
An account of the genus *Viburnum* L. from South India

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Abstract

In conformity with the taxonomic studies on Caprifoliaceae Juss. sensu lato in India, the present authors could record as many as four species of Viburnum L. (V. coriaceum Blume, V. erubescens Wallich ex DC., V. hebanthum Wight et Arnott, V. punctatum Buch.-Ham. ex D. Don) from the Nilgiri hills and its adjoining regions of South India. Artificial key to the identification of the concerned species has been provided along with precise illustration and information about flowering and fruiting periods, distribution, type specimen and specimens examined. Among them V. hebanthum Wight et Arnott has been found to be endemic to South India. On the basis of construction of phylogenetic tree based on analysis of rbcL gene sequence the present work suggests the genus to be the member of its own family Viburnaceae.

KEYWORDS: Artificial key, Viburnum, Phytography, Endemic, South India, Phylogenetic tree.

INTRODUCTION

Caprifoliaceae Juss., also known as of beautiful "honeysuckles", belongs to the order Dipsacales of the subclass Asteridae under Magnoliopsida and includes about 400 species (Cronquist 1988). The taxonomic domain of Caprifoliaceae has been frequently revised especially in the context of *Sambucus* and *Viburnum*, which are traditionally given the membership of Caprifoliaceae *sensu lato* (Hara 1966, 1971, Heywood 1978, Ohashi 1975, Rau 1975, Willis 1982) although *Viburnum* L. was placed in Adoxaceae by Judd et al. (1999), Mabberley (2008), APGIII (2009), and Watson and Dalwitz (1992 onwards) and in its own family Viburnaceae by Rafinesque-Schmaltz (1820), Takhtajan (1997) and APG IV (2016).

Viburnum, familiar as European Cranberry bush, Guelder Rose, Water Elder, is mostly a resident primarily of the temperate regions of the northern hemisphere and secondarily in the subtropical portions of Asia and Latin America. Although the Himalayas provide very comfortable accommodation to most of the species of this genus, a few of them also grows in Nilgiri and Palani Hills of South India.

STUDY SITE

South India is in the peninsular part of India covering the Deccan in the shape of a vast inverted triangle, bounded on the west by the Arabian Sea, on the east by the Bay of Bengal and on the north by the Vindhya and Satpura ranges. The geography of the region is diverse, encompassing two mountain ranges, the Western and Eastern

Ghats and a plateau in between. The rivers Godavari, Krishna, Tungabhadra, Kaveri, and Vaigai are important non-perennial sources of water. The flora of southern part of the country is rich in endemic species. As a biodiversity Hot Spot, Western Ghats cover a significant part of South India where in certain interesting families like Adoxaceae and its native Caprifoliaceae are sustained which otherwise prefer the Himalayan accommodation for being more hospitable to them. The study site of the present work encompasses different regions of the Western Ghats covering Nilgiris and Palani (Palani) Hills, Coorg, Dodabetta and Ootacamund.

MATERIALS AND METHODS

This work is based on thorough study and scrutiny of pertinent literature (Clarke, 1880; Fyson, 1977; Gamble, 1966; Sharma and Singh, 1984), specimens preserved in the Central National Herbarium (CAL), as well as the herbaria of the Southern Regional Circle of Botanical Survey of India, Coimbatore (MH), and those collected during field work in the Nilgiri Hills. Standard taxonomic methods were followed to describe each species and to prepare a comprehensive key to identification of the concerned species. Among the 17 species of *Viburnum* L. growing in India, four have been recorded from South India. The recorded species have been arranged alphabetically giving their scientific names, citations, basionyms and synonyms, wherever necessary along with information about type specimens, flowering and fruiting periods, distribution and specimen examined and use.

In context to the controversy in the systematic position of *Viburnum* L., a phylogenetic tree was generated based on analyses of *rbcl* gene sequences. The sequences of *rbcl* gene (*gene Id: Viburnum coriaceum: KP2811818.1, Viburnum erubescens: HQ591724.1, Viburnum hebanthum: HQ591729.1, Viburnum punctatum: HQ591757.1, Adoxa moshcatellina: NC_034792.1, Sambucus nigra NC_045061.1, Lonicera japonica NC_026839.1 and Leycesteria formosa: NC_057000.1*) were retrieved from the data base of NCBI. Multiple alignments of sequences and phylogenetic tree were developed using Mega 11 software by Neighbor-Joining (NJ) tree method with 1000 bootstrap values. Bootstrap values (1000 replicates) were calculated by the method of Felsenstein (1985) to validate the reproducibility of the branching pattern of the tree.

