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On the identity and distribution of *Vasconcellea pubescens* (Caricaceae) in Asia

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वैस्कोन्सेल्लिया प्यूबेसेन्स (कैरिकेसी) का एशिया में वितरण एवं पहचान

कोनिक्कल माम्बेटा प्रभुकुमार, चंद्रासेरिल नारायण सुनील, वानारत्ता वेट्टिल नवीन कुमार, तरूण छाबरा, एन मोहनराज एवं इंदिरा बालाचंद्रन

सारांश

प्रस्तुत शोध पत्र में वैसकोन्सेल्लिया प्यूबेसेन्स (कैरिकेसी) का एशियाई देशों में वितरण एवं सही पहचान को रंगीन छायाचित्रों से वर्णित किया गया है। इसी के साथ हमारे द्वारा वैसकोन्सेल्लिया सेस्ट्रीफ्लोरा एवं कैरिका कंदमारकेन्सिस नामों का लैक्टोटाइपिफिकेशन भी प्रतिपादित किया गया है।

ABSTRACT

The present paper discusses the identity and distribution of *Vasconcellea pubescens* (Caricaceae) in Asian countries with detailed description and colour photographs. Here we also designate the lectotypes for the names *Vasconcellea cestriflora* and *Carica candamarcensis*.

Keywords: *Carica papaya*, India, Mountain Papaya, Nilgiri

INTRODUCTION

The family Caricaceae Dumort. is a small family of flowering plants, best known for the fruit crop *Carica papaya* L., comprising 34 taxa under six genera (Mabberley, 2017) distributed in tropical & warm America and tropical Africa. *Vasconcellea* A. St.-Hil. is the largest genus of the family comprising 20 taxa (Mabberley, 2017). The genus is distributed throughout South America, with a concentration of diversity in the Andean valleys of Ecuador (Carvalho & al., 2014).

During the course of a botanical exploration in Nilgiris district of Tamil Nadu during 2011, one of us (KMP) observed the occurrence of one wild papaya in vegetative condition in the Long Wood Shola forests at an elevation of 2400m asl. The plant was quiet distinct from the normal *Carica papaya* by means of its pubescent nature on the leaves. Subsequent observation of two years revealed that, the plant was on fruiting stage during 2013 and flowering stage during 2016 and 2017 respectively. The 5–locular nature of the ovary helped us to confirm the generic identity as *Vasconcellea*. After a critical

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study with the perusal of relevant literature, comparison with the type specimens deposited at various herbaria and expert's comments, the species was identified as *Vasconcellea pubescens* A. DC., a native of America. From a thorough literature study (Moreno, 1980; Badillo, 1971, 1983, 1993, 1997, 2000, 2001; National Research Council, 1989; Hofer & al., 2000; McVaugh, 2001; Morales & al., 2004; Rodríguez & al., 2005; Van Droogenbroeck & al., 2006; Scheldeman & al., 2011; Carvalho & Renner, 2012; Carvalho, 2013; Carvalho & al., 2014) surprisingly it became apparent that this species had not been recorded from any of the Asian countries in wild condition. The present paper provides the identity of *V. pubescens* A. DC. in India and other Asian countries with detailed description and colour photographs.

It is also pertinent to mention that, two synonyms of *V. pubescens* viz. *V. cestriflora* and *Carica candamarcensis* were also described without designation of any types which needs to be lectotypified. According to the ICN 2017, Art. 9.3 lectotypes were designated here. (Turland & al. 2018)

TAXONOMIC TREATMENT

Vasconcellea pubescens A. DC., Prodr. 15(1): 419. 1864.

Papaya pubescens (A. DC.) Kuntze, Revis. Gen. Pl. 1: 253 1891. **Lectotype:** PERU: Pasco, Pozuzo, Ruiz Lopez, H.; Pavón, J.A. s.n (F, designated by Badillo 1993).

