CINNAMON OR TRUE CINNAMON

NOMEN CLATURE:

BOTANEAL NAME: Cinnamonum zeylanicum Blume

SYNONYM: Cinnamonum verum

FAMILY: Lauraceae

Indian names:
Bengali. Gujarati, Marathi, Oriya, Punjabi, Urdu :- Dalchini
Hindi: Dalchini, Darchini
Kannada, malayalam: Lavangapatti
Sanskrit: Darushila
Tamil: Sanna lavangappatti

DESCRIPTION AND DISTRIBUTION

Cinnamon, Nutmeg, clove and allspice are the important tree sps., grown in certain pockets of Kerala, Karnataka and Tamilnadu. While the production of tree sps., in India is approximately 5000 tones per year, the requirement is around 8000 tonnes. We import 2500 tonnes of clove, 300 tonnes of nutmeg, and 60 tonnes of cinnamon causing a drain in foreign exchange to the Rs. 250 to 300 million. Thus there is a lot of scope for raising tree sps., in the western and eastern ghats of south India, north-east region and Andamanislands.

Cinnamon was one of the first spices priced and enjoyed by man since the early days of civilization. It was precious not only as a flavoring agent for food, but was esteemed as a medicine, as a perfume and as one of the aromatics burned as incense. The Egyptians were importing cinnamon nearly 2000 years before Christ; wealthy Romans luxuriated in cinnamon scented baths. Every medieval magician kept mentioned it in their herbals, and even now use it medicinally.

Cinnamon is one of the most import tree spices of India. Like its cousin Cassia, Cinnamon consists of layers of dried pieces of the inner bark of branches and young’s shoots from the young tree Cinnamonum zeylanicum, which are obtained when cork and cortical parenchyma are removed from the ‘whole bark’. The thickness of the bark ranges from 0.2 to 1.0 m.m pure cinnamon is from any admixture with Cassia which is considered inferior to the former in appearance, flavor and odour. As possible
morphologically to distinguish one from the other in the whole form, it is difficult to identify them in powder form.

The quality of cinnamon depends, among other factors, on the region where it is grown. Ceylon Cinnamon and cinnamon from the SEYCHELLES Island are considered to be among the best. In India, cinnamon is grown on the West coast. At Anjarakkandi, Cannamore district, Kerala, there is a 248 acre Randa Tara cinnamon plantation – one of the biggest and perhaps the oldest cinnamon plantation in Asia. It also grows on the Western Ghats, from South Canara southwards at lower altitudes.

**VARIETIES OF CINNAMON**

Several cultivars are known, but mostly sweet or honey types are cultivated extensively. For bark and bark oil, 2 varieties of cinnamon viz., Navashree (sl 63) and Nithyashree (IN 189) yielding 55.6 kg and 54.2 kg dry bark/ha/year, respectively have been recommended for cultivation. These were selected based on their regeneration capacity, yield and quality. They have leaf oil recovery of 2.8% & 3% and eugenol content of 62% & 78%, respectively. A eugenol-rich leaf oil yielding cinnamon variety Sugandhini (ODC-130) with a leaf oil yield of 300 ml/tree/year, oil recovery 1.6% on fresh weight basis (3.7% on fresh weight basis) and eugenol 94% is recommended for leaf oil. Young flushes of IISR Navashree are purple in colour which turn into green in 7–10 days, while in IISR Nithyashree this occurs in just 2 days. Both the lines are recommended for all cinnamon growing regions of the country. SL 63 (IISR Navashree) is a superior open pollinated selection from Sri Lankan introductions. IISR Nithyashree is another superior open pollinated selection from elite tree from Anjarakandy, Cannamore.

**GENETIC RESOURCES OF CINNAMON**

Cinnamon and Cassia are like cousins and these are the two oldest spices known to mankind. Cinnamonum verum is the true cinnamon of commerce. Cassia is obtained from various like C. cassia, C.burmanii, C.loureirii and C.tamala.

**ORIGIN AND DISTRIBUTION**

Cinnamonum schaefeffe (layraceae) is a large genys having more than 250 sps., distributed in south and south-east asia, China and Australia. only a few sps., are important commercially. Cinnamon is the dried bark of Cinnamonum verum (syn. C. zeylanicum). It is indigenous to Sri Lanka which produces the largest quantity and best
quality of cinnamon. Seychelles and Malagasy Republic are the other major cinnamon producing countries.

CINNAMON

Cinnamon was first introduced in India from Sri Lanka. Cinnamon is cultivated in South India, especially in the states of Kerala, Karnataka, and Tamil Nadu. The cultivation is more prevalent in the hilly regions of the Western Ghats. The oldest plantation of cinnamon is the Anjarkandy Estate in the Cannamore district of Kerala. The planting material was said to be brought by European settlers from Sri Lanka. In Sri Lanka, distinct cultivars are prevalent, such as sweet honey cinnamon, camphor cinnamon, snake cinnamon, astringent cinnamon etc., of these only sweet honey cinnamon is cultivated commercially.

The South Indian sps., of cinnamon was studied by Gamble(1912) and more recently by Kostermans91913). 12 sps., of cinnamon were reported to be endemic to South India .little is known about the origin or inter relationships of C. verum. In a cluster analysis study of the South Indian sps., C. verum was found to be more closely related to C. malabatrum.

OTHER RELATED SPS

Among the economically useful related taxa, camphor is important as a source of camphor, used in many pharmaceutical preparations. C.glaucescens (sughanda kokila) is a Nepalese sps., the oil if which is used in perfumery. The immature fruits of some sps., like C. cassaia constitute the ‘cassia buds’ ( also called ‘kala nagakesar’), used extensively in the preparations of pan in India.

CYTOLOGY

The earliest cytological studies of cinnamon were done by Tackholm and Solderberg (1917) and reported a somatic number of 2n=24 in C.sieboldii. later studies confirmed 2n=24 as the somatic number for C. verum on the basic number x=12. the remarkably uniform chromosome number in a primitive genus like Cinnamonum (lauraceae in general) is unusual and this indicated that polyploidy has not played any role in the evolution of this genus.
TAXANOMY

Cinnamomum verum is a medium sized tree with smooth grey, fragrant bark, terminal bud with few inconspicuous bud scales, early caduceus. Bark is the economically useful part of cinnamon. The bark tissue is characterized by secretion cells containing mucilage or oil. The presence of islands of sclerenchyma in the pericyclic region is a characteristic feature of certain spp., including C. verum and C. cassia. These bark characters are useful in the detection of adulterations of true cinnamon with wild cinnamon.

Leaves variable in size, ovate, ovate- lanceolate or elliptic, opposite, triplinerved, the two basal or sub basallateral nerves, strongly ascent, often reaching the tip of the leaf. Hairs simple when present; oil and mucilage cells are always present in both mesophyll layers. Idioblasts are also present in the palisade and spongy parenchyma.

Flowers in panicle, pseudoterminal many flowered. Flowers pale yellow, perianth silky, bracts deciduous, actinomorphic, bisexual, trimerous, perigynous, perianth in two whorls of these each, stamens 9+3 in four whorls of three each on slender filaments, the innermost row modified into staminodes rather well developed with stalks. Fertile stamens show valvular dehiscense. Ovary superior, one celled with one pendulous ovule, style well developed with triangular stigma.

Fruit is a fleshy ovoid berry, black to purplish black, glossy, one seeded. The perianth tube growing out into a more or less deep fleshy cup in which the base of the fruit is seated. The tepals at the rim are indurate and persistent entirely or only partly.

POLLINATION

Flowers are adopted to cross pollination. Each flower opens on 2 consecutive days; the first day the stigma is receptive and on the second day the anthers dehisce. The pollination agents are honey bees.

GENETIC RESOURCES

In order to collect and conserve the available variability in these crops, systematic surveys have been made since 1976 in different parts of India. Exotic collections have also been made in cinnamon. These indigenous and exotic germplasm collections are being maintained at the germplasm repository at NRC for spices Calicut. They include
166 cultivated types and 35 related and wild types. 14 exotic accessions of cinnamonum verum from Sri Lanka are also maintained. The related and wild sps., of cinnamon were collected from the western ghats and North Eastern India. These include C. camphora which is not a spice crop but an economically important tree which yields camphor oil and the south Indian sps., like C.malabatrum, C.perotetti.

DOCUMENTATION AND EVALUATION

The documentation and evaluation of cinnamon germplasm, is carried out based on a minimum descriptor prepared at NRCS Calicut. Cataloguing is done based on various morphological, yield and quality attributes. wide variability is observed as cinnamon is adopted for cross pollination.

MORPHOLOGICAL CHARACTERS

Of all the characters of cinnamon, leaves are the most variable. The variability is seen both within and between the sps., the leaf length varies from 50-150 mm, and leaf breadth from 20 –70 mm, petioles 10-70 mm, which is grooved on the upper surface. Difference in leaf shape includes ovate, ovate- lanceolate, elliptic and elliptic- ovate. The flushing time coincides with the monsoon. 4 different flush colours were noted among the cinnamon collections, viz., pure purple, purple dominated with green, green dominated with purple and pure green. Leaf colouration is due to the presence of a cyanin glycoside (anthocyanin).

CROP MANAGEMENT

Since both cinnamon and cassia have similar requirements of soil, agroclimate and cultural practices, the cultural practices described below are applicable to both cassia and cinnamon, which are akin and belong to same family; Lauraceae

SOIL AND CLIMATE

Cinnamon and cassia flourish well in the humid regions, receiving an annual rainfall of 150-200 cm with an average temperature of 27°C. prolonged dry spells without rains are unfavourable for their growth. They can come up in places from almost sea level to an elevation of 1000m above sea level.
Cinnamon is a hardy plant which can be grown in almost all types of soils under a wide range of climates. The quality of the bark is highly influenced by the soil and ecological factors. In Sri Lanka, which is the major cinnamon growing country in the world, it is cultivated on the white sandy soil. Well drained deep sandy soil rich in humus are ideal for cinnamon cultivation. The best economic produce is obtained when grown in silicaceous sandy soils, and the yield is high in other types of soils under Sri Lankan conditions. Waterlogged and marshy areas may be avoided.

**PROPOGATION**

There are 3 methods of propagation of cinnamon;

1) Cinnamon is propagated through seed. This is the easiest and the most widely adopted method. It is usually necessary to bag fruits which are either packed from tree or the fallen ones collected from the ground. Ripe purple seeds would be ready for collection during June – July. Seeds are removed from the mother trees with desirable characteristics like
   a) smooth bark
   b) erect stem
   c) easy peeling of bark
   d) vigorous growth
   e) free from pests and diseases
   f) other good qualities like sweetness, pungency and flavour of bark.

Propagation by tissue culture is also successful at the NRCS (1994), but it still awaits its commercial adoption. Selected adoption. Selected seeds are washed free of pulp and then sown without delay as the seeds have a low viability. Seeds are sown in nursery beds in pits filled with a mixture of sand: soil: cattle manure (2:2:1). In beds, seeds are sown in holes 2.5 cm deep and 10 cm in diameter in rows of about 20 cm apart. About 20 seeds are sown or it may be reduced to 8 per hole. Beds of 1m width and convenient length were suggested by Bavappa and Ruettiman. Seeds may be sown in rows of 12 cm apart and covered with a thin layer of soil. Seeds are sown in nursery beds during July-August in India. Beds may be watered and shade provided during early stages.
Instead of sowing in nursery beds, they may be sown in polythene bags of 10cm×20 cm size filled with soil and compost. The seeds germinate within 15-20 days. Frequent irrigation is necessary for maintaining adequate moisture.

2) it can also bepropogated by planting cutting and layers.

3) in old/ established plantations, propogation is done by transplanting old cinnamon tree-stumps, which are dug out along with as much soil with roots as possible and planted in sites already made in the field. They are given good shade and watering for 2-3 weeks when buds sprout. Greater care is required in digging out stumps to ensure no serious injury to the roots, which will cause death to the stump. The main advantage in this method of propagation is that the twigs would be ready for harvest in 1 year compared to 3 years in seedlings.

ROOTING RESPONSE OF ELITE CINNAMON LINES

The objective of this study was to standardize an ideal method for propogation of cinnamon by cuttings and to find out the rootability of 9 elite lines viz., SL 5, SL 44, SL 53,SL63, SL65, IN189, IN203, IN310,AND IN312. ROOTING OF TERMINAL CUTTINGS OF CINNMON WITH IBA 2000ppm was standardized. 9 elite lines of cinnamon, superior in their yield and quality were studied for variability in their rooting capacity. Cinnamon line SL5 was the best with high rooting % and good development of primary and secondary roots.

Cinnamon fruits ripen in July- August. Fully ripe fruits are collected when they fall down. Bats, crows, wood- pigeons and other birds relish and swallow the fruits of cinnamon. The fruits should, therefore, be protected and handled promptly. The seeds pass out along with the bird- castings without losing viability.

And thus cinnamon seeds are disseminated in forests etc., The fleshy berries are heaped in the shade to soften and rot. The mass is then trampled and pulp free seeds are then washed and dried in shade and sown without much delay. Frequent irrigations are necessary for maintaining adequate moisture.

Kannan and Balakrishnan (1967) sowed freshly harvested daily for the first 7 days and weekly for 7 weeks thereafter. The highest rate of germination of 94% was obtained by sowing the seed on the third day of its harvest. By the end of second week after
harvesting, the germination was reduced to 52%; after 40 days of storage of seeds, there was a complete loss of viability. Besides, the seeds sown during the first week germinated within 20-25 days; afterwards 32-42 days were required for germination. As the seeds have a short period of viability, they are sown without much delay. Raised seed beds are made 1m wide and of suitable length with adequate provision of drainage. The seeds are sown in lines 12 cm apart and are covered with a layer of soil to a thickness of about 2.5 cm. The beds have to be provided with artificial shade and watered regularly. Germination occurs in about 20-25 days. The seedlings are transferred to mud pots or polyethylene bags when they are 6 months old.

TRANSPLANTING SEEDLINGS INTO POLYTHENE BAGS

THE SEEDLINGS ARE TRANSPLANTED INTO POLYTHENE BAGS (30 CM×15 cm) containing a mixture of soil, sand and well decomposed FYM(3:3:1), when they are of about 15 cm height. The seedlings are ready for planting in the main field when they are 1 year old.

PROPOGATION OF CINNAMON BY CUTTING

Cinnamon can also be propagated by cuttings. Vegetative cuttings of cinnamon with 1 or 2 leaves can be made to root within 40 days under humid conditions in a closed bin propagator with diffused light. Seradix could hasten their rooting. Cutting kept in a moist coir dust in a polythene bag roots within 60 days.

TRANSPLANTING SEEDLINGS

Seedlings are transplanted in the main field when they are about 10-12 months old at a spacing of 2 cm between plants and rows. The planting is done in pits of 60 cubic cm which are dug earlier and filled with compost and top soil. The most appropriate time for planting is June- July in order to take advantage of the South-west monsoon prevails. In the early period, it is necessary to provide artificial shade. Seedlings grow well in the open as well as under partial shade. Weeding and mulching reduces the weed growth, 3-4 weedings in a year are sufficient. Weeding during June- July and Oct- Nov and digging in aug-sep are practiced in Randathara in Kerala state.
MANURING AND INTERCULTIVATION

Systematic manuring is practiced in India for this crop. Since leaves and shoots are economic parts and Nitrogen promotes vegetative growth, nitrogenous fertilizers are advocated for quick and rapid growth. The common practice is to mulch the plant bases with the trash obtained during weeding. One earthing up is given at the time of shoot collection in June. For better growth, it is essential that the plants are manured systematically.

A fertilizer mixture of urea, rock phosphate and muriate of potash in 2:1:1 is suggested. The rate of application suggested is 200, 400, and 600 kg/ ha for first, second and third year respectively. for an adult plant NPK in 100:18:100 g per year is recommended. The Kerala Agricultural University recommended a fertilizer schedule of 20:20:25 g of NPK along with 20 kg of compost per year from the fifteenth year onwards. Fertilizers may be applied in 2 splits during May-June and September-October.

Fertilizers to supply 20 g N, 18 g P₂O₅ and 25 g K₂O are given per seedling in the first year and this dose is doubled in the second year. Every year, the dose of fertilizers is increased gradually so that grown up plant of 10 years and above may receive 200 g N, 180 g P₂O₅ and 200 g K₂O. Cattle manure @ 20 kg/ plant may also be applied.

