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# ***Kuhlmanniodendron* Fiaschi & Groppo, a new eastern Brazilian genus of Achariaceae *sensu lato* segregated from *Carpotroche* Endl. (formerly included in Flacourtiaceae)**

PEDRO FIASCHI<sup>1\*</sup> and MILTON GROPPPO<sup>2</sup>

<sup>1</sup>*Herbário André Maurício Vieira de Carvalho, Setor de Recursos Ambientais, CEPEC/CEPLAC, Km 22 da rodovia Ilhéus-Itabuna, Itabuna, Bahia, Caixa Postal 7, 45600-970, Brazil*

<sup>2</sup>*Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras, Universidade de São Paulo, Avenue, Bandeirantes 3900, 14040-901, Ribeirão Preto, São Paulo, Brazil*

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***Kuhlmanniodendron*** Fiaschi & Groppo, a new genus of the tribe Lindackerieae (Achariaceae *sensu lato*) is created to accommodate *Carpotroche apterocarpa* Kuhl., a species previously described based on incomplete floriferous and fruiting material from the rainforests of Espírito Santo state, eastern Brazil. The genus is defined by a unique set of character states, including leaves with *Clusia*-like venation and scaly trichomes, flowers with glabrous stamen filaments and three free styles, and indehiscent fruits with a smooth surface (sometimes with vertical ribs when dried). A description and illustration are provided, with comments on geographical distribution, phenology and generic relationships, and an emended key to neotropical genera of Lindackerieae. © 2008 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2008, 157, 103–109.

ADDITIONAL KEY WORDS: Atlantic rainforests – Brazil – Espírito Santo – Lindackerieae – Salicaceae – taxonomy.

## INTRODUCTION

The family Flacourtiaceae *sensu lato* has long been considered one of the most difficult to characterize morphologically and to recognize in the field (Lemke, 1988; Gentry, 1996; Chase *et al.*, 2002; Daly, 2004). Given the reproductive and vegetative variation found among its members, as well as the absence of useful characters to define the family, it is not uncommon to misplace some groups of plants in the Flacourtiaceae, both in the herbarium and out on fieldwork.

Recent contributions from both morphological and chemical studies (Hickey & Wolfe, 1975; Spencer & Seigler, 1985; Bernhard & Endress, 1999) and macromolecular phylogenetic analyses (e.g. Chase *et al.*,

2002) have shown that it is possible to recognize two groups in place of the previously adopted unnatural Flacourtiaceae. In modern classification systems (see APG II, 2003) one of these two groups is included in an expanded Salicaceae *s.l.* (syn. Flacourtiaceae), the other in an expanded Achariaceae *s.l.* (syn. Kiggelariaceae; Bernhard & Endress, 1999). Until now, only four genera of Achariaceae were known from the Neotropics: *Chiangiodendron* from the tribe Pangieae (Sosa, Chase & Barcenas, 2003), and three genera of Lindackerieae (*sensu* Chase *et al.*, 2002), *Lindackeria*, *Carpotroche* and *Mayna*.

While examining some unidentified 'Flacourtiaceae' in the CEPEC herbarium, we found some specimens of an unusual plant that we could assign to *Carpotroche apterocarpa* Kuhl., a species described from fruiting and incomplete flowering material (Kuhlmann, 1935). After the collection of additional fertile material and the discovery of some recent collections

\*Corresponding author. E-mail: pedrofiасhi@hotmail.com  
Current address: Department of Biology, Virginia Commonwealth University, Richmond, VA 23284-2012, USA

misplaced in the Clusiaceae at the CVRD and MBML herbaria, we concluded that this species did not belong to *Carpotroche*, and required a new combination. Indeed, Sleumer (1980: 47) excluded it from *Carpotroche* and suggested that it should also be excluded from Flacourtiaceae, given the different type of venation of the leaves, very similar to the pattern found in species of *Clusia* (Clusiaceae).

A preliminary phylogenetic analysis of *rbcL* sequences placed *Kuhlmanniodendron* in the tribe Lindackerieae (*sensu* Chase *et al.*, 2002) (bootstrap equal to 60%) in the 50% bootstrap majority-rule consensus tree, together with *Caloncoba* Gilg., *Campostylus* Gilg., *Lindackeria* C.Presl., and *Xylothea* Hochst. in a non-resolved clade (Gropppo *et al.*, unpublished data). Morphological features (discussed later) also support the retention of *Carpotroche apterocarpa* in the tribe Lindackerieae (Chase *et al.*, 2002). Therefore, contrary to the conclusions of Sleumer, we confirmed that this species had been correctly placed among the achariaceae flacourts by Kuhlmann, but we also noted that some of its characteristics (e.g. flowers with three free styles and stigmas, glabrous stamen filaments and smooth fruits) did not support placement in *Carpotroche*. Thus, a new genus, *Kuhlmanniodendron*, is proposed to accommodate *Carpotroche apterocarpa*.