Results:

Systematic Discourse

Viburnum L.

Mostly shrubs, or small trees with opposite, simple, entire, toothed or lobed leaves; corymbs, 5 – 15 cm across, with large, showy sterile flowers in some species; flowers small, whitish to creamish or pink, 3 – 5 mm across, corolla tubular-funnel-bell-

shaped with five lobes, often fragrant; stamens 5 epipetalous. carpels 3, syncarpous with the nectaries ; fruit on seeded, spherical, oval or flattened , red to purple, dark blue, or blackdru

Key to the Species

- 1a. Leaves alternate, flowers not fragrant. **1.V. coriaceum**
- 1b. Leaves opposite, flowers fragrant:
- 2a. Corolla rotate; peltate scales in lower surface of leaves, branchlets and inflorescence**1. V. punctatum**
- 2b. Corolla tubular; peltate scales absent:
- 3a. Leaves, sinuate, with tuft of hairs in the axil of nerves beneath, bark brown.....**3. V. hebanthum**
- 3b. Leaves, serrate, pubescent only on nerves in the ventral surface, bark grey.....**4. V. erubescens**

1. *Viburnum coriaceum* Blume, Bijdr. 656. 1826. Clarke in Hooker f., Fl. Brit. India 3: 5. 1880; Hara in Fl. E. Him. 234. 1966, 2: 127. 1971. Sharma and Singh, Fl. Karnataka 121.1984. Gamble, Fl. Madras Pres. 1: 407.1915 and 1: 575. 1997 (rep. ed); *V. capitellatum* Wight et Arnott, Prodr. Fl. Ind. Or.388. 1834

Vernacular names: Basmol (Hindi), Helusunde, Elesande (Kannada) Mottumokkan(Malayalam)

Type:Java, (Indonesia) C. L. von Blume, #s.n.[('type',NY00278657)].

An evergreen large shrub with alternate, oblong-lanceolate, coriaceous, glabrous, hairy towards axils on nerves beneath, entire, leaves, 5-13 x 2-5cm, petiolate, petiole ca.2.0-2.5cm, estipulate. Flowers small, white, in terminal umbellate or corymbose cymes; not fragrant; bracteate with small bracts and without bracteoles. Calyx greenish; tubular-obconical, glabrous. Corolla white with 5 short erect lobes, tubular, tube very short, 4mm in length, glabrous. Stamens 5, epipetalous, with purplish anthers. Fruit a small succulent elliptic drupe, beaked and ribbed, reddish brown when young turning black on maturity. Seeds solitary, dorsally bi grooved (Fig. 1).

Flowering and fruiting: May to November. Distribution: Hills of Northern Coimbatore; Coonoor (Nilgiris) at 1800m or higher altitude, Chikmagalur (Mullayanagiri range), Coorg or Kodagu (Western Ghats), Manjolai (Kerala); [also in the Himalaya

(Kumaon to NEFA, 1200–2500m), extending to Myanmar, S.E. Asia and S.W. China.].

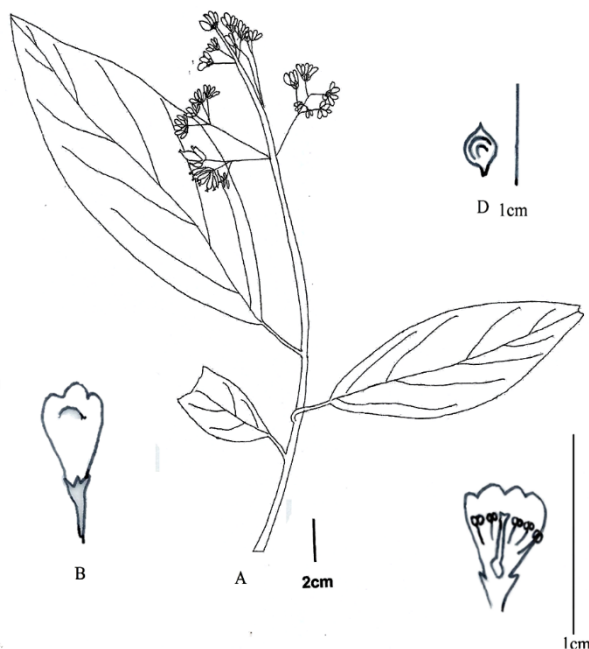


Figure. 1: A-D. *Viburnum coriaceum*; A: Habitat, B: Flower, C: Flower Split Open, D: Fruit.