The organic manure is given in one dose just at the commencement of the monsoon in May-June. The fertilizers are applied in 2 equal split doses in shallow trenches dug around the plant, one in May-June along with the organic manure and the other in Sep-Oct.

WEEDING

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. 3-4 weedings are required during a year for 2-3 years. Weeds should be burnt away from the plants.

A study carried out to find out the relation between the colours of young flushes and quality parameters revealed that the plants with purple coloured flushes yielded about 29% more bark oil as compared to plants with green-coloured leaf flushes; while both the categories were at a par with regard to bark oleoresin and leaf oil %, thus indicating
that flush colour can be taken as a criterion for selecting quality seedlings at the nursery stage. Sweet taste with aromatic fragrance, pale brown and thin bark with high yield is the ideal type of cinnamon needed.

**PRUNING OR CROPPING**

At the initial periods, the growth may be slow but as the plant advances in age, the growth is faster. When the plants are 2 years old, they are coppiced or cut back during June-July to a height of about 12 cm from the ground level. The stump is then covered by earthing up. This is repeated for every side shoot, developing from the main stem, during the succeeding season so that the plant assumes the shape of about 2 m height, and a bunch of canes suitable for peeling would crop up in about 4 years time. Regular peeling operations can be commenced in the case of seedling bushes from the fourth or the fifth year, depending upon the extent of development of peeler shoots.

**CROP IMPROVEMENT**

The main aim of cinnamon breeding is to evolve lines having both high yield and quality of bark. Besides quality evaluation is also very important for the development of value added products. Quality evaluation for bark oil, leaf oil and bark oleoresin was carried out and 9 elite cinnamon lines were selected. The next step is to evaluate the selected lines for yield.

**BREEDING STRATEGY FOR CINNAMON**

Germplasm collection, conservation and evaluation

- Quality evaluation for bark oil, leaf oil and bark oleoresin
- Selection of cinnamon elite lines
- Clonal multiplication of selected lines
- Replicated field evaluation trials of seedlings and clonal progenies of selected lines for yield
- Selection of a few elite lines (considering yield and quality)
The seedlings of cinnamon are attacked by certain pests. The important pests affecting cinnamon trees are

* pink shoot borers
* leaf eating caterpillars
* red ants
* termites

**PINK SHOOT BORERS:** They can be controlled by smearing the surface with BHC 50% WP at 1% concentration to the stem and branches. Spraying with 0.25% BHC OR Carbaryl is also effective.

**LEAF EATING CATERPILLARS (Metisor plana);**

They can be controlled by dusting BHC 10%. Leaf feeding caterpillars on older seedlings could be controlled by spraying 0.05% Quinolphos. Leafminers infest sometimes tender leaves of seedlings. These can be controlled by spraying 0.05% monocrotophos(NRCS).

**RED ANTS:** They sometimes make their nests by bringing together leaves of cinnamon plants. These ants thus spoil leaves and become a nuisance at the time of cutting shoots. Dusting BHC 10% will control this pest.

**TERMITES:** They are also seen causing damage to cinnamon seedling and to the stumps left after cutting. Dusting with 10% BHC will control this pest.

**NEW RECORD OF INSECT AND MITE PEST**

Seven species of insect were found attacking cinnamon in addition to those reported earlier.

**Fascellina castanea:** This looper which appears during oct-nov is a defoliator. it measures about 2.5 cm and is blackish-brown with 3 pairs of tubercles on the abdomen. The first pair of tubercles is reddish with white spots while the remaining tubercles are blackish. There are 2 black spots behind the last pair of tubercles. There is a median tubercle towards the anal end. The larva prefers older leaves.
**Hyposidra infixaria**: This is a greenish looper with white markings, and feed on leaves. It is relatively more abundant in January.

**Cleora alienaria subsp., rasanaria swinhoe**: This subsp., which is endemic to Andamans is a defoliator. The larva is green with a light-yellow head having a faint greenish yellow lateral band, confined to posterior end: the anterior and posterior ends have black markings on the dorsal surface.

**Dercitina sps., O;COLEOPTERA F:CHRYSMELIDE**

Beetles are small and black with a brown thorax. Feeding by adults results in holes in leaves. They prefer tender leaves and occur in large numbers in December.

**HETEROPTERA: PLATYSPIDAE**

Coptosoma variegata: the green adults and nymphs are found in large numbers during April- May. They suck sap from tender shoots and fruits.

**CINNAMON MAJOR FESTS**

Cinnamon Butterfly [Chilasa elytia L]

This is the most destructive pest of cinnamon and is widely distributed in all cinnamon growing areas in India. The pest is generally seen in the field during December – June. The larval feed on the tender and slightly mature leaves in severe cases of infestation, the entire plant is defoliated and only the middrips of leaves white the portions of beiscs remain. The adults are large; the mails have blackish brown wings with white spots on the outer margins; females black wings with bluish white markings eggs are laid on tender leaves shoots and they hatch in three four days. The larval stage comprising of five instars.

**VARIABILITY STUDIES**

71 cinnamon accessions studied for variability quality parameters and association revealed high co-efficient of variation for dry and fresh bark yields, bark oleoresin, leaf
oil, bark oil, leaf size index and % recovery of bark. Association analysis revealed significant correlation of fresh weight of bark and leaf oil with dry bark yield. Bark oil was negatively associated with leaf oil.

Elite cinnamon lines, based on quality analysis

<table>
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<tr>
<th>Sl no</th>
<th>Cinnamon types</th>
<th>Elite nos</th>
<th>Leaf oil %</th>
<th>Bark oleoresin %</th>
<th>Bark oil %</th>
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<td>1</td>
<td>Indian cinnamon</td>
<td>189</td>
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<td>15.81</td>
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<td>6.03</td>
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<td>Range</td>
<td>Cv%</td>
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<td></td>
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<td>maximum</td>
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<td>Leaf length (cm)</td>
<td>13.08</td>
<td>8.75</td>
<td>20.69</td>
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<td>Leaf breadth (cm)</td>
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<td>3.31</td>
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<td>Fresh wt of bark (gms)</td>
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<td>840.00</td>
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<td>Recovery of bark (%)</td>
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<td>10.70</td>
<td>80.00</td>
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<td>Bark oleoresin (%)</td>
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<td>305.00</td>
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Q U A L I T Y

The quality of cinnamon depends on their appearance and on the content and aroma or flavour character of volatile oil. Bark yields 0.5 to 3% volatile oil and it consists 60-75% cinnamaldehyde besides eugenol, cinnamyl acetate, linalool, 1:8 cineole, beta caryophyllene, benzyl benzoate and various other minor terpenoids and terpene alcohols.

Cinnamon leaf on distillation yields cinnamon leaf oil, the main constituent of which is eugenol (60-70%). The bark oil yield varies from traces to 3.85% in the germplasm accession with SL5 recording maximum. C. cassia is preferred by some due to its high aroma. Unlike cinnamon, various parts of C. cassia contain only one type of essential oil in which cinnamaldehyde is the main constituent. Leaf oil content of cassia ranges from 0.7-2%.

A study carried out to find out the relation between colours of young flushes and quality parameters revealed that the plants with purple coloured flushes have about 29% more bark oil as compared to plants with green coloured leaf flushes.
YIELD

After attaining proper yielding stage yield/ha is 200-300 kg bark and 35 kg leaf oil per year. Improvement in yield is envisaged by selecting high yielding high quality types. In the yield evaluation study, emphasis is given to fast- growing types with high regeneration capacity as the final yield is based on the growth rate of the seedlings which is coppiced once in 2 years for extracting the bark. In the yield evaluation studies, 9 high quality lines identified by NRCS has been assessed for their general vigour and regeneration capacity, for both seedlings and clonal progenies. Seedling progenies were found to be better than the clonal progenies in their performance in the fifth year after planting. There is ample scope for upgrading the cinnamon quality through inter specific hybridization between C. verum and C. cassia.

HARVESTING

The cinnamon harvesting starts from the fourth or fifth year after planting, depending upon the availability of peeler shoots. Stems are cut during rains to facilitate peeling. The best time for peeling is when new flushes and leaves are hardened after rains.

There are cutting seasons in South India, which more or less synchronise with 2 monsoons. The appropriate time for cutting shoots for peeling is determined with reference to the circulation of sap between the wood and the corky layer. The sap flow generally occurs soon after the onset of monsoon showers I.e, by about June and November for the South West and North East monsoons respectively. The sap flow and time for peeling are judged by the peelers by making a test cut on the stem with a sharp knife. If the bark separates readily, cutting should commence immediately, otherwise such shoots which donot satisfy the test,are left for a future occasion. The shoots should be of atleast 2 years growth with the bark having a uniform brown colour and should have attained a length of 1 to 1.25 m and a thickness of not less than 1.25 cm. Shoots, satisfying these requirements, are cut and bundled after removing leaves and terminal shoots.

Regular peeling operations commence from fourth or fifth year. The best quality is obtained from thin bark of shoots in the center from the middle portion of shoots. Fully developed cinnamon shoots of 1.5-3.0 cm diameter, harvested during rainy season (July-August), GIVE GOOD QUALITY BARK AND HIGH YIELD. FROM THE FIRST
CUTTING AFTER 3-4 YEARS, 56-67 KG OF QUILLS PER HA CAN BE OBTAINED. IN A MATURE PLANTATION THE YIELD IS AROUND 180-200 KG OF QUILLS PER HECTARE.

POST – HARVEST TECHNOLOGY

PREPARATION AND CURING OF BARK SPICE FOR MARKETING

Preparation and curing of bark requires sufficient expertise. The various steps involved are

1* cutting of branches of the right size and shape in the right season at the right stage of maturity

2* scraping of outer rough corky layer

3* peeling and skillfully removing the bark from the inner wood

4* 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 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 shiits 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.
PEELING AND CURING

The peeled slips or bark from cinnamon branches are gathered and packed one above the other with their concave and convex surfaces in juxtaposition until the packings measure about 20-30 cm wide and 30-45 cm long. These slips are piled up within enclosures of sticks and wrapped up in mats. The packs are kept overnight in that condition for curing or for allowing so-called ‘fermentation’. Actually no real fermentation process develops. A little softening of the bark does occur. With the result that the peels become more easily pliable for the subsequent piping operation or the removal of the epidermis and the green cortex.

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 inlaid into larger ones to form compound quills. They are then arranged systematically end to end in lengths of about 90 cm.

DRIYING

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 unpealable bark removed in small chips from over matured shoots.

BARK ANATOMY

Bark anatomy of 4 spp., of cinnamon –3 cultivated [C.verum, C.cassia, C.camphora] and the most common wild cinnamon [C.malabatrum] differs with regard to many characters such as the nature of sclerenchymatous groups in the perycyclic region,
nature of phloem rays, distribution of phloem fibres and presence of crystalline inclusions. The differences in the true cinnamon [C.verum] bark and in the taxonomy of the genus.

The genus cinnamon [Lauraceae] comprises 250 sps., which have recently been reviewed by Shylaja and Manilal(1992). Out of these, 25 sps., have been reported from Indian subcontinents where they are mostly distributed in Western ghats and the adjoining areas and the N.E. regions. Of, these the following sps., are of economic importance.

The bark is thicker in c.VERUM AND c.CASSIA, COMPARITIEVELY THINNER IN c.MALABATRUM AND THINNEST IN c.CAMPHORA. IN ALL THE 4 Sps., barks are characterized by secretion cells containing mucilage or essential oil droplets. The bark is also characterized by islands of sclerenchyma in the pericyclic region in C.cassia, C.verum and C.malabatrum while such a band is absent in C.camphora. this is the demarcating zone between extra perycyclic region comprising phellum and phelloderm and the secondary phloem. The salient features of the bark tissues of the 4 sps., are given below.

### BARK CHARACTERISTICS OF CINNAMON SPS.,

<table>
<thead>
<tr>
<th>Cinnamon sps.,</th>
<th>b.t</th>
<th>e.p.t</th>
<th>p.t</th>
<th>p.r.w.</th>
<th>d.s.l.</th>
<th>p.f.</th>
<th>p.o.</th>
<th>r</th>
<th>p.r.f</th>
<th>o.cr. i</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>C.verum</td>
<td>0.95</td>
<td>0.64</td>
<td>0.30</td>
<td>0.03</td>
<td>0.29</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>0.92</td>
<td>++</td>
</tr>
<tr>
<td>C.cassia</td>
<td>0.97</td>
<td>0.60</td>
<td>0.36</td>
<td>0.03</td>
<td>0.30</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>0.65</td>
<td>++</td>
</tr>
<tr>
<td>C. camphora</td>
<td>0.59</td>
<td>0.38</td>
<td>0.28</td>
<td>0.03</td>
<td>0.62</td>
<td>++</td>
<td>-</td>
<td>0.92</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>C.malabatrum</td>
<td>0.73</td>
<td>0.38</td>
<td>0.36</td>
<td>0.06</td>
<td>0.12</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>0.46</td>
<td>+</td>
</tr>
</tbody>
</table>

1* Bark thickness  
2* Thickness from epidermis to pericycle  
3* Phloem thickness
4* Phloem ray width  
5* Distance between sclerenchyma islands  
6* Presence of phloem fibres  
7* Presence of oil globules  
8* Presence of raphides  
9* Phloem ray frequency  
10* Presence of other crystalline inclusions  
   + very sparse  
   ++ frequent  
   +++ very frequent  
   - Absent  

ECONOMICS OF CULTIVATION  
Though cinnamon may start yielding from the fourth or fifth year, economic yields are obtainable only from the tenth year. During the intervening period, however, the plantation may maintain by itself or provide a marginal income to the grower. The estimated expenditure in bringing up 1 ha of plantation to the tenth year is roughly Rs, 20000/- . the expenditure, thereafter will be about Rs., 5000/- per annum. On the basis of an average yield of 250 kg of quills and 35 kg of leaf oil, the estimated gross income will be Rs., 10000/- per hectare per annum. 

PRODUCTS AND END USES  
The 4 cinnamon sps., of importance in international trade are C.verum and cassias from C.cassia, C.burmanii and C.loureirii. the dried barks of all 4 sps., are widely used as flavouring agents; and, in addition, they are utilized to a varying extent for the distillation of their bark oil and for the preparation of solvent extracted oleoresins. 

The second class of products are the essential oils obtained by distillation of the leaves of C.verum [cinnamonum leaf oil] and from the distillation of leaves and twigs of C.cassia [ the cassia oil of commerce]. A small volume trade also exists in ‘cassia buds’, the dried immature fruits of C.cassia, which are also used as a spice.
The major use of cinnamonum and cassia barks, both in whole and ground forms, on a world-wide basis is for domestic culinary purposes, which in the industrialised western countries the major outlet is in the flavouring of processed foods. The spices are traded internationally in the whole form and grinding is carried out in the consuming centers. The ground spices find application in the flavouring of bakery products, sauces and pickles, puddlings, curry powder, some beverages and confectionery. The preference for cinnamon or one of the 3 types of cassia in particular applications varies from country to country. The 4 sps., are often blended during grinding to prepare a mixed cinnamon/cassia ground spice.

The oleoresins are prepared mainly by the flavour industries of Western Europe and North America; and they have similar applications to the ground spices in the flavouring of processed foods.

CINNAMON BARK OIL IS MAINLY PRODUCED BY DISTILLATION OF IMPORTED MATERIAL IN western Europe and North America. A little cinnamon bark oil is distilled in Srilanka but this is considered to be a lower quality product. Cinnamon bark oil is used in both flavouring and perfumery; in the former application, it is incorporated into baked goods, sauces and pickles, confectionaries, beverages of the coca cola types, and in the some dental and pharmaceutical preparations.

In comparison to cinnamon bark oil, the production of cassia bark oil is on a relatively small scale with distillation being undertaken in the importing countries. These oils find a limited use in soaps, perfumes, some spice essence and beverages.

Cinnamomum leaf oil [from C. verum] is distilled in Sri Lanka, the Seychelles and the Malagasy Republic. The oil is used per se in flavouring and perfumery and, also, as a source of its major constituent, eugenol.

Cassia oil of commerce is produced in China. It contains cinnamaldehyde as its major constituent and is used for similar purposes to cinnamon bark oil in perfumery and flavouring [after rectification] but its applications are rather more limited.

