Nordic Journal of Botany 25: 281–285, 2007
doi: 10.1111/j.2007.0107-055X.00069.x,

Subject Editor: Torbjörn Tyler. Accepted 14 September 2007

# *Cinnamomum champokianum* sp. nov. (Lauraceae) from Assam, northeastern India

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*Cinnamomum champokianum* Baruah & S. C. Nath. is illustrated and described as a new species, with a note on its leaf, panicle and stem bark essential oils, reported earlier as a variant of *Cinnamomum bejolghota* (Buch.–Ham.) Sweet.

In India, the genus *Cinnamomum* is represented by 37 species (Hooker 1885, Kostermans 1983, Manilal and Shylaja 1986, Mohanan and Henry 1991, Baruah and Nath 2001a), distributed mainly in the western Ghats and adjoining areas, the Andaman Islands and the eastern Himalayas. From the northeastern region of India, 14 species are reported so far (Kanjilal et al. 1940, Rabha et al. 1979, Deb 1981, Nath and Barua 1994, Baruah and Nath 2001a).

During the course of an ethnofloristic study on the members of *Cinnamomum* (Lauraceae) growing in northeastern India, since 1994, the authors collected a wild-growing specimen, from the Jorhat area (83 m) of the Assam region. The specimen appeared distinct from other species collected and described so far, and is aromatic and evergreen, as are other species in the region. The plant as a whole is known in the region as 'Pati-hunda', while its leaves are known as 'tejpat' or 'tejpat manbi' and the stem-bark as 'dalchini' or 'naga-dalchini' and it is being used by the local people as a substitute of tejpat and cinnamon spice respectively (Baruah 2000, Baruah and Nath 2006).

After consultation of herbarium specimens at Central National Herbarium, Howrah (CAL) and relevant literature (Hooker 1885, Kurz 1887, Kanjilal et al. 1940, Haridason and Rao 1987), the taxon was recognized by us as a variant of *C. bejolghota* (Buch.–Ham.) Sweet (Baruah 2000, Baruah and Nath 2005). Later, the same specimen was sent to the Kew Herbarium (K) for further confirmation, and was then identified as *C. tamala*. These identifications raised curiosity about the identity of this plant, and it was critically examined with respect to its morphology and foliar micro-morphology. The characters were found to be significantly different from those of *C. bejolghota* and *C. tamala*, and closer to *C. bejolghota* than to *C. tamala*. In view of the above characters, the authors concluded that the plant concerned is a separate entity although allied to *C. bejolghota*. Hence, it is described and illustrated here as a new species.

## Material and methods

The specimen was collected from Jorhat area (86 m) of Assam in northeastern India and the information about its local use was gathered on the basis of interviews with local people. The collected specimen was dissected, illustrated, studied, and compared with the classical morphological characters described in relevant floristic literature (Hooker 1885, Kurz 1887, Kanjilal et al. 1940, Haridason and Rao 1987), as well as herbarium specimens at CAL and foliar micromorphological characters (Baruah and Nath 1997, 1998, 2001b).

The methods for epidermal and venation studies as described by Baruah and Nath (1999) and Neog Barua et al. (1994), respectively were followed. However, absolute areoles and absolute veinlet termination numbers were calculated following the formula described by Gupta (1961).

Voucher specimens of the taxon are lodged at the Herbarium of Regional Research Laboratory (CSIR), Jorhat, Assam (RRLJ, unregistered herbarium acronym), India and was also sent to the Herbarium of Botanical Survey of India, Eastern Circle, Shillong (BSI), India.

## *Cinnamomum champokianum* Baruah & S. C. Nath sp. nov. (Fig. 1)

*C. bejolghota affinis, sed folia breviora, subtus pilis unicellularibus filiformis, stomata numerosa; petioli exasperati concavi; flores longi; perianthium oblongo–elliptico–lanceolatum; filamenta sericea; staminodia hastata et acutata; ovarium ellipsoidem, nec non frutus ellipsoideus vel oblongus differt.*