Specimens examined: Kundha, 1800m, K. M. Sebastine 2167 (CAL); Hulical Droog, 1733m, K. M. Sebastine 4169 (CAL); Upper Palmis, 6800' [2040m], C.E.C. Fischer 2866 (CAL); Mancholai, 1067m, Kerela, K. M. Sebastine 5450 (CAL). Pambar Shola, Kodaikanal, 2350m, C. A. Barber 7506 (MH); Attikan State, 1400m, V. Narayanswami 3877 (MH); Kodaikanal Shola, Bawns 2643 (MH); Perumalmalai- Kodaikanal, 2000m, K. Ramamurthy 23412(MH); Pillar rock- Kodaikanal, 2000m, K. Ramamurthy 23333 (MH); Pulney hills, Anonymous 23827 (MH); Kodai, T. Ramachandra Rao 94033(MH); Kodaikanal Hills, K.C. Jacob 16152 (MH); 27th Mile, Naduvattam, 1700m, M. Mohanan and J.V. Sudhakar 1223221 (MH); Kaikatty towards Kotogiri, 1850m, E. Vajravelu 36912 (MH); Shola, Near Koil Peak, 1500 m, G.V. Subbarao 40430 (MH); Kurisimalai, 1800m, J.L. Ellis 37784 (MH); On way to Anaikatti from Kapathmund, 1700m, G.V. Subbarao 37385 (MH); Carrington, 2025m, K. Vivekananthan 40714 (MH); Coorg (Karnataka), Major R. A. Beddome 1809 (MH); Conoor, Rhamnur, Anonymous 1022 (MH); Brumaghirris, Blume 66869 (MH); Nilgiris, Anonymous 23833 (MH); Sirur to Ebanad, 1500m, G.V. Subbarao 36445 (MH); Kodanad R. F., 1900 m, E. Vajravelu 36779 (MH); V. Carrington, 2000m, B.V. Shetty 34305 (MH); Kothabar, 2000m, K. M. Sebastine 4866 (MH);

2. *Viburnum erubescens* Wallich ex DC., Prodr. 4: 329. 1830; Wall., Pl. As. Rar. 2: 29, t.134. 1831. Clarke in Fl. Brit. India 3: 7. 1880. Gamble, Fl. Pres. Madras 576(407). 1919; Hara, Fl. E. Him. 320. 1966; Matthew, Fl. Pl. Kurseong 42.1981; Naithani, Fl. Chamoli Dist.1:279.1984; Mukherjee, Fl. Pl. Darjiling 111.1988; Hajra *et al.*, (Ed.) in Materials for Fl. Arunachal Pradesh 1; 563.1996; Swarup *et al.*, Shola For. Kerala 45. 1998; Sasidh., Fl. Periyar Tiger Reserve 167. 1998; Chauhan in Singh, Singh *et* Mondal, Fl. Manipur 1: 460.2000. R.A. King in Grierson and Long, Fl. Bhutan 2(3): 1359. 2001. Pal, Fl. Lower Subansiri Dist., Arunachal Pradesh 1:392.2013.

Type: Napalia (Nepal) 1821 Wallich Catalogue, #No. 459('Type', NY00278660) [Type? Nepal, Wallich, N., #s.n. PH00028935]. Nepal, Kumaon (Kamaon), T.R. Dudley, s.n., Isotype E 00265429.