<table>
<thead>
<tr>
<th>BOTANICAL NAMES</th>
<th>VERNACULAR NAMES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
CINNAMONUM BARK GRADES

The cinnamon and cassia barks of commerce have been traditionally marketed under a number of vernacular names, and these have been listed according to sps., by Lawrence. Changes in the production structure and grading system in some of the spice growing countries in recent years have led to some of these vernacular names falling into disuse.

The grades of bark currently marketed by the major producing countries are described below.

Accepted botanical designation of the cinnamonum sps., used in the flavour industry

<table>
<thead>
<tr>
<th>Accepted Botanical Name</th>
<th>Vernacular Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. verum [C. zeylanicum]</td>
<td>Ceylon cinnamon</td>
</tr>
<tr>
<td></td>
<td>Seychelles cinnamon</td>
</tr>
<tr>
<td></td>
<td>True cinnamon</td>
</tr>
<tr>
<td>C. cassia</td>
<td>Chinese cassia</td>
</tr>
<tr>
<td></td>
<td>Cassia lignea</td>
</tr>
<tr>
<td></td>
<td>Canton cassia</td>
</tr>
<tr>
<td></td>
<td>Kwantung cassia</td>
</tr>
<tr>
<td></td>
<td>Yunna cassia</td>
</tr>
<tr>
<td></td>
<td>Honan cassia</td>
</tr>
<tr>
<td>C. loureirii Nees</td>
<td>Saigon cassia</td>
</tr>
<tr>
<td></td>
<td>Vietnam cassia</td>
</tr>
<tr>
<td>C. burmanii Blumes</td>
<td>Cassia vera</td>
</tr>
<tr>
<td></td>
<td>Batavia cassia</td>
</tr>
<tr>
<td></td>
<td>Java cassia</td>
</tr>
<tr>
<td></td>
<td>Macassar cassia</td>
</tr>
</tbody>
</table>
CEYLON CINNAMON

The grading of Ceylon cinnamon is quite elaborate in comparison to other sources of the spice, and exports include compound quills and certain lower grades, obtained as by-products in the preparations of quills, which are known as ‘quillings’, ‘featherings’ and ‘chips’. Grading is essentially done on the basis of physical appearance and there is no close correlation with volatile-oil content, which may range between 0.5-2.0%.

Compound quills, measuring 42 ins., long [just over 1m], are sorted into grades according to the thickness of bark. 3 main qualities are exported: the ‘fine’ or ‘continental’ grades, the intermediate ‘Mexican’ grades, and the ‘Hamberg’ grades. Within each category, there is a further classification according to the thickness of the quills.

Ceylon cinnamon quills imported into the United Kingdom are mainly used industrially in the manufacture of a wide variety of processed foods or for the production of cinnamon bark oil or cinnamon oleoresin. A small quantity is either cut up into pieces about 15 cm long or ground into a fine powder or mixed with other spices by spice merchants or millers for the retail pharmaceutical and grocery trades.

Quillings, which consists of broken pieces of quills of all grades, are used mainly for grinding, but also for distillation of cinnamon bark oil. Featherings, which consist of inner bark of twigs and twisted shoots, are used for the same purposes as quillings. Chips are comprised of trimmings of unpeeled cut shoots, shavings of outer and inner bark and odd pieces of thick bark. This material is used mainly for distillation.

A more detailed description of the grading of Ceylon cinnamon is provided in the “The world types and commercial classification” section.

SEYCHELLES CINNAMON

This is variously graded as compound quills, simple quills, and quillings, thin scraped bark and rough unscraped bark. The last grade is the largest export, and is used largely in the formulation of mixed spices. Its essential-oil content is low, and according to trade opinion, averages about 0.8%.
MALAGASY CINNAMON

This was customarily offered to the market in both its unscraped and scraped forms; but latterly the bark has been offered as ‘mixed’, whereby sometimes the scraped bark is packed separately within the bales comprising the lot, and at other times it is packed unscraped and scraped within the same bale. Its essential oil content averages about 0.7% the use of Malagasy cinnamon are similar to those of Seychelles cinnamon, which it closely resembles.

INDONESIAN CINNAMON

The Korintji and Padang [syn., Batavia] forms are graded by appearance into A,B,C AND D types according to length, colour and quality, and are sold on their content of volatile oil. The USA is the main importer of Indonesian cassia, and experience there shows that the volatile oil content usually varies between 1.3% for Korintji C and 2.7% for Batavia A. there is one other grade, Batavia AA, where the oil content is of little importance since the product is sold [in the USA] for packing in glass bottles where appearance is all important.

A small amount if a third type, cassia vera, produced mainly in Java, Celeves and other neighbouring islands, is exported mainly from Makassar, the German Federal Republic being the chief importers.

CHINESE CASSIA

This trade has been simplified during the 20 years [1954-74] during which this product was prohibited from the US market. Formerly, 2 grades of broken quills of Kwantung cassia[cassia lignea] and 3 grades of whole quills of the superior Kwangsi cassia, all differing in thickness of the bark were offered, but Chinese cassia is now available only in 2 forms, whole quills and broken [no,1 and no,2, the latter being cheaper], either scraped or unscraped according to demand. The quality of the cassia depends upon its colour, its thickness and its oil content. Kwantung cassia has an oil content of at least 1.7 ml per 100 g, and Kwangsi 3.4 to 4.0 ml per 100 g, according to information provided in 1974 by the Native product corporation, peking[ via the British Embassy]. This contrasts with Landes(1951), who reported that best quality kwangsi cassia contained 2 to 2.75% volatile oil and Kwantung 1 to 1.2%.
The names Honan or Yunnan cassia which were formerly used to describe the finest qualities of Kwangsi cassia, are no longer used, and the Chinese sell kwangsi and kwantung cassias under the brand names Tung Sing and Si chang respectively. Cassia is supplied by mainland China to Hongkong in bales of approximately 50 kg which are made up of bundles of 4 lb [about 2 kg].

VIETNAMESE CASSIA

According to Landes (1952), Saigon cassia was produced in the district of Binndinh and in the regions of the Tchany and Tchampong mountains, and exported from Saigon in 4 grades based upon the thickness of the bark, namely:

1) Thin bark, usually 1/32 in [0.8 mm], but thin bark from the Tchamy region was usually paper thin.

2) Medium bark, usually over 1/16 to 1/8 in thick.

3) Thick bark usually over 1/8 in [3.2 mm] thick.

4) Broken bark – all the Saigon cassias were usually very tightly curled in several layers and, in the process of eliminating the dirt, much of the bark was broken; added to it were the pieces cut off the rolls[quills] when they were being bundled.

Information from C.C.C. International Ltd [1974, personal communication] showed that, upto about 1964, the vast majority of shipments into the USA consisted if Saigon thin and medium broken cassia, but since that time supplies have been extremely scarce and no comments on the thickness of the bark have been possible. The volatile oil content of saigon cassia can vary from 1 to 7%, although in the majority of samples the oil content is between 3.75 to 4.5%.

In the USA, spice millers cut selected pieces of the 3 types of cassia bark into short lengths for sale as ‘whole cinnamon’. The great bulk of the cassias imported is ground to produce ‘ground cassia- cinnamon’. The various kinds of cassia bark are different in flavour and degree of aroma, but all are agreeable, fragrant and aromatic. Saigon cassia is generally acknowledged to possess the fullest and finest flavour and it is the preferred type in the USA. The various types are ground separately or blended to meet the needs of the bakery and food processing industries, being used directly in the ground form or for
oleoresin extraction. Ground cassias are sold for domestic culinary use, usually without distinction as to type, under the label of ‘cassia-cinnamon’.

PROCESSING AND MANUFACTURE

PREPARATION OF SPICE

The quality of cinnamon and the various cassias is primarily assessed on the basis of their appearance and on the content and aroma/flavour character of their volatile oil. The relative importance of these quality attributes is dependent, however, on their intended end use, the appearance of the spice is rather more important when it is to be used for grinding or for the preparation of the essential oil or the oleoresin.

The spices are prepared and supplied to the market in various forms, the most elaborate type of product being the compound cinnamon quills from Sri Lanka.

CEYLON CINNAMON

The harvesting and preparation of cinnamon in Sri Lanka is generally undertaken for a farmer by contract peelers, usually a group of 2 families. Sufficient material is cut for a day’s peeling, the working day being from about 6 am to 7 pm. Stems, measuring 1.2-5 cm in diameter, are cut early in the morning and the twigs and leaves are detached; the last may be retained for distillation purposes. The cut stems are then bundled and are transported by bullock cart to the peeling shed.

The peeling operation consists of stripping the bark and preparing quills of 42 ins. Length [just over 1m] from the inner bark. The procedure used for peeling is dependent upon whether the whole operation is to be undertaken in one day or over 2 days. If the peeling is to be accomplished within one day, the outer bark is first removed using a crude curved knife and this is usually done by the young boys in the family group. The stripped stem is next rubbed briskly with a heavy brass rod to loosen the inner bark. The removal of the inner bark is undertaken by the men using a small rounded knife with a point on one side to facilitate ripping.
The knife is made of brass or stainless steel since other metals are said to stain the bark. 2 cuts are made round the stem about 30 cm apart and 2 longitudinal slits are made on opposite sides of the stem. The inner bark is then carefully eased off the wood with the pointed side of the knife. The alternative approach to peeling involves removing the outer and inner bark in 1 step, in 2 rectangular pieces using the pointed knife and the rubbing rod. The strips are then packed together in bunches, wrapped in matting and are left overnight; by this means they are kept moist and undergo a slight fermentation. This facilitates the subsequent scraping off of the epidermis, cork and the green cortex with curved knife on the following day.

The curled pieces of inner bark, stripped by either of the methods described above, are next assembled into compound quills or pipes by the women in the group. The best and longest quills are used on the outside and the inside is filled with smaller pieces of bark which cannot be joined together easily. The compound quills are then rolled by hand to press the outside edges together and the ends are neatly trimmed with a pair of scissors. Drying is accomplished in the shade as direct exposure to the sun at this stage can result in warping. The quills are commonly spread out for air drying on a rush mat suspended under the roof of the peeling shed. In order to obtain firm and compact quills, they are rolled by hand daily until judged sufficiently dry. The dried quills thus obtained consists of a mixture of coarse and fine types and are yellowish brown in colour.

After the propagation of the quills has been completed, they are sold by the farmer together with any ‘quillings’, ‘featherings’ and ‘chips’. The grading of Ceylon cinnamon is done on the basis of appearance by the dealers in the trading centers such as Colombo and Ambalangoda prior to export. The quills are bleached if necessary by sulphur treatment for about 8 hrs and are sorted into grades according to thickness of the bark. The compound quills measuring 42 ins just over 1m are made up into compact cylindrical bales of about 45 kg each and are finally enclosed in a gunny cloth. The qualities normally exported fall into 3 groups— the ‘fine’ or ‘continental’ grades, the ‘Mexican’, and ‘hamburg, or ordinary grades.
DISTILLATION

Cinnamon bark produces 2 oils, a superior type derived from the inner bark and a lower quality from broken quills, chips and bark. In Sri Lanka, a third oil, Katta thel, is produced from bark and twigs for local consumption. Oils produced in the same still from quillings, featherings or chips vary in their constituents; chip oil has a very good odour and flavour although containing 20% less cinnamaldehyde and twice the eugenol of bark oil. Root oil is produced only when a plantation is uprooted for replanting.

Local stills in Sri Lanka have cone shaped bodies made of vertical planks of wood, tightly bound by horizontal metal bands, and so well made and fitted that there is little leakage. A charge is about 200 kg leaves, with steam generated in a separate boiler and distilled for 8-9 hr at the height of the bark peeling season, but up to 24 hr in the off-season. Oil yield varies from 0.5-1%[about 30-40 kg/ha], depending on distilling method, time of year leaf is harvested, and whether leaves are fresh or wilted. Many small stills are made from copper built into a stone hearth and heated by a fire beneath. About 23=27 kg chips and 180-225l water is the usual charge, distilled for 5hr; residual water from one distillation is collected and used in the next. Oil yield is approximately 0.2%, stills developed by the Ceylon institute of scientific and industrial research[CISIR] give yields of 0.5-2% from chips, although oil quality frequently improves before an increase in yield. Very similar methods are generally used in India, although large private plantations in Kerala state have upgraded their stills and obtained yields of 1.5-2.5%.

Leaf oil is usually complementary to bark production; leaves stripped from shoots, together with small leafy twigs and stems, are left in the field for 3-4 days, then transported to the distillery. Stills in INDIA, Sri Lanka and Indonesia are usually located at a convenient site, since leaves are bulky and difficult to transport, and constructed of materials locally available. Thus, regional leaf oil can be very variable, but where more modern equipment has been installed, oil is produced by distilling leaves collected during Jan-Sep, with an average yield of 1.8-2t/ha. A charge is 300kg fresh leaves, distilled for about 6 hr. under the government’s 1982-1986 development plan, 2 modern distilleries were constructed, but neither achieved full commercial operation as the local people abandoned cinnamon production for less onerous jobs in the booming tourist industry.
Detailed information on leaf distillation is lacking, with little basic data on the effects of the various methods employed, such as oil yield and any change in oil consumption resulting from distilling fresh leaves or leaves wilted for up to 7 days, or charge composition and distillation time. This and similar information is essential to ensure that a distillery operates efficiently and profitably, and greatly assists the integration of leaf oil production with other plantation operations.

GOVT INCENTIVES FOR CINNAMON PRODUCTION AND MARKETING

The state govt of Kerala, Tamilnadu and Karnataka have schemes for production and distribution of seedlings to a limited extent. Seedlings are distributed at present from the district Agricultural Farms at Kozha in Kottayam district, Mannuthy in Thrissur district, from Taliaparamba in Cannamore district and Peringamala in Thiruvananthapuram district, from Horticultural Research Station, Ambalavayal, in Calicut district of Tamilnadu and from the Horticultural Experimental Station, Chethalli, in Coorg districts of Karnataka. The growers in the respective states can contact them.

Since the quantity of cinnamon bark produced is very much limited and scattered in some districts of Kerala and Tamilnadu, there is no established marketing system for it. Credit facilities to the farmers are available from the co-operative Credit Societies for cultivation of the crop.

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 ISI; that are graded according to their length, breadth and thickness.

QUILLS

They are the long compound rolls of bark up to 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
Smaller pieces left after the preparation of quills also go 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, shavings of outer and inner barks, which cannot be separated or which are obtained from small twigs by beating or hammering and odd-pieces of outer bark.

And odd pieces of outer bark. They invariably contain more or less inferior bark and woody material. This admixture is labeled chips which constitute the most inferior grade of cinnamon.

Detailed quality standards have been laid down under the PFA, and described in section 8. 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]: 2.2%
- Fibre: 20.3%
- Carbohydrates: 59.5%
- Total ash: 3.5%
- Calcium: 1.6%
- Phosphorous: 0.05%
- Iron: 0.004%
- Sodium: 0.01%
- Potassium: 0.4%
WORLD TYPES AND COMMERCIAL CLASSIFICATION OR GRADES OF CINNAMON

TYPE SRILANKA [CEYLON]

This is the dried bark of cultivated varieties of cinnamonum zeylanicum Blume[F: Lauraceae]. Cinnamon, type Sri Lanka[Ceylon], is produced in 4 forms.
a) Quills  b) Quillings  d) featherings d) chips

<table>
<thead>
<tr>
<th>Commercial designations of the grades and qualities</th>
<th>Diameter of Quills, mm max</th>
<th>No. of whole quills(1050mm) per kg min</th>
<th>Extent of foiling(%) max</th>
<th>Minimum length of quills in a bale</th>
<th>Pieces of tubes &amp; broken pieces of the same quality per bale, (%(mm)max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alba Continental C00000 special</td>
<td>6</td>
<td>45</td>
<td>Nil</td>
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<td>MEXICAN</td>
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<tr>
<td>M000000 Special</td>
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</tr>
<tr>
<td>M000000</td>
<td>16</td>
<td>22</td>
<td>60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Composition varies according to the quality and region. According to different authors, the following range of variation may be seen:

- Moisture: 5.40-11.4%
- Volatile: 0.3-2.8%
- Fixed oil: 0.3-1.9%
- Fibre: 25.6-30.5%
- Carbohydrates: 16.6-22.6%
- Proteins: 3.0-4.5%
- Total ash: 3.4-6.0%
- Ash-insoluble in acid: 0.02-0.06%

### PHENOLIC ACIDS IN CINNAMON AND OTHER TREE SPECIES

Phenolic acids of 5 commercially important sps., namely, cinnamon, nutmeg, and mace were quantitated by high performance liquid chromatography using external standard method. Protocatechuic acid was predominant phenolic acid in cinnamon bark, and gallic acid dominated in clove buds. The major phenolic acids in cardamom seeds and nutmeg were caffeic acid + vanillic acid while ferulic acid and synapic acid predominated in mace.

