

## Diversity of *Cinnamomum* Schaeffer (Lauraceae) in Terai and Duars region of West Bengal, India

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### Abstract

There are about 250 species in the genus *Cinnamomum* Schaeffer (Lauraceae), distributed mainly in the tropical and sub-tropical regions of the world. Among them, 26 species of *Cinnamomum* were reported from India. So far there is no comprehensive report published on this genus from Terai and Duars region, which is located at the foot of 'Himalaya Hotspot'. Present paper reported six species of *Cinnamomum* from Terai and Duars belt along with their local names, salient features, exsiccatus, status, flowering and fruiting periods and geographic distribution.

**Key words:** *Cinnamomum*, Terai, Duars, Diversity, Distribution, use.

### INTRODUCTION

The genus *Cinnamomum* Schaeffer of Lauraceae contains about 250 species which occur naturally in Asia and some in South and Central America, and Australia (Mabberley 2008). Of these about 26 species occur in India (Anonymous 1992). The term *Cinnamomum* is derived from the Greek word 'Kinnamomon' which mean spice (Sharma & Nautiyal 2011). Several species of *Cinnamomum* are recognized as valuable spices as well as essential oil yielding plants having immense aromatic potential (Baruah 2012). These are mainly used for flavoring food and widely applied in pharmaceutical preparations because of their hypoglycemic, stimulant and carminative properties (Smerq & Sharma 2011). Leaf and bark of various species have astringent, warming stimulant, carminative, blood purifier, digestive, antiseptic, anti-fungal, anti-viral, anti-bacterial properties and can help to reduce cholesterol and blood sugar levels (Kamath *et al* 2003; Mir *et al* 2004; Jayaprakasha *et al* 2006; Cheng *et al* 2006). 'Camphor' is derived from *C. camphora*, employed in pharmaceuticals, especially liniments and insecticides (Seth 2004). So, the genus *Cinnamomum* is economically very important. Unfortunately, no complete floristic work is presently available which has been performed on these members in Terai-Duars of West Bengal. This region is situated at the foot hill region of 'Himalaya Conservation Hotspot' recognized by IUCN and very rich in biodiversity. Generally, the Northern part of West Bengal, west of the river Tista is referred as Terai (25° 57" to 26° 36" N latitude and 89° 54" to 88° 47" E longitude) and Duars (located between 26° 16" to 27° 0" N latitude and 88° 4" to 89° 53" E longitude) is referred to the foot-hill region located on the east of Tista (Ghosh 2006; Roy *et al* 2009; Das *et al* 2010).

Considering this knowledge gap, main aim of the present study was framed to investigate the distribution of *Cinnamomum* species in Terai and Duars region. Beside this, for proper identification of species an artificial key was made and for each species correct nomenclature, phenology, ecology and distribution were provided.

### MATERIALS AND METHODS

During 2009 – 2012 extensive field survey were undertaken for documentation of the species of *Cinnamomum* available in different parts of Terai and Duars region. Plant specimens were collected at the vegetative, flowering and fruiting stages. The collected specimens were processed into mounted herbarium sheets following standard herbarium techniques (Jain & Rao 1977). The processed plant specimens were identified using the relevant taxonomic literature (Hooker 1886; Brandis 1906; Kanjilal *et al* 1940; Long 1984; Li *et al* 2008) and was later confirmed by matching with the authentic specimens housed in various herbaria *viz.* CAL and NBU. Identified specimens were deposited into NBU Herbarium. Recent literature like Long (1984), Ara *et al* (2007) and Li *et al* 2008 and websites including [www.theplantlist.org](http://www.theplantlist.org) were followed for nomenclatural treatment of the recorded taxa. Distributional status in the world of the identified species was also recorded from literature (Hooker 1886; Brandis 1906; Hara 1966; Long 1984; Alam 1988; Li *et al* 2008; Ara *et al* 2007) and herbarium studies at CAL. Local names and status of different species were documented during field work from the local people and some of the information was noted down from available literature (Cowan & Cowan 1929; Kanjilal *et al* 1940; Prain 1903; Matthew 1981; Banerjee 1993).

### RESULT

From the present survey six species of *Cinnamomum* were collected from different parts of Terai & Duars region in West Bengal. One artificial dichotomous key has been prepared for their easy recognition and species were enumerated below alphabetically accompanied by local names, salient features, exsiccatae, availability status, flowering and fruiting time, occurrence in Terai & Duars region and geographic distribution.