Deciduous, reddish large shrubs or under-trees; bark thin, grey with opposite, ovate-oblong, serrate-serrulate, acute, glabrous thin leaves having variable size, 4.5- 10 x 3-7cm, pubescent only on nerves in the ventral surface, shortly petiolate, up to ca.2cm, exstipulate, Flowers in lateral pendant or terminal thyrsi-form paniced cymes, whitish or pinkish in colour on red pedicels, fragrant. Calyx made of 5 tubular sepals. Corolla salver-shaped with slender and short tube and five spreading rounded lobes, white. Stamens 5, epipetalous with dark purple anthers. Fruit an ellipsoid, red or reddish black drupe. Seeds obovoid, compressed, with a single broad and deep ventral groove (Fig. 2).

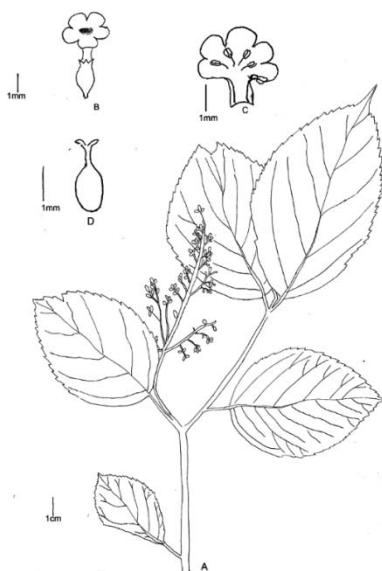


Figure. 2: A-D. *Viburnum erubescens*; A: Habitat, B: Flower, C: Flower Split Open, D: Gynoecium.

Flowering and fruiting: April to October.

Use: Fruits are eaten locally raw or cooked or the soft drink prepared with fruit juice and other ingredients is used as tonic. Root juice is used in healing of cough.

Distribution: Western Ghats, in the higher Sholas of Nilgiris and above 2100m (Tamil Nadu), Idduki (Kerala), Sri Lanka; also, in the Himalayas (Kumaon to Bhutan: 1200 – 2500m), extending to Myanmar and S.W. China(1800-2200m).

Specimens examined: Ootacamund, 7000', G. King, 1952218, 195220 and 195221, BSI (CAL); Ootacamund, 8500', A.Meebold 11876 (CAL); Ootacamund, 7000', J. S. Gamble 11544 (CAL); Ooty, Nilgiri, 8000', C. B. Clarke 11110 and 11104(CAL); Ootacamund, Ph. Guinet 623 (CAL); Nilgiri Hills, 7250' C.E.S. Fischer 3950 (CAL); Nilgiri Hills G. King 1338 and 1343 (CAL); Ootacamund, Madras Province, 7000', D. Brandis 195214 and 195215, BSI(CAL). Kukul- Pulney, Bhowmik 16534 and 23852 (MH); Ooty, 2350m, J.S. Gamble 17481 (MH); Doddabetta, Anonymous 23850 (MH); Ootacamund, C. A. Barber 6427 (MH); Doddabetta forest, 290m, E. Vajravelu 76512(MH); Prospect estate- Pykara, 1925 m, B. D. Sharma 35871 (MH); Kotagiri-Ooty road, 2000m, D. B. Deb 31542 (MH); Governor Shola, J. L. Ellis 37910 (MH); Doddabetta R. F., 2575m, B. D. Sharma 35871 (MH); Glenmorgan, 2000m, N.C. Rathakrishnan 38058 (MH); Ithalav- Ooty, 2100m, J. L. Ellis 34528 (MH); Doddabetta, Anonymous 23851 (MH).

3. *Viburnum hebanthum* Wight et Arnott, Prodr. 388. 1834; Gamble, Fl. Madras Pres. 1: 407.1915 and 1: 576. 1997 (repr. ed). Flora of Tamil Nadu, VOL. I, 1983.

Vernacular name: Kadambu (Badaga)

Type: Peninsula India, Wight 1255 (E00174723), Peninsula India, Wight 1258 (CAL0000010569).

A small whitish or bright green spreading tree with a strong heavy unpleasant smell, bark brown, thin with prominent lenticels, wood light reddish brown. Leaves opposite, decussate, erect, in dense tufts at the shoot ends, elliptic to ovate, 4.5-7 x 2.4-4cm, acute, distantly sinuate or sinuate dentate, nerved with 3 pairs of secondary nerves, coriaceous, glabrous, with tuft of hairs in the axil of the nerves beneath; base acute to slightly rounded, petiole ca. 1.5cm in length, canaliculated; stipule caducous. Flowers in compound corymbs or umbels, slightly pilose upwards; greenish white with small linear bracteoles, 1.2-1.4cm in length. Calyx tube made of 5 pubescent sepals. Corolla tube densely pubescent. Fruit an ovoid, one-seeded drupe (Fig. 3).