Carica pubescens Lenne & K. Koch, *Index Seminum (Berlin) 1854 (App.): 12. 1854. Vasconcellea cundinamarcensis* V.M. Badillo, *Ernstia 10(2): 78 2000 ("as* "Vasconcella"). Neotype: ECUADOR: Azuay, Bulan-ponte, Siglaloa, Monsica, Horovitz, S. 1035 (MY, selected by Badillo 1997).

Vasconcellea cestriflora A. DC., Prodr. 15(1): 418 1864. *Carica cestriflora* (A. DC.) Solms, *Fl.* Bras. 13(3): 185 1889. *Papaya cestriflora* (A. DC.) Kuntze, Revis. Gen. Pl. 1: 253 1891. Lectotype (designated here): COLOMBIA, 1857, I. F. Holton 713 (G00226222!), isolectotype G00226149!.

Carica candamarcensis Hook. f., Bot. Mag. 101: t. 6198 1875. *Papaya candamarcensis* (Hook. f.) Kuntze, Revis. Gen. Pl. 1: 253 1891 *(as "cundinamarcensis").* Lectotype (designated here): ECUADOR, s.n. (K000500503!), isolectotype Q; Syntype K000500504!).

Carica chiriquensis Woodson, Ann. Missouri Bot. Gard.45: 30 1958. Type: PANAMA: Chiriqui, Finca Lerida, al bordequebrada Velo, La Horqueta, cerca de Boquete, Allen, P.H. 4675 (holotype MO, isotypes G, K).

Medium sized trees with white milky juice, 3.5–5 m tall. Trunk with scars of fallen leaves, glabrous. Leaf palmately 5–6-lobed, which are again divided into smaller lobes with acute to short acuminate apex, blade 20–50 × 18–50 cm, glabrous on adaxial surface and pubescent abaxially especially on the mid nerves and veins; petiole 20–60 cm long, 1–2 cm in diameter. Plants monoecious with yellowish-green flowers. Male inflorescences axillary, peduncle 3–6 cm long, slender. Male flowers creamy-yellow, c. 2.5 cm long; calyx c. 2 mm long; corolla tube c. 1.2 cm long; pistillode c. 6 mm long. Stamens in two whorls, outer whorl of the stamens anthers c. 1.8 mm long; apex acute; inner stamens filaments c. 2 mm long, glabrous; anthers c. 1.3 mm long. In female plant 2–4 floral bud arise in the leaf axils; peduncle short, 1–2 cm long. Bracts fleshy, leafy, 0.8–1 cm long, caducous, glabrous. Calyx united, 5–lobed, 6–7 mm long, acute, green and fleshy. Petals 5, 3–4 × 0.5–0.7 cm, lanceolate, acute or shortly acuminate, outwardly curved, pale green and pubescent on outside and creamy–yellow, glabrous inside. Ovary 5–locular, ellipsoid, 1.1–1.5 × 0.5–0.8 cm, slightly angled, glabrous. Style short and thick, well-defined, 6–7 × 2.5–3 mm, glabrous; stigma lobes 5, c. 5 mm long, glabrous. Fruit ellipsoid, 8–14 × 4.5–6.2 cm, dark green in young and turning yellow during ripening, glabrous. Seeds brown, 5.5–7 × 2.2–2.6 mm, surface with projections, each enclosed in the fleshy mass, elliptic, oval or fusiform in shape, glabrous. **(Fig. 1, 2)**

Flowering and *Fruiting*: Throughout the year

Distribution: The plants naturally occurs in cloud forests above 1500 m above sea level in Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia, Mexico, Uruguay and introduced in Chile. The highest number of species is found in Southwestern South America more precisely in the Northern Andes region viz. Ecuador and Peru (Carvalho & al., 2014; Campos, 1998).

Etymology: The generic name is derived from the name Simao de Vasconcellos a Jesuit who was one of the first to write a history of Brazil during the XVII century. The specific epithet denotes the pubescence nature of the plant (Carvalho & Renner, 2012).