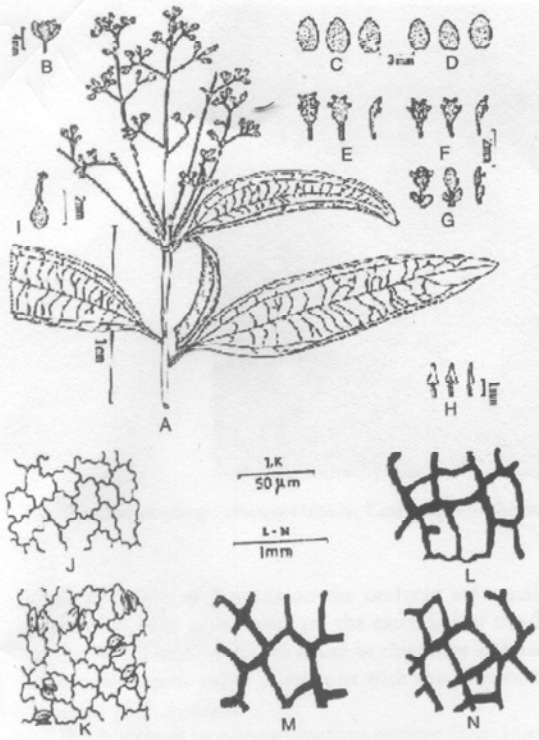


Fig. 1. (A)–(I). Morphological structures of *Cinnamomum champokianum*. (A) a flowering twig, (B) single flower, (C) perianth of whorl I, (D) perianth of whorl II, (E) stamens of whorl I, (F) stamens of whorl II, (G) glandular stamens of whorl III, (H) staminodes, (I) pistil, (J) and (K) foliar epidermal structures ((J) upper surface, (K) lower surface)), (L) to (N) foliar minor venation structures ((L) apical region, (M) middle region, (N) basal region)).

**Type**: India, Assam, Jorhat (83 m), 25–03–1994, Baruah & Nath, RRLJ 1603 (BSI, holotype; RRLJ and BSI, isotypes).

A moderate-sized evergreen tree, attaining a height of 6–7 m, trunk up to 95 cm girth, current year shoots almost quadrangular; bark brownish–white, brittle, very slimy, almost odourless, inside creamish–white, turning darker brown on exposure, 5–10 mm thick; leaf buds silky tomentose, conical; leaves opposite to sub-opposite or alternate on the same twig, coriaceous to firmly coriaceous, aromatic, shining above, green, pale green below, glabrous above but sparsely distributed, microscopic, unicellular, simple, filiform hairs present on lower surface, highly polymorphic (Fig. 2). Even in a single plant the leaf shapes ranges from narrowly elliptic–obovate–lanceolate to oblong–lanceolate, rarely broadly elliptic–lanceolate, apex obtusely acute to rarely acute or shortly acuminate, base acutely cuneate to rarely obtuse or rounded, variable in size, 4–9 × 8.5–25 cm, triple-nerved; epidermal cells tetragonal to polygonal and moderately sinuous, hypostomatic, stomata sunken, 644 stomata $mm^{-2}$, stomatal index 19.00, areoles tetragonal to polygonal, vein endings simple, average frequency of areole $mm^{-2} = 6.47$; lateral nerves continued to the tip, basal to suprabasal perfect, nervules faint on both surfaces, midrib stout, rarely weak to moderate; petiole rough, slightly concave above, 2 mm in diameter, 0.7–1.5 cm long; panicle pseudo-terminal, axillary to solitary axillary, lax flowered, not spreading, stout, purple–brown to pale green, minutely pubescent, becoming glabrous with age, shorter or equal to the leaves, up to 10 cm in length, but at fruiting stage panicle spreading, up to 25 cm in length, longer than leaves and with leaves of variable size, gall formation at the pedicel in this stage observed to be a common phenomenon, but the flowers that bear fruits have no gall; flowers 6–7 mm long, pale yellow, pedicel 3–4 mm long, perianth 3+3, sub-equal, 3–3.5 mm long, oblong–lanceolate, bluntly acuitish, silky tomentose on both surfaces; stamens 3+3+3, 2–2.5 mm long, pale yellowish–green, anther 4-locular, introrse, whorl III extrorse, filaments silky minutely puberolous, glands of whorl III yellow, attached 1/3 of the base of the filament; staminodes 3, 1.5–2 mm long with narrowly hastate acuitish head, filament silky puberolous; pistil 2 mm long, ovary ellipsoid, silky pubescent, style thickish, stigma peltate; fruit up to 1 cm long, ellipsoid to oblong, purple–black when ripe, fruiting perianth truncately 6-lobed, cup deep, later spreading when dry. Flowers in March–May, fruits in June–September.

## Distribution

Very rare and endemic to Assam. Recorded so far only from the in type locality.