Flowering and fruiting: April to October Distribution: Endemic to the Western Ghats in Sholas of the Nilgiris hills from 1800 - 2400m and Palani (Palani) Hills, common in

Ootacamund and below the downs to Pykara Mayavarum (Mayiladuthurai), [2000 and 2400 m]

Specimens examined: Nilgiri and Coorg region [Kodagu], Anonymous 195148 (BSI SC); Nilgiri, Anonymous 195150, (MH); Shola edges and Kundhas of Nilgiri District (7500') C.E.C. Fischer 195147 (MH); Kodanand- Kotagiri (1853m), K. Subhramanyam 1151 (MH); Casin Hill, Ootcamand, Nilgiri Hills, 7250' [2175m], C.E.C. Fischer 3958 (MH). T.R. Bazaar, Shola, 1960 m, J.L. Ellis 34752 (MH); Upper Bhavani, 2300m, B.V. Shetty 34139 and 34154 (MH); Avalanche, 1925 m, K. Vivekananthan 40634 and 42914 (MH); Way to Nilgiri Peak- Mudimundu, 2300 m, J.L. Ellis 43395 (MH); Mullimund- Avalanche, 2025 m, B.V. Shetty 37604 (MH); Naduvattam, 2100m, M. Mohanan and J.V. Sudhakar 122785 (MH)

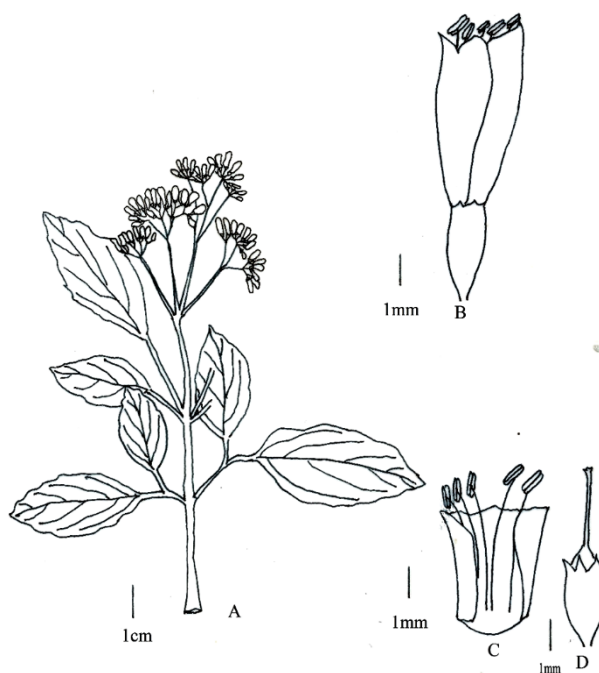


Figure. 3: A-D. *Viburnum hebanthum*; A: Habitat, B: Flower, C: Flower Split Open, D: Gynoecium.

4. *Viburnum punctatum* Buch. -Ham ex G.Don, Prodr. Fl. Nep.142. 1825; Keshava Murthy and Yoganarasimhan, Fl. Coorg (Kodagu) 213. 1990; Sasidharan, Biodiversity documentation for Kerala- Flowering Plants, part 6: 209. 2004. Sharma and Singh, Fl. Karnataka 122.1984. *Viburnum acuminatum* Wall. ex D. C., Prodr. 4: 325 1830. Gamble, Fl. Madras 1: 575. 1997 (rep. ed); *V. punctatum* Buch. -Ham var.

acuminatum Clarke in Hooker f., Fl. Brit. India 3: 5. 1880. Vernacular names: Konakaram (Tamil), Yelle' sunde' (Badaga), Nonna (Kannada) Konakkara (Malayalam).

