required are normally 5 ton lots. Cinnamon bark oil is packed in 10 kg capacity screw top aluminium containers, two containers to a case. Cinnamon leaf oil and cassia leaf oil are packed in epoxy resin lined 180-200-kg capacity steel drums.

For smaller quantities, the oils may be packed in high density polyethylene (HDPE) containers but lengthy storage therein is not recommended. Minimum quantities purchased by importers vary from as little as 20 kg for the expensive bark oil to 1 tonne lots for the leaf oil.

The cassia and cinnamon oleoresins are usually packed in polyvinyl chloride (PVC) plastic pipes of 15-20 or 25 kg capacity each. Minimum quantities are variable but could be as little as 50-100 kg, although larger quantities are preferred.

Storage of Cinnamon and Fumigation

Containers of cinnamon should be stored in covered dry premises, well protected from the sun, rain and excessive heat. The storeroom should be dry, free from objectionable odours and proofed against entry of insects and vermins. The ventilation should be controlled so as to give good ventilation under dry conditions and to be fully closed under damp conditions. In a storage warehouse, suitable facilities should be available for fumigation as well.

Transport of Cinnamon

The containers should be so handled and transported that they are protected from the rain, from the sun or other sources of excessive heat, from objectionable odours and from cross infestation, especially in the holds of ships.

Processed products

The commercial products of the cinnamon and cassia trees are (1) whole and ground cinnamon/ cassia, (2) essential oils, and (3) oleoresins

Cinnamon/Cassia Bark Oil

Cinnamon bark contains 0.5 to 1.00 per cent volatile oil. It is reported to vary from 0.95 to 3.55 per cent. The essential oil, generally manufactured the USA and Europe, is steam distilled mainly from cinnamon chips and refuse left over after preparation of quill for the spice trade. Bark the following properties: specific gravity 15.5°C: 0.0150-1.030; optical rotation 20°C: 0 to -8°C refractive index at 20°C is 1.565-1.599. It is light yellow colour when freshly distilled and changes to red on storage. It contains cinnamaldehyde 60-75%,

eugenol and benzaldehyde etc. Synthetic cinnamaldehyde and cinnamon leaf oil are the common adulterants for bark.

Cinnamon leaf oil

Cinnamon leaves and very tender twigs/shoots are collected, dried partial shade for a day or two to expel most of the moisture and transferred to big stills which steam under 15lb pressure is passed through the bottom of the metallic stills/boilers. This process of steam distillation continued for 7-8 hours and the distillate after cooling through condenser collected. The oil being heavier than water be easily separated from water by the decantation and filtration process. The being aggressive/corrosive in nature is packed and stored in dark-brown glass containers. Its yield varies 1.6 to per cent. It has pungent odour, hot taste and contains 70-80 per cent eugenol and traces of cinnamic aldehyde. The oil is yellowish with slight camphoraceous odour resembling that of clove oil. It has a specific gravity at 15.5°C: 1.045-1.055; optical rotation at 20°C: 1 to +3°; refractive index at 20°C: 1.530 to 1.548. it contains eugenol 70-90%, cinnamaldehyde and benzaldehyde.



Physico-chemical Quality Specifications of Cinnamon-Leaf Oil

Physical specifications. The oil should be a bright yellow clear liquid, free from sediment, suspended matter, separated water and adulterants when tested. It should be soluble in 2 volumes of 70 percent alcohol (ethanol).

Cinnamon and Cassia Oleoresins

Cinnamon and cassia oleoresins are extracted by using a suitable organic solvent from commercial species of cinnamon and cassia, notably from chips. Bark is distilled for the preparation of oleoresin and the recovery is about 10-12 per cent. It is a dark brown liquid containing 50 per cent of volatile oil and has to be diluted before using it as a flavouring agent. Cassia oleoresin is normally produced from Indonesian cassia which is much cheaper than Chinese cassia, Oleoresins are mostly manufactured in Western Europe and the USA

Other Products

The other minor products are (i) root bark oil (ii) cinnamon seed oil (iii) cinnamon buds for flavouring and spicing goods like quills and quillings

Packaging and Storage

Packing. The material (oil or oleoresin) shall be supplied in air tight and preferably amber coloured glass, aluminium containers, permitting a minimum of air space, or as agreed to between the purchaser and the supplier.

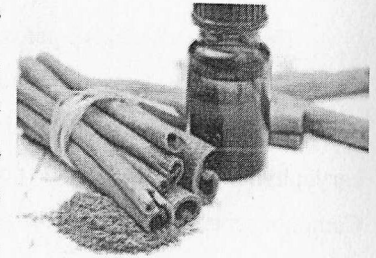
Storage. The material shall be protected from light and stored in a cool and dry place.

Uses

Cinnamon is a very useful spice tree. Every part of the tree, viz. bark, wood, leaves, buds, flowers, fruits and roots, all find some use.

Stem Bark

Cinnamon bark is one of the most popular spices in use in every home. It has a delicate fragrance and a warm agreeable taste. It is extensively used as a spice or condiment in the form of small pieces or powder. It is aromatic, astringent, stimulant and carminative and also possesses the property of checking nausea and vomiting. Cinnamon is used for flavouring confectionery, liquors, pharmaceuticals, soaps and dental preparations. Powdered cinnamon is a constituent of chocolate preparations made in Spain. Cinnamon is also used in candy, gum, incense, soaps and perfumes. Cinnamon has also been found to help diabetics in digestion of sugar.



Stem Bark Oil

Bark oil is extensively used for flavouring confectionery, liquor, pharmaceuticals, soaps and dental preparations. It has a high germicidal activity but on account of its irritant properties, it is not used as such. It is also a fungicide. It has the cordial and carminative properties of cinnamon without its astringency and is employed as adjuvant in stomachic and carminative medicines. As a powerful local stimulant, it is sometimes prescribed in flatulent colic and gastric debility.

Cinnamon Leaf Oil

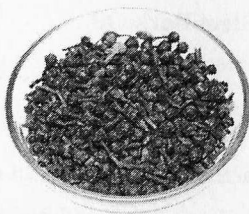
Cinnamon leaf oil equals clove oil in eugenol content (70-95%), which makes it useful in perfumery, cosmetics and flavouring industries. It is used in rheumatism.

Root Bark Oil

The root bark yields 3 per cent oil which differs from both stembark and leaf oils. It is a colourless liquid with a camphoraceous odour. It contains camphor, pinene, cineole, dipentene, phellandrene eugenol, safrole, caryophyllene, borneol, and possibly cinnamic and benzoic aldehydes. Camphor separates out on allowing the oil to stand. The oil, however, is not an article of commerce.

Seed Oil

The seed contains 33 per cent fixed oil, formerly used for making candles. The oil, is also called 'cinnamon suet' is obtained by boiling crushed ripe fruits suspended in water. The oleaginous matter rises to the surface and solidifies on cooling.



Cinnamon Buds

Cinnamon buds are as good for flavouring and spicing as the bark itself.

Cinnamon Wood

Cinnamon wood provides a soft timber for use as a low-grade board wood. Timber is moderately soft, not very strong, seasons without difficulty,

but warps, splits, cracks, and is liable to train. It is faintly scented, straight-grained, medium and fairly even-textured. Thus, almost every part of the cinnamon tree is useful in one way or the other.