#### Key to the recorded species of *Cinnamomum* Schaeffer

- 1a. Leaves opposite or sub opposite ..... 2
- 1b. Leaves distinctly alternate ..... 5
- 2a. Lamina elliptic, thickly-leathery, 15–30 cm long, obtuse or acute, base cuneate .....  
..... *C. bejolghota*
- 2b. Lamina ovate to oblong ovate or ovate-lanceolate, sub-leathery, smaller, acute or  
acuminate but not obtuse, base acute or rounded ..... 3
- 3a. Transvers veins reticulate, acuminate, base acute or rounded, fruits ovoid .....  
..... *C. verum*
- 3b. Transvers veins undulate, long acuminate, base acute or broadly cuneate, fruits obovoid  
or ellipsoid ..... 4
- 4a. Leaves lanceolate or ovate-lanceolate, part of perianth segments persist in fruit  
..... *C. tamala*
- 4b. Leaves elliptic or ovate-elliptic, perianth segments completely deciduous .....  
..... *C. impressinervium*
- 5a. Leaves ovate-elliptic, perianth glabrous ..... *C. camphora*
- 5b. Leaves elliptic or lanceolate, perianth densely tomentose ..... *C. glaucescens*

***Cinnamomum bejolghota*** (Buchanon–Hamilton) Sweet, Hort. Brit. 344. 1826; Long in Gierson & Long, Fl. Bhut. 1(2): 258. 1984; Banerjee, Pl. Res. Jal. Rhi. Sanc. 51. 1993. *Laurus bejolghota* Buchanon–Hamilton, Trans. Linn. Soc. London. 13(2): 559. 1822. *Cinnamomum obtusifolium* (Roxburgh) Nees, Pl. Asiat. Rar. 2: 73. 1831. *Laurus obtusifolia* Roxburgh, Fl. Ind., 2: 302. 1832; Hooker *f.*, Fl. Brit. Ind. 5: 128. 1886; Prain, Beng. Pl. 2: 673. 1903; Matthew, Pl. Kurs. 89. 1981; Cowan & Cowan, Trs. N. Beng. 108. 1929.

**Local name:** *Tezpat, Ram tejpat*

Evergreen trees, up to 25m high. Leaves opposite or sub-opposite; lamina elliptic-oblong or elliptic, 15 – 30 × 4 – 9 cm; obtuse or acute, base cuneate, coriaceous, green and shiny adaxially; triplinerved; petioles 1 – 3 cm. Panicles 12 – 22 cm; perianth segments ovate, 2 – 3 mm, pubescent. Fruits ellipsoid, 6 – 12 mm long.

**Exsiccatus:** Garden of Medicinal Plants, NBU 134 m, *Dibakar Choudhury & AP Das 005*, dated 21.03.2009; Gorumara National Park, 98 m, *Dibakar Choudhury & AP Das 027*, dated 30.05.2009; North Sevoke 190 m, *Dibakar Choudhury & AP Das 064*, dated 26.06.2009; North Rajabhatkhawa, 88 m, *Dibakar Choudhury & AP Das 158*, dated 22.03.2010

**Status:** Common in forests

**Flowers:** February – March; **Fruits:** September – October

**Local distribution:** Throughout Terai & Duars.

**General distribution:** India, Bhutan, Nepal, Bangladesh, China, Myanmar, Thailand, Vietnam.

***Cinnamomum camphora*** (Linnaeus) J. Presl, *Prir. Rostlin* 2: 36. 1825; Hooker *f.*, Fl. Brit. Ind. 5: 134. 1886; Prain, Beng. Pl. 2: 899. 1903; Kanjilal *et al*, Fl. Ass. 4: 60. 1940. *Laurus camphora* Linnaeus, Sp. Pl. 369. 1753.

**Local name:** *Karpur*

Evergreen trees, up to 25 m high; whole plant strongly camphor-scented. Leaves alternate; lamina ovate-elliptic to elliptic, 5 – 9 × 2.5 – 5 cm, green or yellow-green and shiny adaxially, shortly acuminate, base cuneate, both surfaces glabrous; triplinerved sometimes inconspicuously 5-nerved; petioles 12 – 25 mm. Panicles 8 – 10 cm; perianth segments elliptic, 1.5 – 2 mm. Fruits ovoid or subglobose, 6 – 8 mm.