Of these, the most important component is the volatile oil of commerce which finds numerous uses as discussed later. Besides, volatile oil is also prepared from cinnamon leaves, fruits and roots, as a by-product, which too finds use in the trade.

1) Foxing: The occurrence of reddish – brown patches on the surface of the quills, which may become dark brown with time. Foxing can be a) superficial [malkorachedi]
b) heavy [korachedi]

**THIS SUBDIVISION IS BASED ON THE DEPTH OF PATCHES.**

2] extent is determined by visual examination

3] Bale: A package of any one particular grade of quills wrapped with suitable material for export.

**TYPE SEYCHELLES**

This is the bark of branches of *Cinnamomum zeylanicum Blume*, cultivated in Seychelles. Cinnamon, type Seychelles, is produced in 4 forms.

- **ROUGH CINNAMON BARK**: Which consists of slightly curved, elongated, irregular, medium or small pieces of the whole unscraped bark.

- **SCRAPED CINNAMON BARK**: which is obtained from younger shoots from bushes of the same sps., ; the shoots are scraped with a curved knife before the bark is detached from the wood.

- **QUILLS AND QUILLINGS**: which are prepared from the young shoots of bushes, in a way similar to that used for cinnamon, type Sri Lanka [Ceylon]

**GRADES/CLASSIFICATIONS OF CINNAMON ,TYPE SEYCHELLES AND TYPE MADAGASCAR**

<table>
<thead>
<tr>
<th>Commercial designation of the grade</th>
<th>Physical characteristics of the bark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Whole tubes[ full tubes]</td>
<td>Tubes of length about 15cm and bark thickness upto 1mm</td>
</tr>
<tr>
<td>2. Pieces of scraped bark</td>
<td>Broken pieces, rough and grooved scraped bark of thickness upto 2 mm</td>
</tr>
<tr>
<td>3. Pieces of unscraped bark</td>
<td>Broken pieces, rough and grooved, of width upto about 3 cm and length upto 20 cm. the bark can be upto 5 mm thick</td>
</tr>
<tr>
<td>4. Chips, flakes of unscraped bark</td>
<td>Small pieces of unscaped bark of cinnamon stems</td>
</tr>
</tbody>
</table>
TYPE MADAGASKAR

This is the bark of trunks or branches of *Cinnamomum zeylanicum* Blume, growing wild in Madagascar. It is produced either in the form of simple, hollow tubes of unscraped or scraped bark of rather coarse appearance, about 30 cm long, from smaller branches cut with a knife or more usually in the form of unscraped or scraped pieces of bark from the larger branches and trunks broken off with a flat side of a hatchet.

EXTRANEOUS MATTER

The proportion of extraneous matter in whole cinnamon shall not exceed 1% [m/m] when determined by the method described in ISO 927. Extraneous matter comprises leaves, stems, chaff and the vegetable matter. The only mineral matter permitted is sand, earth and dust. In the case of cinnamon quills, type Sri Lanka take about 110 g of quills per bale of continental grade and 230 g of quills per bale of Mexican or Hamburg grades, break them up and inspect the filling. Unscraped inner bark, scrapings, foreign matter, bark of wild cinnamon and other genera shall not be present.

PHYSICO-CHEMICAL REQUIREMENTS

Whole cinnamon and cinnamon powder shall comply with the requirements given in the table.

<table>
<thead>
<tr>
<th>Physico-chemical characteristics</th>
<th>ISO requirements Common type Sri Lanka</th>
<th>Type Seychelles type Madagascar</th>
<th>Method of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content, %(m/m), max.</td>
<td>12.0</td>
<td>12.0</td>
<td>ISO 939</td>
</tr>
<tr>
<td>Total ash, %(m/m) on dry basis</td>
<td>5.0</td>
<td>7.0</td>
<td>ISO 928</td>
</tr>
<tr>
<td>Acid-insoluble ash, %(m/m) on dry basis (max.,)</td>
<td>1.0</td>
<td>2.0</td>
<td>ISO 930</td>
</tr>
<tr>
<td>Volatile oil, m/100g on dry</td>
<td>1.0</td>
<td>0.4</td>
<td>ISO 6571</td>
</tr>
</tbody>
</table>
Whole cinnamon (min.),\[basis,\]
Ground cinnamon (powdered)\[0.7\]

<table>
<thead>
<tr>
<th>Basis</th>
<th>0.7</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole cinnamon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground cinnamon</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GRADING OF QUILLS**

Quills are yellowish brown, cylindrical, approximately 1m * 10 mm diameter; scraped, smooth, thin, rolled with occasional scars, and fine, light-coloured wavy lines running lengthways and clearly visible. A pleasing, fragrant odour and a warm, sweet, aromatic taste. Quills are further separated into compound quills and simple quills.

Quills are also graded by quality and size from H, M, C TO Alba, the finest. H quills are the largest and of uneven colour, while alba quills are smallest, pencil-sized, smooth and uniform in colour with no blemishes, and sold at a premium. The large H-grade quills are the most frequently adulterated by inclusion of poorer bark. Discoloured quills may be bleached using a sulphur treatment. Unscraped and scraped bark is also locally traded, and together with the last 3 grades is most frequently distilled to produce bark oil. Bark from other countries is also graded but not to the same extent. However, grading is complicated by the use of the designation cinnamon to include cassia in some countries, and to cover either indiscriminately in others.

Bark grading to International Standards Organizations requirements will eventually become universal. ISO 6539-1983 already covers cinnamon from Madagascar, that donot meet these requirements for the spice will be downgraded in major international markets. The American Spice Trade Association [ASTA] specifications requires cinnamon to contain not more than 2 dead insects, 1mg/lb mammalian excreta, 2 mg/lb other excreta, 1% mould by weight, 1% insect defiled by weight and 0.5% extraneous foreign matter by weight.

The main use for bark is as spice in quills or powder. Small quills are added to meat and similar dishes and removed after cooking, are an ingredient in sweet pickled products and are added to hot punches and similar drinks. Ground bark or powder is commonly added to curries, pilafs and stews in the middle east ans asia, where its antibacterial properties due to the phenol content may help counteract the effects of bad
meats. Powder is preferred in confectionery, pies, baked products and a variety of sweet
dishes. In Mexico, cinnamon mixed with chocolate is a favourite beverage and cinnamon
powder is often sprinkled on chocolate drinks in fast-food outlets worldwide. Both bark
and powder are frequently adulterated in their countries of origin, but not the retail
products sold by major food processors in western countries. However, in the USA
cassia is often labeled cinnamon, not to deceive but because consumers and the US food
drug and Cosmetic Act do not discriminate between them.

**OILS:**

A striking feature of the 3 cinnamon oils is the difference in the major
constituent; cinnamaldehyde up to 60% in bark oil, eugenol up to 80% in leaf oil and
camphor up to 60% in root bark oil. The finest quality oils are obtained by solvent
extracting distillate, or supercritical carbon dioxide extraction. The main constituents of
Sri Lankan cinnamon oils and the main characteristics of bark oils from selected origin
are listed in table.

**Main constituents of Sri Lankan cinnamon oils (%)**

<table>
<thead>
<tr>
<th>constituent</th>
<th>Leaf oil</th>
<th>Bark oil</th>
<th>Root bark oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,8-Cineole</td>
<td>0.15</td>
<td>1.65</td>
<td>15.2</td>
</tr>
<tr>
<td>camphor</td>
<td>-</td>
<td>trace</td>
<td>60.0</td>
</tr>
<tr>
<td>linalool</td>
<td>1.5</td>
<td>2.3</td>
<td>1.2</td>
</tr>
<tr>
<td>terpinol</td>
<td>0.15</td>
<td>0.4</td>
<td>3.8</td>
</tr>
<tr>
<td>cinnamaldehyde</td>
<td>1.3</td>
<td>74.0</td>
<td>3.9</td>
</tr>
<tr>
<td>cinnamyl acetate</td>
<td>0.8</td>
<td>5.0</td>
<td>0.3</td>
</tr>
<tr>
<td>eugenol</td>
<td>87.0</td>
<td>8.8</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**PROCESSED PRODUCTS**

The commercial of the cinnamon and cassia trees are

1) whole and ground cinnamon/cassia
2) essential oils
3) oleoresins

these are briefly described as follows.
CINNAMON/ CASSIA BARK OIL

Cinnamon bark contains 0.5-1% volatile oil. It is reported to vary from 0.95-3.55%. The essential oil, generally manufactured in the USA and Europe, is steam distilled mainly from cinnamon chips and refuse left over after the preparation of quills from the apice trade. Bark oil has the following properties-

1) specific gravity at 15.5º c : 0.0150-1.03
2) optical rotation at 20º c : 0 to 8º
3) refractive index at 20º c : 1.565 to 15.99

It is light yellow in 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 oil. A beginning has been made in the export of cinnamon bark during recent years.

CINNAMON LEAF OIL

Cinnamon leaves and very tender twigs/shoots are collected dried in partial shade for a day or two to expel most of the moisture and transferred to big stills in which steam under 15 lb pressure is passed through from the bottom of the metallic stills/boilers. This process of steam distillation is continued for 7-8 years and the distillate after cooling through condenser is collected. The oil being heavier than water can be easily separated from water by the decantation and filtration process. The oil being aggressive/corrosive in nature, is packed and stored in dark brown glass containers. Its yield varies from 1.6-3.4%. It has a pungent odour, hot taste and contains 70-80% eugenol traces of cinnamic aldehyde. The oil is yellowish with a slight camphoraceous odour resembling to that of clove oil it has

1) specific gravity at 15.5º c : 1.045 to 1.055
2) optical rotation at 20º c : -1 to +3º
3) refractive index at 20º c : 1.530 to 1.548
it contains eugenol 70-95%, cinnamaldehyde and benzaldehyde. The physico-chemcal specifications are set out in below table.

### Physico-chemical specifications or requirements of cinnamon leaf oil

<table>
<thead>
<tr>
<th>Sl no.,</th>
<th>Physico chemical characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Relative density at 27º / 27º Celcius</td>
<td>1.030 to 1.056</td>
</tr>
<tr>
<td>2</td>
<td>Refractive index at 27º</td>
<td>1.525 to 1.536</td>
</tr>
<tr>
<td>3</td>
<td>Phenol (as eugenol), % by mass min.</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>@ aldehyde (as cinnamic aldehyde) % by mass max.,</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>water soluble materials</td>
<td>nil</td>
</tr>
</tbody>
</table>

### SEASONAL VARIATION IN RECOVERY OF LEAF OIL

The yield and quality of cinnamon leaf oil is dependent on number of factors, like the geographical origin of the leaf material, leaf cropping, distillation practice used and season, etc.,

The yield of oil from different plants during the different seasons studied varied significantly. It is presumed that summer period is the best for the highest recovery of oil from cinnamon leaves.

Cinnamon leaf oil of good quality is being manufactured at Anjarakkandi Plantation, Cannamore district, Kerala. It has many pharmaceutical, perfumery and other uses. Ramachandra Rao et al [1988] have reported upon the major constituents of oils in leaves of C. zellanicum grown in Orissa; which showed a very wide variation in eugenol content from 0 to 89% in leaf.

### 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% alcohol[ethanol], occasionally with opalescence, when tested.
CINNAMON AND CASSIA OLEORESINS

Cinnamon and cassia oleoresins are extracted by using a suitable solvent from commercial sps., of cinnamon and cassia, notably from chips. Bark is distilled for the preparations of oleoresin and the recovery is about 10-12%. It is a dark brown liquid containing 50% of volatile oil and has to be diluted before using it as a flavouring agent. Cassia oleoresin is much cheaper than Chinese cassia. Oleoresins are mostly manufactured in Western Europe and the USA. India too has started manufacturing and exporting cinnamon oleoresin.

OTHER PRODUCTS

The other minor products are
1) root bark oil
2) cinnamon seed oil
3) 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 in a cool and dry place.

USES OF CINNAMON

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 apice or condiments 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 confectionary, 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 diabetes in digestion of sugar[Health and Nutrition, OCT ., 1990].
STEM BARK OIL
Bark oil is extensively used for flavouring confectionary, liquors, pharmaceuticals, soaps and dental preparations. It has a high germicidal activity (r.w. coefficient, 14); 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 gastrodynia, flatulent colic and gastric debility. The dosage is 1-3 minims.

FUNGITOXIC PROPERTIES OF CINNAMON BARK OIL
During screening of vapours emitted by different parts of higher plants, the bark of Cinnamomum zeylanicum exhibited the strongest toxicity, inhibiting mycelial growth of two test fungi viz., Aspergillus flavus and Aspergillus niger completely. The volatile antifungal fraction was isolated in the form of an essential which was standardized by physico-chemical properties and gas layer chromatography (GLC). THE Minimum Inhibitory Concentration (MIC) of the oil was found to be 400 ppm against both the test fungi. The oil showed fungi-static nature as its MIC but proved fungicidal at higher doses. The fungitoxic potency of the oil was found thermostable and possessing long shelf-life and was sustainable to heavy inoculum density. The oil showed broad range of activity inhibiting all 35 storage fungi tested at its MIC [400 ppm]. This, the oil may constitute an ideal, indigenous and effective fumigant preservative for protection of rice in particular and other food commodities in general.

CINNAMON LEAF OIL
The yield of leaf oil varies from 1.6-3.4%. cinnamon leaf oil equals clove oil in eugenol content [70-95%], which makes it useful in perfumery, cosmetics and flavouring industries. In the USA, the cheaper Seychelles oil is used as a source of eugenol in the synthesis of vanillin, while Ceylon oil, which is considered superior, is employed for perfuming soaps. It is also used for flavouring sweets and confectionary and is a
common adulterant for the bark oil and in that respect, leaf oil completes with clove stem and clove leaf oil. Cinnamon leaf oil is used as an embrocation in rheumatism.

ROOT BARK OIL

The root bark yields 3% oil which differs from both stem bark and leaf oils. It is a colourless liquid with a camphoraceous odour. It has

1) specific gravity: 0.994

2) optical rotation D: +50° c

It contains camphor, pinnene, 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% fixed oil; formerly used for making candles. The oil, also called ‘cinnamon suet’ is obtained by boiling crushed ripe fruits suspended in water. The oleoresins 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, crackers and is liable to strain. 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.

OLEORESIN

The term ‘cinnamon oleoresin’ is a general one and includes the oleoresins extracted with organic solvents from any of the 4 commercial spp., of cinnamomum or, may be, mixtures of them by a few spice processors in, principally, the USA and the UK, but also in France and the Netherlands. The oleoresins from Ceylon cinnamon, C.verum
is preferred in the UK and the products obtained from C.burmanii from Indonesia and C.loureirii from Vietnam are most popular in the USA, but both countries manufacture oleoresins from other of the 4 sps.,

These oleoresins differ in the quality of their flavour and odour and in the content and composition of volatile oil and, therefore, in their flavour strength. This is usually prepared by extracting cinnamon bark with organic solvents; the yield using ethanol is 10-12%, using benzene 2.5-4.3%, and more recently 1,1,2-trichloro-1,2,2,-trifluoroethane has been used. Oleoresin is a deep reddish or greenish brown rather viscous liquid, with a volatile oil content of 16-65%. Its major use is in flavourings, cake and similar mixes, pickles, prepared meats, convenience foods and related products where flavour stability at high temperature is important. Oleoresins are normally commercially available dispersed on various bases and usually sold on a volatile oil content of 23-27% or 65%.

**LEAF OIL**

The oil is a yellow to brownish yellow liquid, with a warm, spicy and somewhat harsh odour, lacking the richness of bark oil; the taste is slightly bitter, burning, very spicy and powerful. The oil is placed in the dry-woody, pronounced spicy group by Arctander[1960]. Eugenol content of SriLankan leaf oil can be 60-65% or 70-85% depending on the district of origin. Seychelles leaf oil is a valued source of eugenol, usually above 90%, with phenols 78-95% and aldehydes 5%. Madagascar oil has a eugenol content of 70-90% , and a distinguishing feature is the relatively high benzyl benzoate content; neither is generally available.