## Foliar epidermis

The leaves are hypostomatic. Stomata are sunken in nature, randomly distributed and irregularly oriented. The number of stomata $mm^{-2}$ and stomatal index are 644 and 19.00, respectively. The epidermal cells are tetragonal to polygonal with their cell walls sinuous in nature. The length and breadth of epidermal cells in upper and lower surfaces are 24.15 µm and 21.60 µm, and 15.53 µm and 12.25 µm, respectively while their number $mm^{-2}$ in upper and lower surfaces are 3085 and 2785, respectively. Simple, unicellular, filiform and sparsely distributed hairs present only in the lower surface of the leaves (Fig. 1J–K).

## Foliar venation

The major venation pattern is of acrodromous type. Midveins are straight to slightly curved and the two lateral primary (1′) veins are running in convergent arches along with the midvein but not reaching the leaf apex. The 2′ veins arise on both sides of the 1′ veins in an opposite or sub-opposite manner and extend toward margins where they are upturned and gradually disintegrated at the apical and basal margins. Number of 2′ veins varies between the different leaves. Likewise, the angle between 1′ and 2′ veins varies in different portions of the same lamina. The super-adjacent 2′ arches are simple and predominant. The 3′ angles are right angle–right angle, acute angle–acute angle (RR–AR). The 3′ veins which arise on the admedial side of the 2′ veins are curved and join the midvein. The

Fig. 2. *Cinnamomum champokianum*. Leaf polymorphism in a single plant during flowering season.

angle of origin of 2′ veins on the midvein are equal to the angle of 3′ vein which arise on the exmedial of the 2′ veins of the leaf. The 3′ veins are equal in thickness and are either anastomous with other 3′ veins or with the 2′ veins to form random reticulations.

With regards to minor venation pattern (Fig. 1L–N), the veins of 4′ and 5′ orders originating from the 3′ veins constitute the areoles or vein islets. The areoles are tetragonal to polygonal in shape, and their sizes differs between the apical, middle and basal regions of the lamina ($0.45 \times 0.29$, $0.58 \times 0.42$ and $0.53 \times 0.32$). The average number of areoles $mm^{-2}$ is 6.5. The vein endings are simple. Number of veinlet entering in areoles $mm^{-2}$ is 2.7, absolute areole number is 44 400 and absolute vein entering number is 17 400.

### Etymology

The specific epithet *champokianum* is given in honour of Prof. (Dr) Champok L. Boissya, FNASc, FLS, FNRS, FISPP, eminent botanist and former head of the Dept of Botany, Gauhati Univ., Assam, India.

## Discussion

*Cinnamomum champokianum* Baruah & S. C. Nath. sp. nov. is allied to *C. bejolghota* (Buch.–Ham.) Sweet., but can be distinguished from the latter by the characters given in Table 1. The differences observed between the two taxa are found to be indicative of separate species. These two taxa differ from each other by their leaf size and floral morphology, including the shape and size of the individual floral parts as well as fruit shape and size. The differences between the two taxa in the above characters are further supported by the hair types, number of stomata and stomatal index found on the lower surface of leaves as well as venation characters like size and number of areoles and the nature of veinlet termination.

### Notes on essential oils

The plant parts of this new species (*C. champokianum* Baruah & S. C. Nath.) are aromatic. The essential oils obtained from the leaf, panicle and stem bark of this newly described species have already been reported as *C. bejolghota* variant II. (Nath et al. 1999, Baruah and Nath 2002).

The oils obtained from the leaf, panicle and stem bark of the aforesaid taxon, were in 0.1%, 0.2% and 0.1% yields, respectively. Each oil was found to be a pale yellow to almost colourless (leaf, panicle) mobile liquid, possessing a sweet to spicy (leaf, bark) odour. Refractive indices at 25°C of the oils were as follows: leaf = 1.482, panicle = 1.4771 and stem bark = 1.4852.