**Exsiccatus:** Garden of Medicinal plants, NBU 134 m, *Dibakar Choudhury & AP Das 175*, dated 10.05.2012

**Status:** Rarely planted

**Flowers:** March – April; **Fruits:** July – August

**Local distribution:** Planted in University of North Bengal campus, Sukna, etc.

**General distribution:** India, China, Japan, Korea, Vietnam and widely cultivated all over the world.

***Cinnamomum glaucescens*** (Nees) Handel–Mazzetti, *Oesterr. Bot. Z.* 85: 214. 1936; Long in Gierson & Long, Fl. Bh. 1(2): 259. 1984; Banerjee, Pl. Res. Jal. Rhi. Sanc. 51. 1993. *Laurus glaucescens* Buchanon–Hamilton *ex* Nees, *Pl. Asiat. Rar.* 2: 70. 1831. *Cinnamomum cecidodaphne* Meisner, *Prodr.* 15(1): 25. 1864; Hooker *f.*, Fl. Brit. Ind. 5: 135. 1886; Cowan & Cowan, Trs. N. Beng. 108. 1929; Kanjilal *et al*, Fl. Ass. 4: 58. 1940.



**PLATE - I:** Species of *Cinnamomum* Schaeffer in Terai and Duars region of West Bengal: **A.** *C. tamala*; **B.** *C. verum*; **C.** *C. camphora*; **D.** *C. bejolghota*; **E.** *C. impressinervium*; **F.** *C. glaucescens*

**Local name:** *Malagiri, Gonserai*

Evergreen trees, up to 15 m high; young shoots tomentose, becoming glabrate. Leaves alternate; lamina ovate–elliptic, 7 – 15 × 3.5 – 8 cm, shortly acuminate, base broadly cuneate or rounded; lateral veins 4 – 6 pairs; petioles 6 – 12 mm. Panicles brownish–tomentose, densely clustered on young shoots. Fruits globose, 8 – 10 mm.

**Exsiccatu:** Sursuti Forest, Lataguri, 102 m, *Dibakar Choudhury & AP Das 115*, dated 20.02.2010

**Status:** Less common

**Flowers:** January – February; **Fruits:** April

**Local distribution:** Found only in Gorumara National Park – Lataguri area.

**General distribution:** India, Bhutan, Nepal, Bangladesh; endemic to Indian subcontinent.

*Cinnamomum impressinervium* Meisner, Prodr. 15(1): 21. 1864. Hooker *f.*, Fl. Brit. Ind. 5: 129. 1886; Cowan & Cowan, Trs. N. Beng. 108. 1929; *Long in* Gierson & Long, Fl. Bhut. 1(2): 258. 1984. *Cinnamomum albiflorum* Hooker *f.* & Thomson *ex* Meisner, Prodr. 15(1): 21. 1864. *Cinnamomum cacharensense* R.N. Parker, Repert. Spec. Nov. Regni Veg. 31: 126. 1932.

**Local name:** *Sissi, Korsane*

Evergreen trees, up to 15 m high. Leaves opposite or sub-opposite; lamina elliptic or ovate-elliptic, 8–20 × 3–5 cm, finely acuminate, glossy adaxially with strongly impressed 3 veins; petioles 7–12 mm. Panicles 6–10 cm, pubescent, perianth segments 2–3 mm. Fruits ellipsoid, 10–12 mm long.

**Exsiccatus:** Sukna, Mahananda Wildlife Sanctuary, 215 m, *Dibakar Choudhury & AP Das 145*, dated 24.02.2010

**Status:** Less common

**Flowers:** July; **Fruits:** December

**Local distribution:** Found only in Mahananda Wild Life Sanctuary.

**General distribution:** India, Bhutan, Nepal; Endemic to Eastern Himalaya.

*Cinnamomum tamala* (Buchanan–Hamilton) T. Nees & Ebermaier, *Handb. Med.-Pharm. Bot.* 2: 426. 1831; Hooker *f.*, Fl. Brit. Ind. 5: 128. 1886; *Hara, Fl. E. Him.* 99. 1966; Prain, Beng. Pl. 2: 899. 1903; Cowan & Cowan, Trs. N. Beng. 107. 1929; *Long in* Gierson & Long, Fl. Bhut. 1(2): 258. 1984; Kanjilal *et al.*, Fl. Ass. 4: 56. 1940. *Laurus tamala* Buchanan–Hamilton, *Trans. Linn. Soc. London* 13(2): 555. 1822.