Major uses of leaf oils are food processors and pharmaceutical companies. Leaf oil as a source of eugenol has lost ground to the cheaper clove leaf oil, except when eugenol is needed for conversion to iso-eugenol used in confectionary products. The only common adulterant is clove leaf oil, used when cinnamon leaf oil is higher in price.

Monographs on the physiological properties of cinnamon bark oil and cinnamon leaf oil have been published by the Research Institute for Fragrance Materials. In the USA, the regulatory status generally recognized as safe has been accorded to cinnamon, GRAS 2289, cinnamon bark oil,, GRAS 2290/2291, and cinnamon leaf oil GRAS 2292.

**ROOT BARK OIL**
Is colourless to pale yellowish-brown, similar in odour to stem-bark oil but weaker, camphoraceous and lacking in fragrance. The major component is camphor upto 60%, which crystallizes out on standing, plus 1,8-cineole upto 16% and eugenol upto 5%. Oil yield from root bark at 1-2.8% is higher than leaf and stem bark. Root-bark oil is produced only in Sri Lanka when an exhausted plantation is replanted and is usually added to other cinnamon oils.

### Characteristics of cinnamon bark oils from selected origins

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Sri Lanka</th>
<th>Seychelles</th>
<th>Madagascar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>1.023-1.040&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.943- 0.976&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.016&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Optical rotation</td>
<td>0º to –1º.8'</td>
<td>-2º30' to –5º 10'</td>
<td>-2º.34'</td>
</tr>
<tr>
<td>refractive index(20ºCelsius)</td>
<td>1.581- 1.591</td>
<td>1.528 – 1.532</td>
<td>1.5746</td>
</tr>
<tr>
<td>Aldehyde as cinnamaldehyde(%)</td>
<td>65-76</td>
<td>22- 84</td>
<td>61.4</td>
</tr>
<tr>
<td>Eugenol content%</td>
<td>4- 10</td>
<td>6 - 15</td>
<td>10</td>
</tr>
</tbody>
</table>

### PACKAGING OF DIFFERENT COMMERCIAL CLASSES OF CINNAMON BARK AND POWDER

**WHOLE CINNAMON**

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

1) cinnamon, type SriLanka in cylindrical bales of about 45 kg each
2) cinnamon, type Seychelles and type Madagascar in bales of about 50 kg each
3) 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 ingress and loss of volatile matter.

### PACKING OF CASSIA AND CINAMON 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, 2 containers to a case.

Cinnamon leaf oil and cassia leaf oil are packed in epoxy-resin lined 180-200 kg capacity steel drums.

For small quantities, the oils may be packed in high-density polyethylene [HDPE] containers but lengthy storage there in is not recommended. Minimum quantities purchased by importers vary from as little as 20 kg for the expensive oil to 1 ton lots for the leaf oil.

The cassia and cinnamon oleoresins are usually packed in polyvinyl chloride [PVC] plastic pails 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 store-room 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 rains, from the sun or other sources of excessive heat, from objectionable odours and from cross infestation, especially in the holds of ships.

**BIOTECHNOLOGY IN CINNAMON**

In cinnamon, a perennial tree spice crop, identification and clonal multiplication of high yielding genotypes becomes an immediate priority due to the long pre-bearing period. Standardization of micropropagation methods will help in rapid multiplication of ‘elite’ planting material in this crop.

Micropropagation of clove and cinnamon from seedlings has been reported. Mature cinnamon and camphor trees could also be successfully micropropogated by shoot tip culture in WPM supplemented with BAP [3 mg/l] and Kinetin [1 mg/l] and the
isolated shoot developed good roots when transferred to growth regulator free medium with activated charcoal[2 mg/l].

A method for the regeneration of plants through somatic embryogenesis from seedling explants in C. verum[ Mini et al], as well as induction of morphogenic calli and rhizogenesis, was standardized at the author’s laboratory. Profuse callus could be induce from leaf and hypocotyls explants on MS medium supplemented with 2,4-D[2 mg/l] and somatic embryogenesis was successful in WPM supplemented with BAP and Kinetin. Somatic embryogenesis from hypocotyls callus in C. camphora has been reported in MS medium supplemented with BAP and NAA. Shoots developed from these were successfully rooted in vitro, in medium with NAA and IBA. Cytological studies on callus tissue revealed changes in chromosome number and nuclear abnormalities possibly leading to somoclonal variations.

<table>
<thead>
<tr>
<th>Crop &amp; Ex plant used</th>
<th>Media Composition</th>
<th>In vitro response</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Shoot tip from seeding</td>
<td>MS+0.5mg{l} NAA 0.5mg{l} BA</td>
<td>Multiple shoots</td>
</tr>
<tr>
<td>Hypocotyls</td>
<td>SH+0.5mg{l}kin +0.5 mg{l} BA</td>
<td>Multiple shoots</td>
</tr>
<tr>
<td>Shoot tips</td>
<td>Whites+IAA, IBA, IPA(0.1 mg{l} each)</td>
<td>Invitro rooting</td>
</tr>
<tr>
<td>Shoot tips from mature trees &amp; sending explants</td>
<td>MS+2mg{l} 2,4-D WPM+3mg{l} BA, 1mg{l} BA, 1mg{l} kin WPM+2g{l} charcoal</td>
<td>Callus, Multiple shoots Somatic embryogenesis, rooting</td>
</tr>
</tbody>
</table>

**FUTURE RESEARCH THRUSTS**

No doubt, the research efforts made by the ICAR institutes, SAU’s and other organizations have made substantial contributions in developing varieties/ hybrids, production technologies including pest and disease management and to a limited extent on post-harvest technologies. However, there are still areas which need positive and
long lasting solutions. The research has to be focused on these points which are enumerated below:

1) Germplasm repository available is very limited. Though related sps., occur in cinnamon in the forests of Western Ghats and North-Eastern regions, there is need to obtain newer accessions in tree sps., like cinnamon specially from the centers of origin viz., Indonesian group of islands including Moluccas

2) In cinnamon, micro propagation through tissue culture also needs to be standardized

3) Quality evaluation of tree sps., like cinnamon is arbitrary and there is need to standardize both organoleptic tests as well as biochemical parameters to correlate with superior quality.

MEDICINAL SPICIES OF CINNAMON

This is a genus of about 250 sps., of evergreen trees and shrubs, usually with aromatic bark.

CINNAMONUM CAMPHORA (L) ‘CAMPHORA TREE’

It is a medium sized tree with an enlarged base and reaches a height of about 12 m. leaves and twigs of these plants have a strong camphor smell. Leaves are smooth, shiny, whitish beneath upto 12cm long. Flowers are yellow in colour. This plant is native to China and Japan; and is cultivated in Nilgiris Hills in India.

They require compost mixture of loamy soil, decayed cowdung, leaf mould and little sand. Plants require moist atmosphere and during growing season adequate watering is needed. Plants are propogated by cutting of young shoots.

Twigs and leaves are used for medicinal purposes. It is a source of camphor. This is a stimulant and aromatic plant containing essential oil and tannin. The oil obtained by distillation is used to treat diarrhoea, rheumatism and muscular pains. It is very useful in bronchitis and pneumonia. It also stimulates uterus, menstruation and uterine haemorrhages.
Since it contains tannin it has an astringent effect, increases constipation unless mixed with laxative. It is known to be antiseptic, circulatory stimulant and has a calming effect in cases of hysteria, neuralgia and general nervousness.

**CINNAMONUM BURMANII BLUME ‘Malay cinnamon’**

This sps. is native to India, China, Malaysia and commercially cultivated in Sumatra. The bark contain essential oil. It is used as a carminative and flavour.

**CINNAMONUM LOUREIRII NEES “Saigon cinnamon”**

This sps., is native to South-East Asia. The bark contain essential oil 0.8-1.4%, it constitutes cinnamic aldehyde, phenols, pinene, phellandrine, caryophyllene. It is used as a carminative and flavour. To relieve nausea, flatulence and diarrhoea it is employed.

**CINNAMONNUM TAMALA “INDIAN CASSIA” “TEJ PATA”**

It is a small tree. Leaves are 3 nerved. Flowers are yellow white and fruit black when ripe. It occurs in the Himalayan region of West Bengal, Assam and Garhwal. Leaves of this plant is useful. It is regarded as carminative and spice. It is used for treatment of diarrhoea and colic pain.

**CINNAMONUM VERUM [Syn. C. zeylanicum]; “Ceylon cinnamon”**

An evergreen tree upto 8 m tall. Leaves are thick, leathery, large, ovate, pointed at tip, shining green in colour. Flowers appear in large hairy clusters, minute in size. Fruits are oblong or ovate, dark purple in colour, one seeded. The tree is native contain essential oil. The oil contains 90% cinnamaldehyde and small quantity of cinnamic acid, cinnamyl acetate and eugenol. It is known as stomachic, germicide and carminative. Used in the treatment of diarrhoea, gastric debility, flatulence, nausea and vomiting.

**DIFFERENCIATION OF CINNAMON AND CASSIA BARKS**

Experienced dealers and consumers can usually distinguish between the barks of the 4 commercially important cinnamonum sps., on the basis of appearance, odour and
flavour, but a distinction is more difficult with the ground spices. This is a problem in periods of short ages and high prices for authentication of ground spice samples and when adulteration of one spices by another is suspected. A number of workers have devoted effort to devising simple and inexpensive methods to overcome this problem.

Determination of the stem – volatile oil content of spice samples is not a reliable method as the range possible within a given sp.s., can be quite wide; and even gas-chromatography analysis of bark oils has its limitations when applied to mixed samples.

3 types of distinguishing methods for cinnaomon barks have been described in the literature: microscopy, mucilage content determination and thin layer chromatography. Dequecker reported a quantitative microscopic method for distinguishing between C. verum and C. cassia on the basis of fibre size. However, the scope of this study in terms of sample numbers examined was limited and its general utility is therefore uncertain.

Dutta (1961) has reported a method of distinguishing Ceylon cinnamon from C. cassia on the basis of mucilage content. Later Stahl et al (1969) improved and extended this method, which lacked precision, to cassias and cinnamons from other geographical origins. This study showed that a neat separation of cinnamons and cassias on the basis of mucilage content is difficult.

MUCILAGE CONTENTS OF SOME CINNAMONS AND CASSIAS

<table>
<thead>
<tr>
<th>spice</th>
<th>Mucilage %</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceylon cinnamon</td>
<td>2.90; 1.9 – 2.1²</td>
<td>Stahl et., al., 1969</td>
</tr>
<tr>
<td>Seychelles cinnamon</td>
<td>1.58'</td>
<td>Dutta 1961</td>
</tr>
<tr>
<td>Saigon cinnamon</td>
<td>0.73 – 1.10'</td>
<td></td>
</tr>
<tr>
<td>Korintji cassia</td>
<td>8.07'</td>
<td></td>
</tr>
<tr>
<td>Batavia cassia</td>
<td>9.2'</td>
<td></td>
</tr>
<tr>
<td>Cinnamon cassia</td>
<td>9.6 – 10.9²</td>
<td></td>
</tr>
</tbody>
</table>

Betts (1965) developed a thin layer chromatography method for the distilled bark oils to distinguish between eugenol and non-eugenol containing sp.s., He differentiated C. verum and C. cassia by this method, and these findings were supported by the study
of Herisset et al (1972). This approach has been extended by Lawrence who distinguished cinnamonum sps., on the basis of presence or absence of eugenol, coumerin and ortho-methoxy-cinnamaldehyde in a distilled bark oils. A major problem with this method is to distinguish between C.burmanii and C.loureirii where the eugenol content of the latter’s oil does not exceed 0.5%. it has been claimed that as little as 10% C.verum in C.burmanii can be detected by this method, and the presence of C. cassia can be detected in other sps., by the ortho-methoxy cinnamaldehyde spot.

### T.L.C. differentiation of the bark oils from the cinnamonum sps., of commerce

<table>
<thead>
<tr>
<th>Cinnamonum sps.,</th>
<th>Ortho-methoxy cinnamaldehyde</th>
<th>Eugenol</th>
<th>Coumarin</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. verum</td>
<td>Absent</td>
<td>Present</td>
<td>Trace-absent</td>
</tr>
<tr>
<td>C. cassia</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>C. burmanii</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>C. loureirii</td>
<td>Absent</td>
<td>Trace</td>
<td>present</td>
</tr>
</tbody>
</table>

Slazer has pointed out that the abundance of coumarin in the steam-distilled bark oil is not an accurate indication of its abundance in the spice since the compound does not readily distilled steam. A more accurate determination can only be achieved by examining the solvent extracts of the spices.

Earlier Voelkar et al (1967) had demonstrated a two dimensional t.l.c. technique that produced a fingerprint for each cinnamon and cassia bark extract. It is claimed that this technique permitted distinction of within plus or minus 20% of one type in a ground spice mixture. The absolute reliability of this method has, however, become questioned.
STANDARD SPECIFICATIONS

The problem of quoting standard specifications for cinnamon and cassia, and their bark oils, is complicated by the fact that:

1) each of 4 sps., encountered in commerce is known generally in ‘cinnamon’, among other names and

2) one or another of these sps., is recognized as the true source of the spice or bark oil according to the tradition of the importing country. Subject to these conditions, the following standards are extant.

CINNAMON

The British Pharmacopoeia, (1973), defines cinnamon as ‘the dried, inner bark of the shoots of coppiced trees of Cinnamomum zeylanicum Blume, and is known as ‘Ceylon cinnamon’. After a macroscopic and microscopic description of the spice, the standard specified that it should contain:

Acid insoluble ash, not more than : 2%
Foreign organic matter, not more than : 2%
Volatile oil, not less than : 1% v/w

All determined by specified methods of the Pharmacopoeia.

An international standard dealing with the 4 sps., of cinnamomum in separate sections was in the course of preparation at the time of writing, and a British Standard will probably be based on these criteria.

The bureau of Ceylon standards has published a standard CS 81;1970-Specifications for cinnamon products. Part-1 specifies the extrinsic qualities of quills, and part-2 deals with quillings, featherings and chips in a similar manner.

CASSIA

The British Pharmacopoeia defines the various cinnamomum sps., giving rise to sorts of cassia, as well as the minor forms of cinnamon C.verum originating in the Seychelles and the Malagasy Republic, as substitutes or adulterants of Ceylon

‘Cinnamon has been deleted from the US Pharmacopoeia 19, but in the US Dispensatory, 26 th edn, cinnamon is described as ‘ the dried bark of C. loureirii Nees (F. Lauraceae) and contains, in each 100g, not less than 2.5 ml of volatile oil’.

The United States Government Standard defines ‘cinnamon, cassia,’ in the following terms:

**Type 1, Whole:**

1) Batavia cassia shall be the dried bark of cultivated varieties of Cinnamonum burmanii Blume.
2) Saigon cassia shall be the dried bark of cultivated varieties of Cinnamonum loureirii Nees
3) korintji cassia shall comply with the requirements of sub type A.

**TYPE 2 GROUND:**

1) Batavia cassia
2) Saigon cassia
3) Korintji cassia

**TYPE 3, CUT [STICKS]:**

Stick cinnamon shall be cut to specified length from Batavia cassia which shall not exceed 15 mm diameter.

**TYPE 4, FORTIFIED, GROUND:**

Type 4 fortified ground cinnamon shall have a natural cassia or cinnamon base, except that fortified cinnamon shall have the addition of an encapsulated essential oil of cinnamon or cassia or a combination thereof.

Type 1, whole cinnamon, cassia, is required to confirm to the requirements given in the below table, except for the sieve requirements. Type 2 ground cinnamon, cassia
shall confirm to the requirements of the whole cinnamon, cassia and in addition, shall be uniformly ground to comply with the sieve requirements shown in the table.