Fig. 1: Habit of *Vasconcellea pubescens* A. DC.

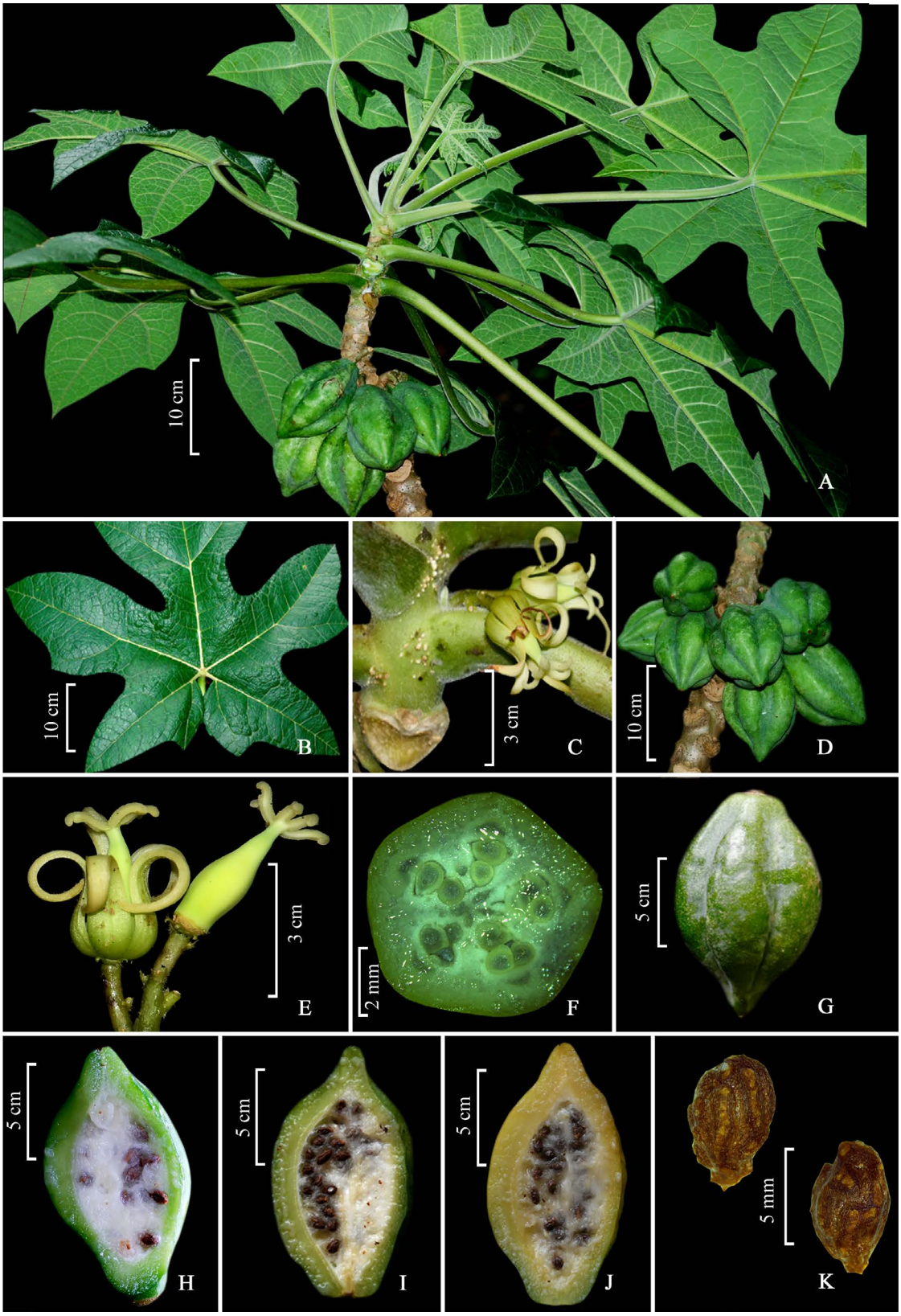

Fig. 2: *Vasconcellea pubescens* A. DC.: **A.** Habit with fruits; **B.** Leaf adaxial surface; **C.** Female inflorescence; **D.** Fruiting twig; **E.** Female flowers; **F.** C.S of ovary; **G.** Fruits; **H.-J.** L. S. of fruits: showing young, mature and ripened conditions; **K.** Seeds.