A small evergreen tree, 4-8m in height with thin, greenish-brown, tessellated, lenticellated barks; wood light red and hard. Leaves opposite, decussate; elliptic or narrowly obovate, up to 10 x 4.5cm, acute to acuminate, revolute, coriaceous, ventral surface with peltate scales; base shortly cuneate; petiole up to 1.5cm long, canaliculated above, peltate scaly. Flowers in terminal compound umbel or corymbiform, buds brownish tomentose, turning creamy white or white, fragrant; bracts ca. 4.20mm, lanceolate, deciduous; bracteoles ca. 1mm, ovate. Calyx tube minutely scaly, teeth minute, obtuse. Corolla rotate, lobes 2.1mm, round, creamy white. Anthers large, much exserted. Fruit a 1-seeded drupe, oblong-ellipsoid, 1cm long, succulent, initially green maturing to pale yellow or white or deep red. Seeds grooved, grooves 2 on the dorsal, 3 on the ventral surface (Fig. 4).

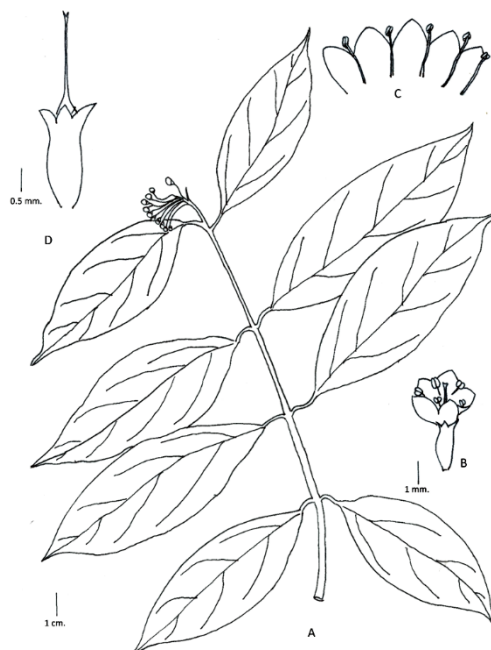


Figure. 4: A-D. *Viburnum punctatum*; A: Habitat, B: Flower, C: Flower Split Open, D: Gynoecium.

Type: In montibus Nilghiry, India, Wallich, N., #465 c (M), M0189590. This is an Isosyntype of *Viburnum acuminatum* Wall. ex DC. [Verified by Holstein, N., 2013], which is now treated as *Viburnum punctatum* var. *punctatum* Buch. -Ham. ex D. Don.

Flowering and fruiting: February to October.

Distribution: In the Western Ghats- South and Central Sahyadri hills; N. Circars, Mahendragiri Hills (1200m); Chikmagalur (Mullayanagiri range), Coorg or Kodagu (Western Ghats), Hassan and Mysore districts in Karnataka; and the hills of North Coimbatore; from Mysore to Travancore in evergreen forests at 900-1800m; on the downs of Nilgiri towards Pykra at 2100m; Lower level of Pulneys; Green hills of Shevaroy from 900-2400m. Also occurs in Nepal, Bhutan, China (South); Southeast Asia (North Myanmar, Cambodia, Indonesia, Thailand, Vietnam)

Use: The leaf-decoction is indigenously used for the treatment of fever and dysentery.