**Local name:** *Tejpata, Tejpat*

Evergreen trees, up to 15 m high. Leaves opposite or sub-opposite; lamina lanceolate or ovate-lanceolate, 10–15 × 2.5–6 cm; shortly and bluntly acuminate, base cuneate, thinly leathery, both surfaces glabrous, triplinerved; petioles 7–13 mm. Panicles 5–10 mm; perianth segments ovate, 2–3 mm. Fruits obovoid or ellipsoid, 8–10 mm long.

**Exsiccatus:** Garden of Medicinal plants, NBU, 134 m, *Dibakar Choudhury & AP Das 002*, dated 21.03.2009; Palashbari, 64m, *Dibakar Choudhury & AP Das 6*, dated 24.03.2009

**Status:** Widely planted for its aromatic leaves; also wild

**Flowers:** February – April; **Fruits:** July – August

**Local distribution:** Cultivated throughout Terai & Duars.

**General distribution:** India, Nepal, Bhutan, Tropical and sub-tropical Himalayan regions.

*Cinnamomum verum* J. Presl, *Prir. Rostlin* 2: 36. 1823. *Laurus cinnamomum* Linnaeus, Sp. Pl. 1: 369. 1753. *Cinnamomum zeylanicum* Blume, Bijdr. 11: 568. 1825; Hooker *f.*, Fl. Brit. Ind. 5: 131. 1886; Prain, Beng. Pl. 2: 899. 1903.

**Local name:** *Darchini, Daruchini, Dalchini*

Evergreen trees, up to 10 m high; bark blackish-brown with cinnamic aldehyde flavor. Leaves opposite or sub-opposite; lamina ovate to ovate-lanceolate, 8–13 × 4.5–6 cm, green and shiny adaxially; both surfaces glabrous, triplinerved; petioles 8–13 mm. Panicle axillary or terminal, 10–12 cm; perianth segments oblong, 2–3 mm. Fruits ovoid, 10–12 mm.

**Exsiccatu**s: Garden of Medicinal plants, NBU, 134 m, *Dibakar Choudhury & AP Das 003*, dated 21.03.2009; Falakata, 62 m, *Dibakar Choudhury & AP Das 007*, dated 24.03.2009

**Status:** Less common

**Flowers:** March – April; **Fruits:** July – September

**Local distribution:** Cultivated several regions of Terai & Duars.

**General distribution:** India, Sri Lanka, China, Myanmar and also cultivated in many other countries in Asia.

## DISCUSSION AND CONCLUSION

This study indicates that several important spices as well as medicinal species of *Cinnamomum* Schaeffer are important assets of the vegetation of Terai and Duars region of West Bengal. One of these is *C. tamala*, which is widely cultivated in Terai & Duars for its commercially exploited *Tejpata* leaves or bay leaves. These leaves are used for cookery worldwide (Sobti & Bradu 1988). The essential oil of *C. tamala* leaves, known as ‘Tejpat oil’ is medicinally used as a carminative, anti-flatulent, diuretic and in cardiac diseases (Gulati 1982). Another important spice, cultivated in this region is *C. verum* which is known for world famous Cinnamon-bark and Cinnamon oil (Senanayake *et al* 1978; ). This oil is rich in trans-cinnamaldehyde with antimicrobial property against several animal and plant pathogens and spoiled bacteria and fungi (Mastura *et al* 1999). In addition to these, another important species, *C. camphora*, is the key source of ‘Camphor oil’ (Lee *et al* 2006). This oil is used in perfume industry and treatment of nervous depression, acne, inflammation, arthritis, cold and fever. It is presently restricted only in *ex-situ* conservation areas of this region. *C. bejolghota* is frequently found in thick forests and forest edges of Terai & Duars region. Local people used its leaves as a substitute of tejpat and bark paste for preventing toothache. Besides, leaf and bark extracts are used in cough, cold and liver troubles (Barbhuiya *et al* 2009). Depending on growing region, *C. impressinervium* attains highest altitudinal (over 2000 m) areas among the recorded species. Leaves of this plant are used as hypoglycaemic, stimulant, carminative and antidiarrhoeal agent (Pullaiah 2006). Essential oils of *C. glaucescens* are used in perfumery and cosmetic preparations. Bark of this plant is used for the treatment of fever and kidney problem (Doley *et al* 2009). Local tribes used the juicy extract of flower for curing several skin diseases.