**US Government Standard Specifications for ‘cinnamon, cassia,**

<table>
<thead>
<tr>
<th></th>
<th>Batavia A</th>
<th>Saigon B</th>
<th>Korintji C</th>
<th>Fortified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture, %, max.,</td>
<td>11.0</td>
<td>10.0</td>
<td>11.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Total ash, %, max.,</td>
<td>5.0</td>
<td>6.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Acid insoluble ash, % max.,</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Volatile oil (ml/100g)</td>
<td>1.25</td>
<td>3.0</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Non volatile ether extract</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Sieve test

<table>
<thead>
<tr>
<th>US standard sieve size</th>
<th>no. 60</th>
<th>no. 60</th>
<th>no. 60</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>% by weight required to pass through min.,</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>-</td>
</tr>
</tbody>
</table>

* The w/w % non-volatile ether extract in Batavia, Saigon, Korintji and Fortified shall not exceed the v/w % of the volatile fraction.

In addition to satisfying the US Federal Specifications, the spice should comply with the cleanliness Specifications of the American Space Trade Association, which are listed in the table.

The food and Drug Administration has set defect action levels for cassia or cinnamon [whole] as follows:

1) an average of 5% mouldy pieces by weight;
2) an average of 5% insect infested pieces by weight
3) an average of 1 mg of extra per lb.

**ASTA CLEANLINESS SPECIFICATIONS**

<p>| Cassia | Cinnamon |</p>
<table>
<thead>
<tr>
<th></th>
<th>0.50</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total extraneous matter, % by weight</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Rodent excreta, pellets per lb, max.,</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Other excreta, mg/lb, max.,</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Whole dead insects, per lb, max.,</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Insect bired or otherwise defiled spice</td>
<td>2.25</td>
<td>1.0</td>
</tr>
<tr>
<td>% by, weight, max.,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mouldy spice,% by weight max.,</td>
<td>5.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The Canadian Government standards for ‘cinnamon or cassia’ and for ‘ceylon cinnamon’ state that:

1) cinnamon or cassia, whole or ground, shall be the dried bark of cultivated varieties of Cinnamomum zeylanicum Nees, or C. cassia L., from which the outer layers may have been removed, and shall contain not more than:
   a)  5% of total ash
   b) 2% of ash insoluble in hydrochloric acid

2) Ceylon cinnamon, whole or ground, shall be obtained exclusively from C. zeylanicum Nees.

CINNAMON BARK OIL

THE British Pharmaceutical Codex, 1973, requires that cinnamon bark oil is obtained by distillation from cinnamon. The oil is a yellow liquid when freshly distilled, gradually becoming reddish-brown with age; its odour is that of cinnamon. It has the following characteristics:

Weight per ml at 20º c: 1.000 to 1.035 g

Optical rotation at 20º c: 0º to –2º

Refractive index at 20º c: 1.573 to 1.595

Solubility in ethanol at 20º c: dissolve 1 ml in 3 ml of ethanol (70 % v/v)

Any opalescence is not greater than a limiting value

Produced by a specified method.

Content of aldehyde: 60-70% w/w, calculated as cinnamic aldehyde, c9h8o, determined by a specified method.
The essential oil association of the USA have published a standard [EOA NO. 87] for Oil Cinnamon Bark Ceylon, which is obtained by steam distillation from the dried inner bark of the clipped cinnamon shrub. The characteristics of the oil, which are closely similar to those of the British Pharmaceutical Codex both in magnitude and methods are as follows:

Specific gravity at 25º/25º c 1.010 to 1.030
Optical rotation at 20º c 0º to –2º
Refractive index at 20ºc 1.573 to 1.591
Aldehyde content 55 to 78 % w/w, calculated as cinnamic aldehyde
Solubility in alcohol (70%) at 25º c soluble in 3 and more volumes

CASSIA OIL

The British Standards Institution has published a standard, BS 2999/17 ;1972, for oil of cassia, which is defined as the product obtained by distillation of the leaves, leaf stalks and young twigs of C.cassia. The oil is reddish-brown and has a characteristic cinnamon like odour and flavour recalling cinnamaldehyde, and has the following constants when tested by method described in BS2073:

Apparent density at 20º c 1.049 to 1.067
Refractive index at 20º c 1.600 to 1.614
Solubility in ethanol(70%v/v) at 20º c soluble in 3 vols
Acid value not greater than 7 and carbonyl value not less than 340

Cassia oil is the cinnamon oil of the United Stated Pharmacopoeia 19, which is the volatile oil distilled with steam from the leaves and twigs of C. cassia rectified by distillation. It contains not less than 80 %, by volume, of the total aldehydes of cinnamon oil.

The oil is described as a yellowish or brownish liquid, having the characteristic odour and taste of cassia cinnamon. Upon ageing or exposure to air, it darkens and thickens. It has the following characteristics when tested by specified methods:

Specific gravity at 25º/25ºc 1.045 to 1.063
Angular rotation at 25º c  -1º to +1º  
Refractive index at 20º c  1.602 to 1.615  
Solubility in 70% alcohol soluble in 2 vols  
Heavy metals  0.004 %  
Halogens  nil  
Resin or rosin oils  nil  
Assay  not less than 80%, by volume, of total aldehydes.

CINNAMON LEAF OIL

The British Standards Institution has published a standard BS 2999/3; 1965, FOR OIL OF CINNAMON LEAF, which is described as ‘the product obtained by steam distillation of the leaves of Cinnamonum zeylanicum Blume. It shall be reddish- brown in colour and shall have a cinnamon- clove odour; according to this specification, it shall have properties shown in table. When tasted by the methods of BS 2073.

The Essential Oil Association of the USA has issued a standard (EOA NO. 56) for cinnamon leaf oil, which is described as ‘the volatile oil’ obtained from the leaves of the true cinnamon shrub C. zeylanicum Nees. It is imported from Ceylon, Seychelles islands, Madagascar and other territories with similar climate’. The oil has the constants see out in table below.

BRITISH STANDARD SPECIFICATION FOR CINNAMON LEAF OIL

<table>
<thead>
<tr>
<th>Optical rotation at 20º c</th>
<th>-2.5º to +2º</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractive index at 20º c</td>
<td>1.530 to 1.540</td>
</tr>
<tr>
<td>Solubility in 70%(v/v)</td>
<td>soluble in 2 vols, sometimes with opalescence.</td>
</tr>
</tbody>
</table>

Ethanol at 20º c

• applicable to oils derived from the above botanical sps., but of unknown geographical origin.

Apparent density (mass per ml) at 20º Celcius

<table>
<thead>
<tr>
<th>Origin of oil</th>
<th>Minimum (g/ml)</th>
<th>Maximum (g/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceylon</td>
<td>1.034</td>
<td>1.050</td>
</tr>
<tr>
<td>Madagascar</td>
<td>1.032</td>
<td>1.052</td>
</tr>
<tr>
<td>South India</td>
<td>1.034</td>
<td>1.050</td>
</tr>
<tr>
<td></td>
<td>Minimum percent by volume</td>
<td>Maximum percent by volume</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Ceylon</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>Madagascar</td>
<td>70</td>
<td>95</td>
</tr>
<tr>
<td>South India</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Seychelles</td>
<td>85</td>
<td>95</td>
</tr>
<tr>
<td>Unspecified *</td>
<td>70</td>
<td>95</td>
</tr>
</tbody>
</table>

*applicable to oils derived from the above botanical sps., but of unknown geographical origin

**ASTA ANALYTICAL PROCEDURES**

**FOR FINDING OUT EXTRANEOUS MATTER IN CINNAMON**

a) The individual subsample is weighed, shaken from the bag, a small portion at a time, with a good light, on the sieve with white paper beneath. As the sample is discharged on the sieve, examine for extraneous/ foreign matter, mammalian, or other excreta.

b) When the entire sample is on the sieve, ti is shaken back and forth a few times. The siftings on the white paper are also examined for live and dead insects, mammalian or other excreta. Calculate the average milligrams of mammaliaan excreta and the average milligram of other excreta across all of the subsample analyzed and report each value separately and as mg/lb

c) Examine entire sample for mold or insect defiled/ infested pieces.

d) Report by count(whole insects) or by weight in milligrams (mammalian excreta, other excreta).

e) Each sample representing the lot is done in sequence in this manner.s
CASSIA STICKS OR VERA AA CASSIA

a) break each stick separately from the entire subsample into pieces with a hammer or weight
b) examine the pieces for mold or insect defiled/infested pieces.
c) The entire stick is considered in the calculations where evidence of contamination is found.
d) Report results of each subsample in % by weight in milligrams.

1) excreta mg/lb = weight excreta(mg)/weight of product (g) 1 lb
2) % moldy/insect defiled/infested product = weight reject product(g)100 weight product (g)
3) % siftings = weight siftings (g) 100 weight product (g)
4) % extraneous matter = weight extraneous matter (g)100 weight product (g)

DEFECT ACTION LEVELS PRESCRIBED BY USFDA FOR CINNAMON

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>DEFECT</th>
<th>DEFECT ACTION LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassia or Cinnamon</td>
<td>mold(mpm-v32)</td>
<td>average of 5% or more pieces by weight are moldy</td>
</tr>
<tr>
<td>bark,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole</td>
<td>insect filth (mpm-v32)</td>
<td>average of 5% or more pieces by weight are insect infested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mammalian excreta</td>
<td>(mpm-v32)</td>
<td>average of 1 mg or more mammalian excreta per pound</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cinnamon Ground</td>
<td>insect filth (AOAC968.38 b)</td>
<td>average of 400 or more insect fragments per 50 grams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rodent filth (AOAC 968.38b)</td>
<td>average of 11 or more rodent hairs per 50 grams.s</td>
</tr>
</tbody>
</table>
Cinnamon is mostly grown in Kerala, but reliable statistics are not available on production of cinnamon and cassia. The

Demand for both is much more than that produced in the country. Thus during 1981–82, 942 tonnes of cassia and 254 tonnes of cinnamon at a value of Rs.33.4 million and Rs.8.58 million respectively were imported into India. Besides, India also imported 14.56 tonnes of cinnamon leaf oil and 3.4 tonnes of cinnamon-bark oil during the same year (1981-82) at a value of Rs.640,000 & Rs.249,000 respectively (Dte.Gen. commercial intelligence and statistic culcutta ; Dte cocoa, arecanut & spices – statistics 1986 ). During 1987-88, only about 1,525 kg of cinnamon were exported from India at a total price of Rs.47,205 and at an average fob value of Rs.30.95 kg and during 1992-93, about 20 tonnes of cinnamon were exported, earning Rs.1,012 million foreign exchange. There is still a need for increasing area under cinnamon, clove & cassia wherever the soil and agroclimatic conditions exist, viz. Assam, NEFA, western ghats etc.

Of the various countries producing cinnamon & cassia, the important ones in international trade are, in the case of cinnamon, Sri Lanka, the Seychelles and the Malagasy Republic (Madagascar); and, in the case of cassia, mainland China, Indonesia and Vietnam. It is also quite possible that Taiwan exports some home-grown cassia exported from there originates in mainland China and Vietnam, Taiwan thus fulfilling an entrepot function similar to that of Singapore and Hong Kong, both of which re-export considerable quantities of these spices each year.

Other countries known currently to be making local use of indigenous or introduced cinnamon variants include India, Burma, Malaysia, Korea, Japan, the Philippines, Fiji, Mauritius, Reunion, the Comoro islands, Zanzibar (Zanzibar island) and one or two islands, the Caribbean Antilles chain of these, India, Malaysia, the Indian ocean islands and the west Indian territories are occasional exporters but their import on world trade has never been significant, save perhaps, on one or two occasions, in the case of India.
According to the systematics survey of world markets for spices conducted by the ITC(1982), the volume and value of the International trade in cassia and cinnamon combined, is about 25,000 tonnes, valued at US $ 35,000.

Of these, the USA alone imported cassia and cinnamon worth about US $ 10,500, followed by Singapore ($4,530), Mexico ($4,111), Hong Kong ($3,335), Germany ($1,930) etc.

The demand for tree spices like clove, nutmeg, mace, cinnamon, cassia is more than the present domestic production. It is estimated that India produces about 5000 MT of these spices but the requirements ranges from 7000-8000 MT. The deficit quantity of herbal spices are also imported into India. The import of these spices requires Rs.26 to 30 crores of foreign exchange annually.

**PRODUCTION:**

**CINNAMON**

International trade in true cinnamon has usually been dominated by Sri Lanka but accurate production statistics have seldom been regularly available, and since a large proportion of local production is consumed domestically, the export figures are no guide to production level. Disruption of trade, e.g. during the Spanish world war, gave rise to replacement of cinnamon in some areas by coconuts, but after the end of the war trade picked up again, and production with it. During the 1960s Sri Lanka exported approximately 1/3 rd of its production, which averaged just over to 10500 tonnes annually b/w 1964 & 1970. The area from which this quantity was obtained averaged around 15,000ha, but annual production per hectare is said to have declined somewhat in recent years, possibly through overcropping which appears to have been a fairly common occurrence in cinnamon and cassia production. The proportion exported has varied considerably over the decades but the quantities consumed by the local population have always been large, at any rate in the twentieth century. All cinnamon produced in Sri Lanka for the export market is cultivated, but wild cinnamon is still exploited for local use.

It is an easier matter to estimate production in the Seychelles, if only because a negligible proportion of local production is consumed in the islands and complete export
statistics are available, but even here the regular expansion and contraction of local stocks implies divergence of production from exports in any one year. As in Sri Lanka, there have been occasional instances of over-exploitation of the trees, followed by considerably lean years. Systematic cultivation of cinnamon is the exception rather than the rule in the Seychelles and there has, more over, been a tendency in recent years for the labour force traditionally responsible for the harvesting of the wild cinnamon to dwindle in size, the tourist and other growth industries generally offering more attractive wages and conditions of employment.

It is difficult to ascertain the precise point in time at which cinnamon production in the Malagasy Republic reached significant levels, although the tree has been established there since long before 1900. although there are few statistics to prove the point, it is likely that, as in Sri Lanka, the local population consumes sufficient quantities of the spice for the export statistics to be generally unrepresentative of indigenous production.

Very little is in record in respect of the minor producers of cinnamon. Just occasionally, reports are received of small export shipments, mainly in the case of Zanziber Island and the West Indian islands of Martinique and Guadeloupe, but in the great majority of cases the spice is locally consumed only.

CASSIA

Similar problems attend any attempt to estimate production figures for the various types of cassia. Neither mainland China, Vietnam nor Indonesia publish regular records of local production and in all the 3 countries there is large-scale local consumption of the spice. Chinese cassia is in fact mainly consumed within the Chinese borders, a relatively small proportion being traded internationally, and the same may well be true also of Vietnamese cassia, which has generally been traded in small quantities only. In the case of Indonesian cassia, it is likely that, as with nutmeg and mace, up to one-half of local production is domestically consumed.

It is not easy to pinpoint the exact nature of the organization of production in the majority of the producing countries. In the Seychelles it is clear that production is now a days much more under the control of the Department of Agriculture than it used to be, probably on account of periodic loss of interest in the spice on the part of small holders.
and estate owners. Similar the export of the spice is now closely controlled by the
government, mainly as a means of ensuring that the quality of the spice is as uniformly
high as possible. In Sri Lanka there is certainly a greater degree of co-operative
organizations of the industry than there used to be, although private farmers and
landowners particularly the former, are undoubtedly still of major importance. Political
developments in mainland China, Vietnam and the Malagasy Republic have tended to
favour more centralized control over the production of cinnamon or cassia but it is not
clear just how far the private grower or collector has dwindled in importance in each
case. However, it is understood that the industry in mainland China is now run on a
collective basis with cultivated bushes in plantations only in Kwangsi and Kwantung
provinces; wild bushes are no longer exploited. In Indonesia the private grower is still
dominant, although it is not clear whether the Chinese buyers follow the same practice as
encountered in the case of nutmeg and mace, namely that of being responsible for the
actual harvesting and collection as well as for subsequent grading and packing. What is
clear is that in cassia producing countries there has been a greater tendency for the flow
of trade to be interrupted, often as a result of political changes and upheavals, than in the
cinnamon producing countries, although sharp fluctuations in the supply of cinnamon
have certainly not been unknown.

TRADE

Any study of recent developments in international trade in cinnamon and cassia
requires that the nomenclature and grading systems for each spice be understood.