Lectotypification: *Carica pubescens* and *Vasconcellea pubescens* are heterotypic synonyms having identical epithet." The priority of *V. pubescens* A. DC. and *V. cestriflora* A. DC., published at the same time, was established by Carvalho (2015), who chose *V. pubescens*, under Shenzhen ICN Art. 11.5.

Vasconcellea cestriflora was described by De Candolle in 1864 based on Holton's collection from Colombia on 1857 (Holton 713). We traced multiple sheets of this homogenous collection from Geneva herbarium (G00226149 & G00226222). The specimen with barcode G00226222 is well preserved and the flowers are separately mounted on the sheet is perfectly fit with the protologue. It is considered more suitable for lectotypification and designated here as the lectotype according to the ICN Art. 9.3 of Shenzhen Code (Turland & al. 2018). **(Fig. 3)**

Fig. 3: Digital Image of proposed lectotype of *Vasconcellea cestriflora* housed at G (barcode G00226222).

The name *Carica candamarcensis* was proposed by Hooker in 1875 based on two unknown collections (without any details of collector) preserved at Kew (K) and Universidad Central herbaria, Ecuador (Q). During the study, we have traced multiple sheets (three) of these heterogenous collections (K000500503-14 May 1875, Q and K000500504- October 1875). The specimen deposited at K, with barcode K000500503 is well preserved with flowers is perfectly fit with the protologue, which is designated here as the lectotype according to the ICN Art. 9.3 (Turland & al. 2018) **(Fig. 4)**