Hence, this study reveals that the species of *Cinnamomum* are very important for economic point of view. But over exploitation of some *Cinnamomum* species, especially collection of bark and leaves cause serious damage to the population of these plants. Besides this, due to loss of habitats caused by deforestation, monoculture and extensive tourism adversely affect the rich diversity of *Cinnamomum* in this region. So, an urgent attention is required to protect these valuable species from destruction in their original habitat.

Apart from the strictly cultivated ones (*C. camphora* and *C. verum*) the local species *C. tamala* is also widely cultivated. *C. impressinervium* is endemic to Eastern Himalaya, *C. glaucescens* is endemic to northeastern region of the Indian subcontinent and *C. tamala* is basically a tropical Himalayan plants.

It is also observed that, cultivated or not, all the species of *Cinnamomum* recorded from Terai and Duars region of West Bengal are economically important. Though none of these local species are under threat for their survival, even then it is important to look for the maintenance of their good population structure in the natural habitat.



## LITERATURE CITED

- Alam, M.K. 1988. *Annotated checklist of the woody Flora of Sylhet Forests*. Forest Research Institute, Chittagong, Bangladesh.
- Anonymous. 1992. *The Wealth of India, A Dictionary of Indian Raw materials and Industrial products*, Vol. III. Publications and Information Directorate, CSIR, New Delhi.
- Ara, H.; Mia, M.K. & Khan, B. 2007. An Annotated Checklist of Lauraceae In Bangladesh. *Bangladesh J. Pl. Taxon.* 14(2): 147 – 162.
- Banerjee, L.K. 1993. *Plant Resources of Jaldapara Rhino Sanctuary*. Botanical Survey of India, Calcutta.
- Barbhuiya, A.R.; Sharma, G.D.; Arunachalam, A. & Deb, S. 2009. Diversity and conservation of medicinal plants in Barak valley, Northeast India. *Indian J. Trad. Knowl.* 8(2):169–175.
- Brandis, D. 1906. *Indian Trees*. Archibald Constable & Co Ltd. London.
- Baruah, A. 2012. *Cinnamomum pauciflorum* Nees (Lauraceae) - a wander and promising source of cinnamon spice and oil from Northeast India. *Pleione* 6(1): 1 - 4.
- Cheng, S.S.; Liu, J.Y.; Hsui, Y.R. & Chang, S.T. 2006. Chemical polymorphism and antifungal activity of essential oils from leaves of different provenances of indigenous cinnamom (*Cinnamomum osmophloeum*). *Bioresour. Tech.* 97: 306 – 312.
- Cowan, A.M. & Cowan, J.M. 1929. *The trees of North Bengal Including Shrubs, Woody Climbers, Bamboos Palms and Ferns*. Allid Book Center, Dehra Dun.
- Das, A.P.; Ghosh, C.; Sarker, A.; Biswas, R.; Biswas, K.; Choudhury, D.; Lama, A.; Moktan, S. & Choudhury, A. 2010. Preliminary report on the medicinal plants from three MPCAs in Terai and Duars of West Bengal, India. *Pleione.* 4(1): 90 – 101.
- Doley, B; Gajurel, P.R.; Rethy, P.; Shing, B. & Hazarika, H. 2009. Ethnomedicinal uses of different speces of *Cinnamomum* Schaeffer (Lauraceae) by ethnic communities in Arunachal Pradesh, India. *Pleione.* 3(1): 9 – 12.
- Ghosh, C. 2006. *Biology of tea garden weeds in Darjeeling Districts of West Bengal (India)*. Ph.D. Thesis, University of North Bengal, India.
- Gulati, B.C. 1982. Essential oils of *Cinnamomum* species. In *Cultivation and Utilization of Aromatic Plants*, Atal, C.K. & Kapoor, B.M. (eds). RRL, CSIR, Jammu.
- Hara, H. 1966. *The Flora of Eastern Himalaya*. 1<sup>st</sup> Report. The University of Tokyo Press, Japan.
- Hooker, J.D. 1886. *The Flora of British India*. Vol. 5. L. Reeve & Co, Kent, London.
- Jain, S.K. & Rao, R.R. 1977. *A Handbook of Field and Herbarium Methods*. Today & Tomorrow's Printers and Publishers, New Delhi.
- Jayaprakasha, G.K.; Kameyama, M.O.; Ono, H.; Yoshida, M. & Rao, J. 2006. Phenolic constituents in the fruits of *Cinnamomum zeylanicum* and their antioxidant activity. *J. Agr. Food Chem.* 54: 1672 – 1679.
- Kamath, J.V.; Rana, A.C. & Chowdhury, A.R. 2003. Pro-healing effect of *Cinnamomum zeylanicum* bark. *Phytoth. Res.* 17: 970 – 972.
- Kanjilal, U.N.; Kanjilal, P.C.; De, R.N. & Das, A. 1940. *Flora of Assam*. Vol. IV. Govt. Press, Shillong.
- Lee, H.J.; Hyuna, E.A.; Yoon, W.J.; Kim, B.H.; Rhee, M.H.; Kang, H.K.; Cho, J.Y. & Yoo, E.S. 2006. In vitro anti-inflammatory and anti-oxidative effects of *Cinnamomum camphora* extracts. *J. Ethnopharmacol.* 103: 208 – 216.