Nomenclature is a particular problem in interpreting trade statistics and in
determining the precise end uses of the individual spices since ‘cinnamon’ and ‘cassia’
are synonymous terms in many countries. With regard to the grades of the spices,
changes have been effected by some of the producing countries, for example, mainland
China has simplified cassia grading over recent years, and by no means all the grades
listed for other countries are invariably marketed at any one time. In the case of Ceylon
cinnamon, the ‘Mexican’ grade, which falls in respect of quality between the ‘Fine’ and
‘Hamburg’ grades, is becoming largely disused in spite of the fact that Mexico is a major
cinnamon importer. Now a days the grades shipped to Mexico are much more likely to be
‘Fines’ and ‘Hamburgs’ than specifically ‘Mexican’ grades. This trend has previously
been encountered with the ‘Spanish’ and ‘Barcelona’ grades, which were of a similar intermediate quality and are now not encountered.

CINNAMON

The Ceylon cinnamon trade was well established in 18th century, exports in the years 1730 and 1750 being 600000 pounds and 700000 pounds (272 ton and 318 ton) respectively. Around the year 1770 the Dutch, who at that time controlled the island, effectively reduced the quantity traded by burning any excess over 400000 pounds (181 ton) as a means a keeping the price up. By the mid 19th century, however, exports were up again and, for example, the average quantity traded between 1837 and 1841 was 205 ton, in 1846 it was 240 ton and in 1866, 374 ton. After 1867, chips began to be marketed as well as quills and this gave rise to a further increase to between 550 and 600 ton per annum in the 1870’s and to between 1500 and 2000 ton by the turn of the century. Wild Ceylon cinnamon was traded in small quantities up until 1900 but disappeared from international trade thereafter. The first 20 years of the 20th century saw a further increase in exports, annual shipments being in the 2000-2500 ton range, of which 40% consisted of chips.

Trade in Seychelles cinnamon did not commerce in earnest until the beginning of the 20th century. It will be appreciated that for many years the industry’s initial promise was not maintained. Production remained depressed between the wars and only began to take an upward turn during the second world war. Thereafter the trade flourished and in 1968 supplies from the Seychelles in fact exceeded those from Sri Lanka. However, this has not been repeated and is unlikely to be in the future. Attempts to prepare quills for the export market are a relatively recent departure and the unrolled bark, either scraped or unscraped, is the main form in which it is known internationally. Seychelles cinnamon bark has always been well regarded and it seems doubtful whether the introduction of quills on to the market has brought about an overall increase in demand of Seychelles cinnamon. Problems have, infact, been encountered in local production of quills through labour shortages and this is one of the general difficulties facing the country.

Madagascar was a producer of minor or negligible significance before the 1960’s but in 1969 about 2000 ton of cinnamon were exported from there and in other recent
years exports have generally been in the 400-1000 ton range. It is probable that Madagascar will continue to be an exporter of some importance.

In most years, at least one half of Sri Lanka’s exports are destined for the USA and Mexico. In the USA, cinnamon is used in conventional spice applications but the large Mexican market is due almost entirely to consumption of cinnamon tea which is so popular there. Since 1972 however, there have been reports of a joint West German Mexican venture to manufacture a synthetic cinnamon powder, as a result of which Mexican imports of cinnamon have been subject to severe restrictions. Of the other buyers of Sri Lanka cinnamon, Peru and West Germany are prominent. In the case of Seychelles cinnamon, the UK, with its traditional overseas connections, used to be by far the most important buyer but the USA now dominates this market, followed by the UK and then, at some distance, the German Federal Republic, the Netherlands and France. Madagascan cinnamon is destined mainly for France and the USA.

MARKET STRUCTURE

In the main importing countries, cinnamon and cassia are mainly handled by the same network of produce merchants, brokers and dealers as in the case of other spices such as cloves and nutmegs. It seems probable that the number of middlemen, both in the exporting and in the importing countries, is declining. Considerable use is made of entrepots, probably more so than with either of the 2 spices just mentioned, in so far as Antwerp, Hong Kong Macao and probably Taiwan are clearly of greater importance, in the case of cinnamon and cassia. Moreover, there appears to be a considerable trade between the 2 entrepots Hong Kong and Singapore.

A large proportion of mainland China’s exports of cassia were traditionally routed through Hong Kong and to a lesser extent, Macao where a substantial proportion of the bark was cleaned and regarded before re-export. However, the marketing pattern for Chinese cassia has changed somewhat since the mid 1950’s, particularly since the removal of the trade embargo on China by the USA in 1971. Direct sales of Chinese cassia to the major importers has increased, conducted usually through the bi-annual conton trade fair, and the importance of Hong Kong seems to have diminished. According to information supplied by the Hong Kong Department of Agriculture
Fisheries in 1976, China appears to have placed a quota on the amount of cassia exportable to Hong Kong and very often, local traders have to depend on imports from Macao to augment their supplies. Also, the changes in the grading system for cassia within mainland cassia have obtained the need for further reconditioning by merchants in Hong Kong. In 1976 there were 10 trading companies engaged in the importing and re-exporting of Chinese cassia.

Indonesian consignments of cassia are in considerable measure routed through Anatwerp, although why this should be so when Rotterdam is the more usual destination with so many other products of Indonesian origin is not readily explicable. In Sri Lanka the usual practice at one time was for the local sellers to arrange and settle contracts with shipping companies, but in recent times there has been a strong trend towards direct links between sellers and buyers or traders in the importing countries.

**PRICE SPREAD OF CINNAMON AND CASSIA**

In May 1996, the price of cassia was Rs.152.50/kg while in June 1996, price of cinnamon (Bombay) was Rs.148.41 kg & that of cassia in Madras was Rs.167.50 kg. This shows the wide fluctuations in regional prices of cinnamon & cassia in India.

Cinnamon and cassia have seldom enjoyed wholly stable prices over any extended period of time and the familiar pattern of fluctuations has been experienced. Between the wars, Ceylon cinnamon was heavily affected by the Depression, and the average price of quills which stood at Rs.2976 per tonne in 1927 had slumped to Rs.551 per tonne by 1933, after which recovery was gradual. The price of chips fell from Rs.510 per tonne to Rs.102 per tonne in the same period. The second world war saw hostilities in the vicinity of many of the cinnamon –producing and cassia-producing areas and prices rose sharply, then eased once the effects of the war and prices aftermath had passed their peak. Price information on cassia for the 1920-45 period is scarce but similar trends seem to have been evident. The cassia producing countries were racked by political turmoil during the 1950’s this resulted in the price of cassia rocketing to unprecedented heights. Users turned to cinnamon as closest alternative and its price also rose but to a lesser extent.
Quillings are less highly priced than top quality fine grade quills, as would be expected, although they may in fact be broken fragments of highest grade quills. In Chinese cassia the ‘broken, no. 1’ grade is not normally very much less expensive than the whole grade, although there is always a differential. There is no obvious relationship between the prices of Chinese, Indonesian and Vietnamese cassia and supply and demand are the main determinants of the relative price levels, although major differences normally disappear quickly as buyers temporarily turned to the cheapest variety. In 1974 prices were very high and this reflected the speculative pressures arising from the worldwide commodity boom rather than any real scarcity. As previously indicated, however, cassia has occasion been very scarce, primarily on account of variations in the quantities available for export from mainland China; cinnamon has been much less affected by shortages of such magnitude.

Future price levels for both cinnamon and cassia could be markedly affected if Chinese and Vietnamese production were to reexpand. In case of China, a small increase in production could bring about a very large increase in exports, owing to the relationship between local consumption and export. World demand is likely to increase only very slowly, and is unlikely to be influenced by a sharp fall in prices, it can only be concluded that an expansion in supply from one source could, though price mechanism, bring about an eventual cut back in production in other countries as a result of unfavourable prices.

**EXPORT/IMPORT TRADE REGULATIONS OF DIFFERENT COUNTRIES**

**EUROPEAN REGULATION ON SPICES**

The spice industry in Europe thrives mainly on the trade in ground spices which are used mainly as food ingredients and hence all the horizontal regulations concerning food processing and sale are of direct relevance to spices. Product specific vertical regulations have not yet been formulated for spices and herbs, but codes of practices and standards relevant to spices and herbs are in existence in many European countries. Presently, the European Spice Association, in collaboration with the Spice Trade Association of various European countries is attempting to lay down uniform standards and code of practices,
for the whole Europe, in line with the EC Food Hygiene directive (93/43/EEC). Until an agreement is reached on the code of practices, the traders should look for the regulations in individual countries.

GERMAN REGULATIONS FOR SPICES

According to the definition given in the ‘Guidelines for spices, spice extracts and spice preparations’, spices are parts of plant e.g. roots, root stems, barks, bulbs, leaves, blossom, fruits, or seeds which due to their natural contents of aromatic and tasty substances are suitable and destined for consumption as seasonings or taste giving ingredients. It goes without saying that spices have to be free from foreign matter and other impurities and that they must not be infested with insects and plant diseases. As far as impurities of animal origin are concerned, attention should be paid to insects, parts of insects, larvae, maggots, mites, rodent hairs etc. the number of bacteria should be small.

The evaluation of spices is based on the past statistical experience regarding the contents of active ingredients (e.g. essential oil) as well as on the ash content and sand content. As a general principle, it is necessary to check all spices for excessive pesticide residues and aflatoxins. The German code of practice, 1988 stipulates the microbiological parameters for food stuffs in general. Among the various parameters Salmonella is considered very serious and if detected in 25 gms of sample, the consignment is violative of the regulations.

DUTCH REGULATIONS FOR SPICE

As a supplement to the Act no. 54 of 1972, Dutch Ministry of National Health and Welfare has promulgated the vertical regulations with respect to Herbs and Spices. These regulations enlist the plants used as herbs and spices, gives the limits for microbial parameters and also specifies the method of analysis. Standard specified for spices (cinnamon) under the code of practice in Netherlands is furnished below:

Cinnamon

Ash content maximum – 8.0%
Sand content(A/S) maximum- 2.0%
Volatile oil minimum – 1.0 %

Ceylon cinnamon
Ash content maximum - 5.0%
Sand content(A/S) maximum- 2.0%
Volatile oil minimum – 1 to 5 %

Requirement of spices (cinnamon) according to honest trading practices in Germany
Maximum moisture – 13 %
Minimum oil content – 2%
Ash –5 to 7 %
Maximum sand content – 1.8 %
(Part of ash not soluble in HCl )

UK REGULATIONS FOR SPICES
Spice and spice mixes, imported to UK are subject to the provision of the Imported Food Regulation, 1984 ( sl. 1984, no.1918) which broadly requires that all foods being imported for human consumption to be sound, fit and wholesome. If it is packed and is intended for immediate retail sale to the consumer, then it should comply with the Food Labeling Regulation, 1984 (sl 1984, no. 1308). Evidence of Salmonella infection would lead to the merchandise being condemned by the public health authorities. Information on import is obtained from customs. The Port Health Authorities check the consignments. The authorities levy the service charges on the importer.

EU REGULATIONS ON SPICES
Though directives have been formulated by European commission on the Horizontal Regulation on food stuffs, Vertical Regulation on spices and herbs are under discussion stage only. Not only the standards, but also the methods to determine the parameters are also under discussion. With regards to maximum levels of pesticides residues that can be tolerated, the commission has given its directives in 1990. This was supplemented by directives issued in 1993 and 1994.
ESA- Individual product specification
Cinnamon (ESA)- Ash % w/w max. – 7%
A/A % w/w max. –2%
Water % w/w max. -14%
V/o % v/w min. – 0.4 %

IMPORT PROCEDURE FLOW CHART

Sample collected for lab examinations
*sample found passable *sample found violate
*apply for *shipment detained
* shipment released reconditioning *shipment refused *destruction
*reconditioning *export *unsuccessful reconditioning
*successful *re-sample

Vietnam is major supplier of cassia and cinnamon products including oils to the European Union (EU) market. The EU market importing 226 tons of cinnamon from Vietnam in 1992, by 1996 the figure rose to 684 (391%).

MEXICO

Cinnamon is the most important spice imported into Mexico, accounting of an average of 2/3rd of country’s total imports of spices in 1970’s. it is estimated that more than 50% of world trade in true cinnamon is absorbed by this market. Further over the 5 year period of 1976-80 imports of cinnamon into Mexico averaged 2224 ton. In recent years (between 1887 and 1999) the average import has been around 2771 ton valued US $ 28.4 million. Sri Lanka provided around 94% of total imports during 1998. the USA is major non- producing supplier of both ground and unground cinnamon to the Mexican market. The Indian export to Mexico has come down from 80 t in 1981 to 10 ton in 1998, while imports from Netherlands have risen dramatically.
MIDDLE EAST COUNTRIES

Middle East countries is a growing market for cinnamon and cassia products. Next to pepper, cassia and cinnamon are the most popular spices in Egypt, Saudi Arabia, Iran, Iraq and UAE. Their import mainly consists of cassia, though a small quantity of cinnamon is also imported from Sri Lanka. China is a major supplier for this vast and vibrant market.

EXPORT: About 94% of total production in world is exported, indicating the commercial nature of crop. Until end of 1970’s Sri Lanka was the leader in the production and export of this commodity controlling the markets of North and South America. The other major importers, like France, Germany and the UK, re-export value added cinnamon products. The share of Sri Lanka’s export has been reduced from 1/3rd of global demand to 1/10th over past 2 decades.

INDONESIA AND CHINA

Major producers of cassia type of cinnamon, increased their production from the beginning of 1980’s and together captured almost 70% of world market. Consequently export from traditional cinnamon producers like Sri Lanka, Madagascar and Seychelles declined drastically from 34.3%, 1.9% & 6.8% respectively in the 1970’s to only about 10.9%, 1.2%, 0.6% respectively in the 1990’s. China and Indonesia substantially increased their share in world trade during this period of about 39.7% and 27.9% respectively. There has been an increasing trend in export of cassia products from Indonesia and China and Vietnam while the true cinnamon export could not keep up the pace.

WORLD OUTLOOK/ PROSPECTS

The world demand is growing gradually. Thus, concerted efforts should be made in India to increase both production and productivity of cassia and cinnamon, wherever technically feasible, keeping in view also the quality of the products fit for export.
MEDICINAL VALUES OF CINNAMON

CINNAMON FOR DIABETICS

Cinnamon, the sweet spice, may help our bodies digest sugar. Test-tube studies at the USDA’s Human Nutrition Research Center reveal that cinnamon and 3 other spices give a boost to insulin, the hormone that carries sugar into our cells.

The researchers measured insulin activity in the presence of ice-cream, peanut butter and 34 spices. Although most substances had no effect on insulin activity slightly, while cinnamon, cloves, turmeric and bay leaves tripled it.

According to USDA biochemist Richard Anderson, these spices may eventually be useful in the treatment of type 2 (adult onset) diabetes. In this form of diabetes, people produce insulin, but often not efficiently enough to meet the body’s need. In addition, their bodies are often somewhat resistant to the effect of insulin.

Theoretically, if a type 2 diabetic consumes cinnamon, which makes the insulin he produces more active, he might need to inject less insulin, or perhaps even none. Anderson believes that a very small amount of cinnamon such as 1/8 tea spoon may have an effect. He now begins tests of cinnamony foods on people with diabetes.

COLD:

Cinnamon is regarded as an effective for common cold. Coarsely powdered and boiled in a glass of water with a pinch of pepper powder and honey, it can be beneficially used as a medicine in case of influenza, sore throat and malaria.

DIGESTIVE SYSTEM DISORDER:

Cinnamon checks nausea, vomiting and diarrhea. It stimulates digestion. A table spoon of cinnamon water, taken half an hour after meals is beneficial in flatulence and indigestion.

NATURAL BIRTH- CONTROL:
This spice can be used for natural birth-control. It has a remarkable effect on checking the early release of ova after child birth. A piece of cinnamon taken every night after a month of child birth thus delays the appearance of menstruation for more than 15 to 20 months and prevents early conception.

**HEAD-ACHE**

Head-ache produced by exposure to cold air can be got rid of by plastering with a paste of finely powdered cinnamon in water.

**TRENDS IN CONSUMPTION AND PROSPECTS**

The general impression conveyed by the trade statistics is that overall consumption of cinnamon and cassia is likely to be a function more of population growth that of any other possible influence. The uses of these spices can be divided into the following broad categories; culinary; processed foods; distillation of the essential oil contained in the cinnamon bark; and oleoresin extraction.

No strong trends in consumption are evident apart from the increased use of the oleoresin, and it can be reiterated that increases in population and income levels are likely to have the greatest influence in the future.