Specimens examined: Sultan Battery, 950m, J.L Ellis 18607 (MH); Sultan Battery, 890m, J. L. Ellis 24012 (MH); on Way to Sultan Battery, 900m, J. L. Ellis 25757 (MH); Pachakanam, 850 m, B. D. Sharma 40828, (MH); Thekkadi, 825 m, K. Vivekananthan 45384, (MH); Idukki to Kattappana, 975 m, C. N. Mohanan and B. Ramannjam. 72036, (MH); Kuttikanam- Peermade (Kotayam District), 1100 m, K. Vivekananthan 20341, (MH); Pannaikadu- Kodaikanal, 1700m, K. M. Sebastine 25007 (MH); Way to Pannikadu, 2000m, D. B. Deb 30861 (MH); Konavakari- Kotagiri, 1833m, K. Subhramanyam 1909 (MH); Konavakari- Kotagiri (Nilgiri District), 2000 m, K. Subhramanyam 1093 (MH); Renimade forest, 1666 m, K.M. Sebastine 2537 (MH); Gymkhana Shola, 1800 m, K.M. Sebastine 2624 (MH); Reserve near Parkside- Pakasutramalai, 2000m, K.M. Sebastine 3950 (MH); Ghat R.F.- Coonoor, 1666m, K.M. Sebastine 4046 (MH); Hulical Droog, 1733m, K.M. Sebastine 4142 (MH); Gudalur- Naduvattam road, 1650 m, K.M. Sebastine 7316 (MH); Benne Forest, 1230m, B.V. Shetty 11848 (MH); Benne Forest (Nilgiri District), 875 m, B.V. Shetty 34428 (MH); Naduvattam- Gudalur road, 1600m, D.B. Deb 31364 (MH); Madanad R.F., 1500m, E. Vajravelu 34932 (MH); Way to Kottacombai- Aravenu, 1900m, E. Vajravelu 35169 (MH); Kodanad R. F., 1875m, E. Vajravelu 36788 (MH); Mahanad R. F., 1500m, E. Vajravelu 36926 (MH); Singara R. F., 1025m, B. D. Sharma 39827 (MH); Singara R. F., 1050m, N.C. Rathakrishnan 37950 (MH); Shola to the West Koil Peak near Ebanad, 1450m, G. V. Subbarao 40432 (MH); Guddalur- Cherambadi, 840m, E. Vajravelu 41773 (MH); On the way from Sirur to Ebanad, 1450 m, G. V. Subbarao 40282 (MH); Kateri- Kundha road, 1500 m, E. Vajravelu 41918 (MH);); Bedguli, on the way to Devagiri betta of Mysore district, A. S. Rao 79812 BSI (MH); Bedguli estate surroundings of Mysore district of Karnataka, Seshagiri Rao Rolla 73817,73819, BSI (WC); Eichala Kolmebetta, North of Ketedevargudi of Mysore district, A. S. Rao 80225, BSI (WC); Vaikkapadappu- Thannikudi (900m) of Idukki district of Kerela, N.

rbcl genes used: *Viburnum coriaceum*: KP2811818.1, *Viburnum erubescens*: HQ591724.1, *Viburnum hebanthum*: HQ591729.1, *Viburnum punctatum*: HQ591757.1, *Adoxa moschatellina*: NC_034792.1, *Sambucus nigra* NC_045061.1, *Lonicera japonica* NC_026839.1 and *Leycesteria formosa*: NC_057000.1) The Neighbour Joining (NJ) tree of the *rbcl* homologs was constructed with the full-length gene sequences by Mega 11 using default parameters and bootstrap value of 1000.

DISCUSSION

The present work accounts for four species of *Viburnum* mainly from 'Sholas' (cōlai in Tamil meaning groves) i.e., stunted tropical-subtropical montane forests found in valleys and in the higher montane regions of South India. Interestingly *Viburnum coriaceum*, *V. erubescens* and *V. punctatum* exhibit disjunction by virtue of their distribution in South India and in the Himalayas with a further spread to Southeast Asia and Southwest China. However, *V. hebanthum* is endemic to Western Ghats-Nilgiri and Palani Hills within an altitude ranging from 2000-2400m above mean sea level. The genus is of very little economic importance, aside from two species. Fruits and root juice of *V. erubescens*, find edible and medicinal uses respectively among local people. Medicinal use of leaf-decoction of *Viburnum punctatum* by the local people for the treatment of fever and dysentery is noteworthy.

The cladogram based on *rbcl* phylogeny shows the phylogenetic tree (Fig. 5) where *V. coriaceum* and *V. hebanthum* belong to the same clade that shares a common node with *V. punctatum*, while *V. erubescens* stands out the last common ancestor (LCA), the four members comprising the clade of *Viburnum*. The clade of *Viburnum* although appears to a separate one, it seems to be closer to the clade comprising of *Adoxa moschatellina* and *Sambucus nigra* representing the family Adoxaceae than the clade comprising of *Lonicera japonica* and *Leycesteria formosa* in the tree that represents the family Caprifoliaceae. So, the placement of *Viburnum* as a separate family being much closer to the family Adoxaceae instead of Caprifoliaceae seems to be more appropriate considering the Neighbor-Joining tree based on *rbcl* phylogeny. However, consideration of all the members of *Viburnum* as well as all those of Adoxaceae and Caprifoliaceae while constructing the *rbcl* phylogeny should confirm the consideration of Viburnaceae as a distinct monotypic family.

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