In GC analyses of the leaf, panicle and stem bark oils, 26, 27 and 23 components accounting 95.21%, 98.52% and 81.60%, respectively, were identified. α-phellendrene alone constitute 32.82% in the leaf oil. Other components of above 2% concentration of the oil are α-pinene (5.30%), β-pinene (2.06%), 1,8-cineole (5.55%), terpineol (2.38%), β-caryophyllene (2.00%) and α-farnesence (11.75%). Linalool (65.00%) is the major component in panicle oil, followed by α-phellandrene (8.90%), 1,8-cineole (3.96%), α-pinene (3.40%) and β-phellandrene (3.00%). The other components of above 1% concentration in the panicle oil were β-pinene (2.55%), β-caryophyllene (2.55%), (Z)-methyl isoeugenol (2.05%) and α-farnesene (1.93%). Likewise, α-terpineol (23.30%) followed by linalool (14.40%) and p-cymene (13.90%) were the main components in stem bark oil. The other components identified in stem bark oil in appreciable quantity were α-pinene (5.30%), 1,8-cineole (6.85%) and (E)-methyl cinnamate (3.06%), and above 1% concentration were β-pinene (1.40%), α-phellandrene (1.46%), terpinen-4-ol (1.70%), (E)-cinnamaldehyde (1.50%), eugenol (1.50%), β-caryophyllene (2.85%) and (Z)-methyl isoeugenol (1.05%).

*Acknowledgements* – The work is supported by a grant of G. B. Pant Inst. of Himalayan Environment and Development, Almora (Uttar Pradesh) India. Thanks to Dr V. B. Hosagoudar, Scientist,

Table 1. Comparative salient characters of *Cinnamomum champokianum* Baruah & S. C. Nath. sp. nov. and the allied species *C. bejolghota* (Buch.–Ham.) Sweet. AR = apical region, MR = middle region, BR = basal region.

| Characters | *C. champokianum* | | | *C. bejolghota* | | |
|---|---|---|---|---|---|---|
| Leaves | highly polymorphic, narrowly elliptic–obovate–lanceolate to oblong–lanceolate, rarely broadly elliptic–lanceolate, apex obtusely acute to rarely acute or shortly acuminate, base acutely cuneate to rarely obtuse or rounded, comparatively small in size (1.7–5.5 × 7–19 cm), with sparsely distributed simple, unicellular and filiform hairs present on lower surface; petiole rough, slightly concave above, up to 1.5 cm long. | | | broadly obovate–elliptic to oblong–elliptic or oblong, apex obtuse to obtusely acute, base acute to decurrently acute, comparatively large in size (5–12 × 15–30 cm), with frequently distributed microscopic papillae present on lower surface; petiole smooth, cylindrical or slightly flattened above, up to 1.7 cm long. | | |
| Stomata $mm^{-2}$ | 644 | | | 35 | | |
| Stomatal index | 19.00 | | | 1.22 | | |
| Foliar venation | AR | MR | BR | AR | MR | BR |
| Size of areoles (mm) | 0.45 × 0.29; | 0.58 × 0.40; | 0.53 × 0.32 | 1.00 × 0.75; | 1.00 × 0.68; | 0.99 × 0.74 |
| | 7.2 | 5.8 | 6.4 | 3.4 | 3.4 | 4.0 |
| No. of areoles $mm^{-2}$ | 2.6 | 2.6 | 3.0 | 3.0 | 3.2 | 4.0 |
| Veinlet entering in areoles $mm^{-2}$ | 2.6 | 2.6 | 3.0 | 4.0 | 4.0 | 4.2 |
| Veinlet termination in areoles $mm^{-2}$ | | | 44 400 | | | 83 600 |
| Absolute areole no. $mm^{-2}$ | | | 17 400 | | | 72 300 |
| Absolute veinlet termination number $mm^{-2}$ | simple | | | dichotomously forked | | |
| Veinlet termination | | | | | | |
| Panicles | spreading only at fruiting stage, shorter or equal to the leaves | | | spreading, exceeding the leaves or shorter than leaves | | |
| Flowers | 6–7 mm long, pedicel 3–4 mm long, Perianth oblong–elliptic–lanceolate, 3–3.5 mm long, stamens 1.5–1.75 mm long, silky minutely puberolous, staminode 1.5 mm long, with narrowly hastate acuitish head, silky puberolous, ovary ellipsoid, silky pubescent | | | 6mm long, pedicel 3 mm long, Perianth ovate–elliptic–lanceolate, 2.5–3 mm long, stamens 1.5–2 mm long, silky pubescent to villous, staminode 1 mm long, with broadly sagittate head, villous; ovary globose, silky puberolous | | |
| Fruits | ellipsoid to oblong, up to 1 cm long | | | ellipsoid or sub-globose, up to 1.3 cm long | | |
| Phenology | flowers in March–May<br>fruits in June–September | | | flowers in January–April<br>fruits in May–August | | |

Tropical Bot. and Res. Inst., Thiruvannanthapuram (Kerela) India for latin diagnosis.

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