Chapter 2

**CINNAMOMUM OILS (INCLUDING CINNAMON AND CASSIA)**

*Cinnamomum* is a large genus, many species of which yield a volatile oil on distillation. The composition of the oil, and therefore its value and the use to which it is put, depends very much on the species that is distilled as well as the part of the plant which is utilized. The most important *Cinnamomum* oils in world trade are those from *C. verum* (cinnamon bark and leaf oils), *C. cassia* (cassia oil) and *C. camphora* (sassafras and Ho leaf oils). The latter species provides oils which are utilized as sources of chemical isolates.

However, a number of other *Cinnamomum* species are distilled on a much smaller scale and the oils used either locally or exported to regional markets. Given the large number of *Cinnamomum* species that exist, their widespread distribution in Asia, and the number
still not characterised in terms of essential oil content and composition, the genus has much potential for providing new tree crops in developing countries. The spice oils cinnamon and cassia are discussed first. An indication is then given of the types of oil found in other *Cinnamomum* species, including *C. camphora*, and those with the greatest perceived potential for future use.

**DESCRIPTION AND USES**

**Cinnamon bark** oil possesses the delicate aroma of the spice and a sweet and pungent taste. Its major constituent is cinnamaldehyde but other, minor components impart the characteristic odour and flavour. It is employed mainly in the flavouring industry where it is used in meat and fast food seasonings, sauces and pickles, baked goods, confectionery, cola-type drinks, tobacco flavours and in dental and pharmaceutical preparations. Perfumery applications are far fewer than in flavours because the oil has some skin-sensitizing properties, but it has limited use in some perfumes.

**Cinnamon leaf** oil has a warm, spicy, but rather harsh odour, lacking the rich body of the bark oil. Its major constituent is eugenol rather than cinnamaldehyde. It is used as a flavouring agent for seasonings and savory snacks. As a cheap fragrance it is added to soaps and insecticides. The oil's high eugenol content also makes it valuable as a source of this chemical for subsequent conversion into iso-eugenol, another flavouring agent.

**Cassia oil** is distilled from a mixture of leaves, twigs and fragments of bark. Cinnamaldehyde is the major constituent and it is used mainly for flavouring cola-type drinks, with smaller amounts used in bakery products, sauces, confectionery and liqueurs. Like cinnamon bark oil, its use as a fragrance is limited by its skin sensitizing properties.

**WORLD SUPPLY AND DEMAND TRENDS**

**Markets**

**Cinnamon bark** oil is a high-value essential oil but the volumes traded are very low. In the ten years since 1983 exports from Sri Lanka, virtually the only supplier of the oil, have never been more than 2.8 tonnes. Exports from Sri Lanka for the six years 1987-92, together with their destinations, are shown in Table 1. The major market is the EC, within which France is the biggest importer. In recent years the United States has emerged as the second largest importing country.
World demand for **cinnamon leaf** oil has been around 120-150 tonnes pa in recent years, met almost entirely by Sri Lanka. Sri Lankan exports (Table 2) have averaged about 120 tonnes pa for the period 1987-92, but this includes an exceptionally low output in 1990. The United States and Western Europe are the largest markets for cinnamon leaf oil. Imports into France and the UK have fallen in the last few years, as they have slightly for India. Hong Kong is a significant importer although most of the oil is re-exported.

The ready availability of eugenol ex clove leaf oil has led to some loss in markets for cinnamon leaf oil. When eugenol is required for further conversion into iso-eugenol, that produced from cinnamon leaf oil possesses a more desirable aroma and flavour than when derived from clove leaf oil. For most other purposes, however, the cheaper eugenol ex clove leaf oil is preferred.

Estimation of world demand for cassia oil is complicated by the fact that export data are not available from the People's Republic of China, the major producer. Furthermore, the oil is only separately specified in import statistics of the USA and Japan, although these are known to be the major markets.

The levels of imports of cassia oil into the USA are shown in Table 3 for the period 1987-93.

Imports into the USA have risen in recent years and, with a soft drinks market which shows no sign of weakening, demand for cassia oil is expected to remain strong. Imports from Japan and Hong Kong are almost entirely re-exports of Chinese oil.

Japanese imports of cassia oil have averaged 60 tonnes pa for the six years 1988-93, virtually all of it coming directly from the People's Republic of China. A significant proportion of the imports are re-exported (to the USA, for example, above).

Supply sources

Sri Lanka is the only regular supplier of **cinnamon bark** and **leaf oils**. With the exception of 1990, when both oils were in short supply, production (as reflected in exports) has remained very constant for bark oil, with a slight downward trend for leaf oil. Internal consumption is small so that production levels are not much greater than exports.

Madagascar and the Seychelles have been intermittent suppliers of leaf oil on a very minor scale in the past. India produces very small amounts of leaf oil for domestic use.
Most cassia oil in international trade is of Chinese origin. There is believed to be significant domestic consumption so total annual production may be in excess of 500 tonnes.

Small quantities of cassia oil are produced in Indonesia, Viet Nam, India and Nepal but these are obtained from species of *Cinnamomum* other than *C. cassia* (see PLANT SOURCES) and are much less widely traded than Chinese oil.

**Quality and prices**

There is no international standard for *cinnamon bark oil* although batches containing cinnamaldehyde at the higher end of the range fetch the higher price. In the United States, an EOA standard specifies an aldehyde content of 55-78 percent.

International (ISO) standards exist for cinnamon leaf and cassia oils. For *cinnamon leaf oil*, ranges between which the major constituent, eugenol, should fall are specified in terms of total phenol content for oils of different origin. Oil from the Seychelles used to be preferred because of its high eugenol content (*ca* 90 percent). In practice, Sri Lanka now accounts for almost all of the oil in international trade and the standard specifies a 75-85 percent phenol content. Another constituent of the oil which contributes to its aromatic character is cinnamaldehyde and for Sri Lankan oil a maximum level of 5 percent is specified. Physico-chemical requirements are also given.

In the United States an FMA monograph, which replaces the old EOA standard, specifies the eugenol content of cinnamon leaf oil in terms of its solubility in potassium hydroxide (80-88 percent).

For *cassia oil*, cinnamaldehyde is the major constituent and a minimum content of 80 percent is specified in the ISO standard. Again, physico-chemical data are provided.

*Cinnamon bark oil* is considerably more expensive than the leaf oil and probably the most highly priced of all essential oils. During 1992 it was being offered at around US$385/kg, largely reflecting the high raw material cost. In 1993 and early 1994 dealers in London were only quoting prices on request.

*Cinnamon leaf oil*, in contrast, has been in the range US$6.50-7.50/kg for most of the last three years. Its price fell gradually from about US$7.50 in early 1991 to US$6.50 in mid-1993. In late 1993 it had risen again to US$7.30/kg and in early 1994 it was US$8.25/kg. Although it is a comparatively low-priced oil it is still more expensive than
clove leaf oil as a source of eugenol (which was approximately US$2.70/kg in early 1994).

**Cassia oil**, too, has remained fairly level in price over the last few years. In the period early 1991 to mid-1993 it fetched US$33-35/kg. It then fell slightly and in early 1994 it was about US$29/kg. These prices are significantly lower than those which prevailed in the early and mid-1980s, when there was a shortage of cassia bark in the People's Republic of China. Any appreciable rise in price above the US$30-35/kg level is likely to encourage end-users to blend cheaply available synthetic cinnamaldehyde with natural cassia oil.

**PLANT SOURCES**

**Botanical/common names**

Family Lauraceae:

| **Cinnamomum verum Presl (syn. C. zeylanicum Nees)** | True or Ceylon cinnamon |
| **C. cassia Presl** | Cassia, Chinese cinnamon, "Cassia lignea" |
| **C. burmannii Blume** | Indonesian cassia |
| **C. loureirii Nees** | Vietnamese cassia |
| **C. tamala (Buch.-Ham.) Nees & Eberm.** | Indian cassia |

Description and distribution

The genus *Cinnamomum* comprises several hundred species which occur naturally in Asia and Australia. They are evergreen trees and shrubs and most species are aromatic. *C. verum*, the source of cinnamon bark and leaf oils, is a tree indigenous to Sri Lanka, although most oil now comes from cultivated areas. Smaller areas of wild trees are found in southwestern parts of India. *C. cassia*, the source of internationally traded cassia oil, occurs wild as a bush in the mountains of southern China but is now cultivated for oil production, mainly in the provinces of Kwangsi and Kwangtung.
The other cassias occur wild on the islands of Sumatra and Java, Indonesia (C. burmannii); in Viet Nam (C. loureirii); and India and Nepal (C. tamala). In all cases the trees are also cultivated.

**Effects of oil production on the natural resource**

Most of the above oils are now derived almost entirely from cultivated sources and there is no longer pressure on the wild resource.

**HARVESTING/PRIMARY PROCESSING**

*Cinnamomum* usually coppices well and commercial production of the bark spices entails cutting the stems low down after an initial establishment period and harvesting the bushy re-growth stems at regular intervals thereafter. In Sri Lanka, a first harvest may be obtained after 3-4 years, although both quality and yields improve with subsequent cutting. The stems are cut during the rainy season to facilitate peeling of the bark. Details of harvesting practice differ slightly from country to country but the basic principles are the same. Strips of bark are then formed into the familiar compound quills (cinnamon) or hollow quills (cassia) of the spices.

In Sri Lanka, **cinnamon bark** oil is produced by distillation of chips and variable amounts of featherings (pieces of inner bark from twigs and twisted shoots) and quillings (broken fragments of quills). In many cases the older form of hydro-distillation is used in which chips and water are placed together in the distillation vessel which is heated by direct fire. The oil distils over in two fractions, one lighter and one heavier than water, and a form of cohobation is used to recover residual oil from the distillation waters. More modern methods involve steam distillation.

The leaves left after trimming the cut stems, as well as those obtained from pruning operations, provide the raw material for production of **cinnamon leaf oil**. They are usually allowed to dry for a few days before distillation. Traditional stills in Sri Lanka are large wooden vessels capable of holding up to 200 kg of leaves, on top of which is fitted a copper still head. Steam is introduced from a separate wood-fired boiler. In some cases, all-metal vessels are used and water-steam distillation is employed.

Chinese cassia oil is produced by hydro-distillation of leaves, twigs and fragments of bark.
Yields and quality variation

For cinnamon and cassia oils there is more potential than usual for variation in oil yields and quality and this makes it difficult to cite typical data. Not only is there the expected intrinsic variation due to different geographical origins of the source raw material, but the composition of the charge that is distilled is liable to vary, particularly in the case of cinnamon bark oil and cassia oil. The method of distillation used (steam vs water-steam vs hydro-distillation) and other differences in distillation practice give rise to further causes of variation.

VALUE-ADDED PROCESSING

Cinnamon and cassia oils are both normally rectified within the importing country before sale to end-users in order to give a cleaner product or to provide an oil with more uniform composition. Rectification is also required to produce feedstock eugenol for subsequent derivative manufacture.

PRODUCTS OTHER THAN OIL

The major incentive to cultivation of *C. verum* and *C. cassia* has been their value as spice crops, for which world demand is considerable (tens of thousands of tonnes of bark annually). Indonesian cassia (*C. burmanii*) is much more important as a spice than as a source of oil and enters international trade along with Chinese cassia. There is some production of oleoresin for flavouring purposes, chiefly in North America from the cheaper Indonesian cassia. Bark also finds local use medicinally, particularly in the People's Republic of China.

DEVELOPMENTAL POTENTIAL

For the cinnamon and cassia oils of international commerce, production of oil is secondary to the production of the spice. The establishment of new areas of these particular *Cinnamomum* species will depend upon demand for the spice and economic returns to the farmer. Whether "waste" material from spice production is then utilized for oil production is, again, dependent on demand, prevailing oil prices and economic returns. The close relationship between the two commodities makes it unlikely that production of oil will shift, geographically, from the traditional centres of spice production.
Research needs

Apart from improvements in distillation practice, the greatest advances in productivity and quality will come from breeding programmes aimed at producing superior germplasm for planting. Some progress has already been made in identifying mother plants which give high yields of oil and high cinnamaldehyde and eugenol contents in the bark and leaves (GURUSINGHE and KIRINDE, 1985) and this work needs to be continued.

OILS FROM OTHER CINNAMOMUM SPECIES

The diversity of *Cinnamomum* as a genus, although not as great as, say, *Eucalyptus*, has analogies with the latter in terms of the variety of chemical types of volatile oil that may be distilled from the plants. Like *Eucalyptus*, the same species of *Cinnamomum* can afford oils with quite different compositions according to the population being studied, i.e. it may exist as different chemotypes. *C. camphora* is a well-known example and the wood from different groups of trees may yield camphor, linalool, safrole or cineole as the major chemical upon distillation.

This diversity, coupled with the ability of most *Cinnamomum* to respond to coppicing (a system of management which enables it to be harvested on a sustainable basis), and a market that is always receptive to new, alternative sources of natural aroma chemicals, makes *Cinnamomum* one of the most promising areas for research. The increasing number of reports in the scientific literature describing the oil characteristics of *Cinnamomum* species is evidence of the attention they are receiving in screening programmes.

Table 4 gives some examples of *Cinnamomum* species which are, or might be, used as sources of commercially valuable chemical isolates.

*Cinnamomum camphora*

*C. camphora* was heavily exploited as a source of camphor in Japan and Taiwan until the Second World War. Trees were felled and logs, stumps and branches distilled to give crystalline camphor and camphor oil. The species was introduced into India during the 1950s. Although yields of camphor are greater for old trees, leaves and woody material can be harvested regularly from plants over five years of age which are kept in a bushy form by coppicing. This form of harvesting is carried out in the People's Republic of China. The availability of cheap synthetic camphor (ex turpentine), however, has
meant that there is now only modest international demand for the natural form. This, combined with the availability of competitively priced Chinese camphor (US$3.65/kg in early 1994) does not make its production elsewhere particularly attractive.

The use of *C. camphora* as a source of Ho leaf oil, on the other hand, has expanded in recent years and it is now an important source of natural linalool (which is still preferred over the synthetic form for some fragrance applications). Chinese Ho oil has largely displaced the use of rosewood as a source of natural linalool.

Fractionation of the camphor-free oil obtained from *C. camphora* provides an oil rich in safrole. This is usually described as Chinese sassafras oil (see SASSAFRAS OIL).

**Other Cinnamomum species**

The ease with which essential oils can be obtained from plant material (and subsequently analyzed in the laboratory) makes them ideal candidates for study as potential cash crops. A screening programme currently underway at the Forest Research Institute of Malaysia focuses on essential oils of indigenous flora and has already examined several *Cinnamomum* species. Some are considered to have economic potential in providing raw materials for local industry and income to farmers who might grow them. *C. mollissimum* leaves, for example, contain an oil which is rich in benzyl benzoate and could find application in insecticidal preparations. The trunkwood could possibly be harvested for mucilage on a coppice system (for mosquito coil manufacture), in the same way as *C. iners* is already being grown in Malaysia.

*Cinnamomum* species other than *C. camphora* which contain safrole in their leaves have potential for utilization, providing oil yields and safrole content are high enough to make its recovery worthwhile from an economic point of view.

Leaves of *C. tamala* (tejpat) are widely used in northern India as a spice but also furnish an essential oil on distillation and this finds some local use. Several chemotypes exist, producing oils rich in cinnamaldehyde or eugenol, but the existence of cheap supplies of these chemicals from other sources (eugenol-rich clove leaf oil from Indonesia, for example) means that *C. tamala* oil is unlikely to find wider international use.

Similarly, cineole-rich oils from *Cinnamomum* cannot compete with *Eucalyptus* oils.
The oils of some other *Cinnamomum* species are employed in whole form for perfumery use although this is usually in a domestic, rather than international context (e.g. *C. porrectum* oil, which is rich in neral/geranial, is distilled in the People's Republic of China). Nevertheless, the existence of a local market may be sufficient to encourage small-scale production of such oils. *C. osmophloeum* is being studied in Taiwan as a possible substitute for cassia oil in the food industry.
Cinnamon Powder

Ceylon Cinnamon
All About Cinnamon

Spice Savvy

Did you know?

Branch of Cinnamon tree
Cinnamon Floral Structure

Cinnamon flower

Cinnamon Orchard
Peeling of Bark

Cinnamon Buds

Peeled barks

Quills ready for marketing

Equipments used for harvesting and processing
Rolling of cinnamon
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