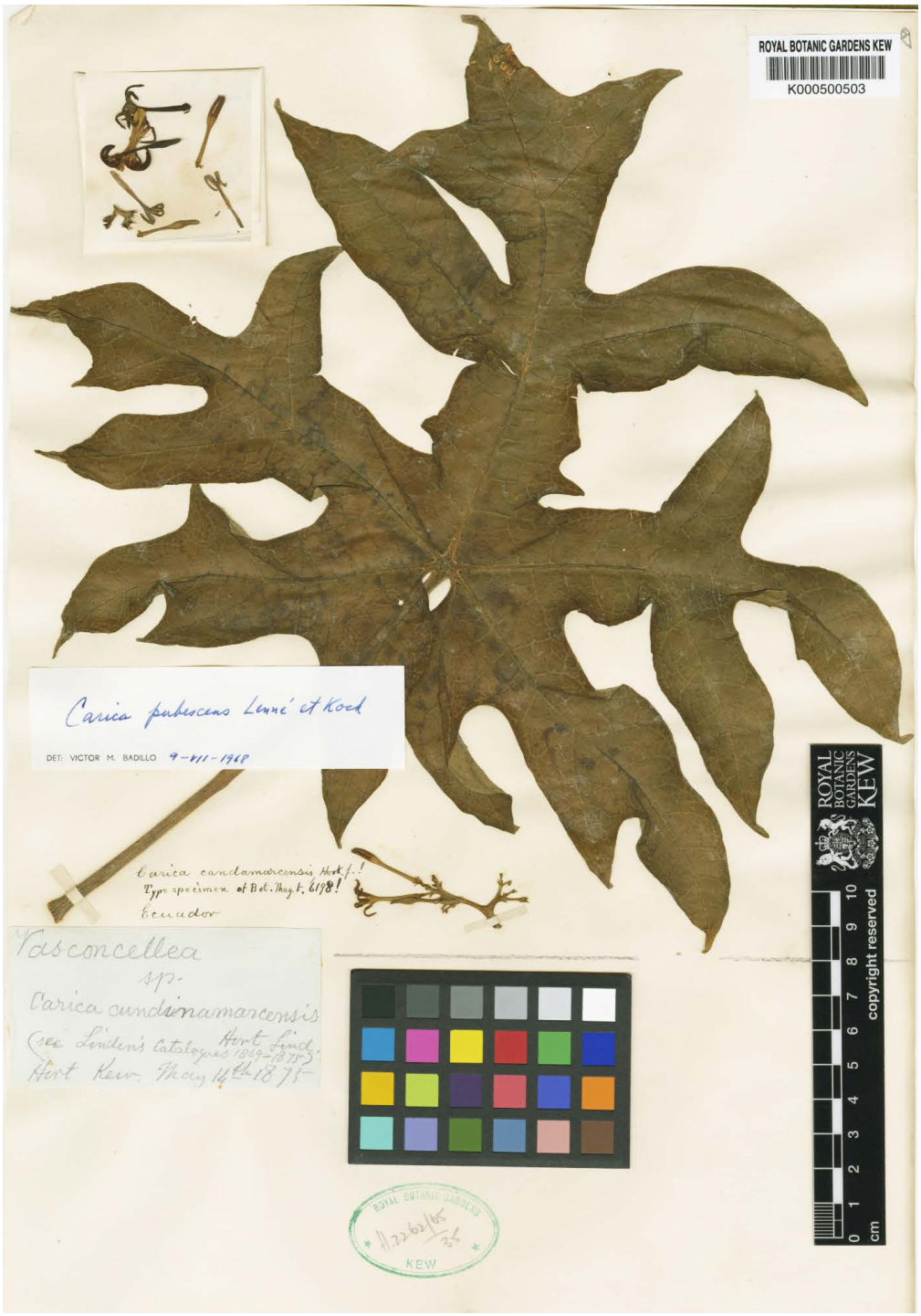

Fig. 4: Digital Image of proposed lectotype of *Carica candamarcensis* housed at K (barcode K000500503).

Discussion: Vasconcellea species are commonly known as "highland papayas" because of the botanical similarity with *Carica papaya*, and also because they are native to the high regions of the Ecuadorian Andes (Morales & al., 2004) which is native to the Andean highlands, of northwestern South America from Colombia to Bolivia southward to central Chile, typically growing at altitudes of 1500–3000 m asl. (Moya- Leon & al., 2004).

The occurrence of *Vasconcellea pubescens* in shola forests of Nilgiri, Tamil Nadu might be an introduction and subsequently naturalized. The information how this species arrived to southern region of India is obscure, however, it is assumed that, it's seeds might be transported during any of the voyage from the Ecuador during colonial era (pers. comm. from Geo Coppens- "indeed, this to be *V. pubescens*, although slightly less pubescent than Colombian forms; possibly from Ecuador, where forms with even sparser pubescence are found. The five ribs also correspond better to Ecuadorian materials than to Colombian ones, as the latter present larger fruits with a more regular shape"). The total number of mature individuals observed during the study were four and the percentage of natural seed germination was zero since 2011.

The family's economic importance lies not only in the papaya fruit, but also in the production of papain, a cysteine proteinase widely used in food and pharmaceutical industries. The recent studies demonstrates that highland papayas are having high concentration of papain-like enzymes are resistance to pathogens which are used in papaya improvement studies (Terashima, 1991; Scheldeman & al., 2011; Coppensd' Eeckenbrugge & al., 2014, Kyndt & al. 2007).

Additional specimens examined: India. Tamil Nadu, Nigiris district, Long Wood Shola, 03 June 2016, *K. M. Prabhukumar* & *Binu Prakash* 9140 (CMPR!). 16 July 2016, *K. M. Prabhukumar* & *Binu Prakash* 9318 (CMPR!); 17 July 2017, *K. M. Prabhukumar, V. V. Naveen Kumar* & *Binu Prakash* 10500 (CMPR!).

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