- Li, X.W.; Li, J.; Huang, P.H.; Wei, F.N.; Cui, H.B. & Werff, H.V.D. 2008. Lauraceae. In *Flora of China*, Vol-7. Wu, Z.Y.; Raven, P.H. & Hong, D.Y. Eds. Science Press: Beijing, China; Missouri Botanical Garden Press. St. Louis, MO, USA.
- Long, D.G. 1984. Lauraceae. In Grierson, A.J.C. & Long, D.G. (eds.). *Flora of Bhutan*. Vol. I, Part II. Royal Botanic Garden, Edinburgh.
- Mabberley, D.J. 2008. *Mabberley's plant-book: A portable dictionary of plants, their classifications and uses*. Cambridge University Press. Cambridge.
- Mastura, M.; Azah, M.A.N.; Khozirah, S.; Mawardi, R. & Manaf, A.A. 1999. Anticandidal and antidermatophytic activity of *Cinnamomum* species essential oils. *Cytobios*. 98: 17 – 23.
- Matthew, K.M. 1981. *An Enumeration of the Flowering Plants of Kurseong*. Bishen Singh Mahendra Pal Singh, Dehra Dun.
- Mir, S.R.; Ali, M. & Kapoor, R. 2004. Chemical composition of essential oil of *Cinnamomum tamala* Nees et Eberm. Leaves. *Flavour Fragr. J.* 19: 112 – 114.
- Prain D. 1903. *Bengal Plants*. Vol-II. Calcutta.
- Pullaiah, T. 2006. Encyclopedia of World Medicinal Plants. Vol-I. Regency Publication, New Delhi. Pp. 558.
- Roy, S.; Mukhopadhyay, A. & Gurusubramanian, G. 2009. Monitoring the resistance of red spider mite (*Oligonychus Coffeae* Nietner) of tea to commonly used acaricides from the Darjeeling foothills and plains of North Bengal, India. *Spring*. 18(2): 10 – 14.
- Senanayake, U.M.; Lee, T.H. & Wills, R.B.H. 1978. Volatile constituents of cinnamon (*Cinnamomum zeylanicum*) oils. *J. Agric. Food Chem.* 26: 822 – 824.
- Seth, M.K. 2004. Trees and their economic importance. *Bot. Rev.* 69(4): 321 – 376.
- Sharma, G. & Nautiyal, A.R. 2011. *Cinnamomum tamala*: A valuable tree from Himalayas. *Int. J. Med. Arom. Pl.* 1(1):1 – 4.
- Smerq, J. & Sharma, M. 2011. Possible Mechanism of *Murraya koenigii* and *Cinnamomum tamala* With Reference to Antioxidants Activity. *Int. J. Pharm. Sci. Drug Res.* 3(3): 260 – 264.
- Sobti, S.N. & Bradu, B.L. 1988. *Cinnamomum tamala* in NW Himalayas. Evaluation of various chemical types for perfumery value. *Ind. Perfum.* 32(4): 334 – 340.