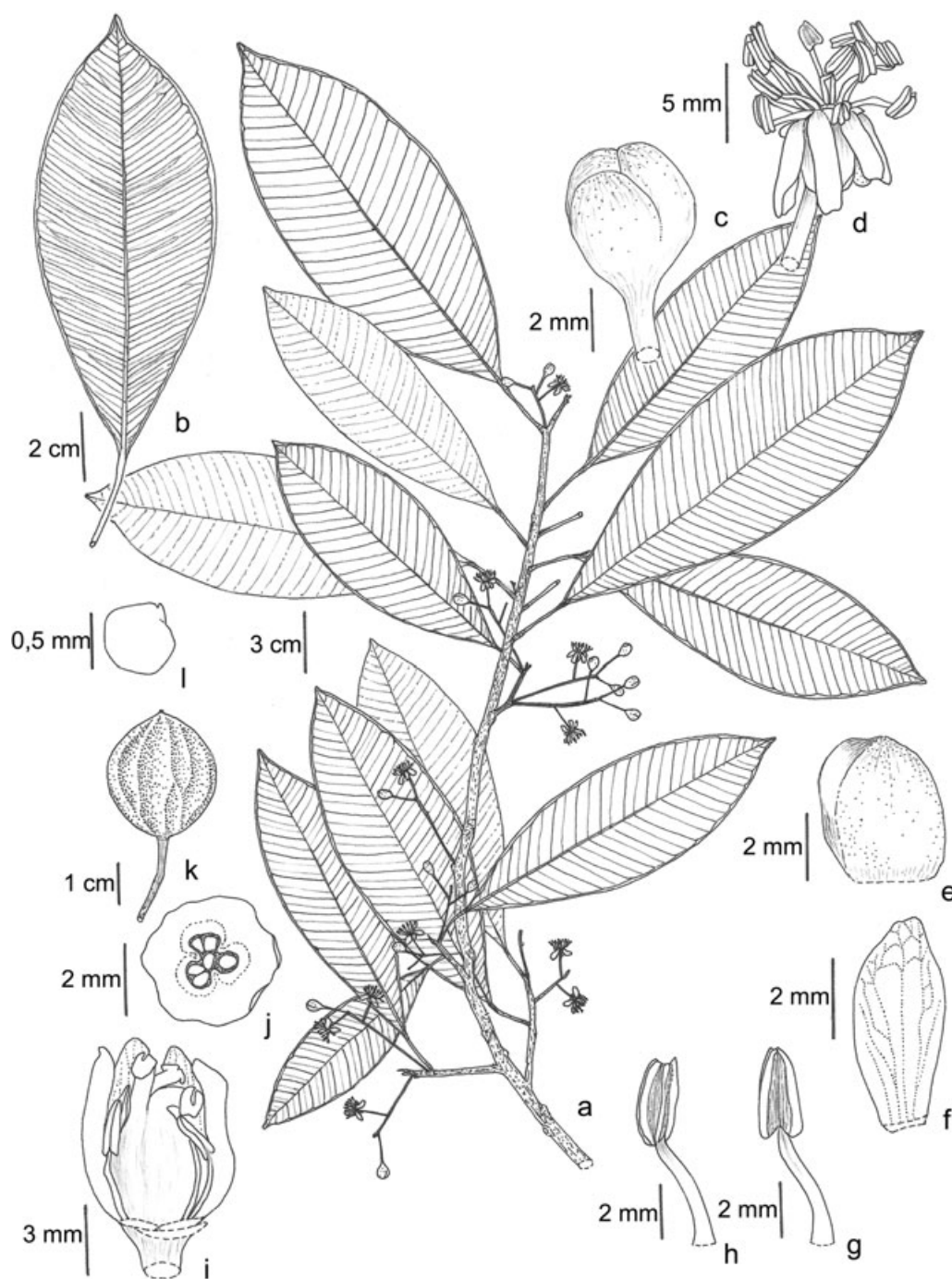
The following emended description is based on samples from mature individuals. Flowers and fruits of herbarium specimens were rehydrated before being measured and drawn. These observations were supplemental to those based on material preserved in 70% ethanol. Terminology of leaf and general morphology follows, respectively, Hickey (1979) and Radford *et al.* (1974), inflorescence terminology follows Weberling (1989) and fruit follows Spuji (1994). Relationships of the new genus and its conservation status are discussed, as well as geographical distribution, habitat preferences and phenology.

**KUHMANNIODENDRON FIASCHI & GROPPPO,  
GEN. NOV.**

Ad trib. Lindackerieae pertinens, ob floribus periantho segmentis asymmetricis instructis, sepalis 3 petalis dissimilaribus, petalis 6 majoribus magisque numerosis quam sepalis, squamula ventralis carentibus, disco glandula carenti, staminibus numerosis atque antheris plus minusve linearibus. Ab *Lindackeria* et *Caloncoba* similis, sed stylis 3 (non 1) differt. Ab *Mayna* et *Carpotroche* etiam similis, sed inflorescentiis monoicis, filamentis staminorum glabris atque fructibus laevibus (neque alatis nec setis aut spinis obsitis) differt.

*Basionym:* *Carpotroche apterocarpa* Kuhlmann, *Archiv. Inst. Biol. Veg. Rio de Janeiro* 2: 87, t. 5. 1935. *Type:* Brazil, Espírito Santo, Três Ilhas, Rio Doce, 20.IX.1930, fr., *Kuhlmann 231*, [lectotype RB, designated by Sleumer (1980) as 'hololectotype', 'duplicates of lectotype' K, n.v., US].

*Treelets to trees* 7–14 m high, 2–8 m until first ramification; distal branches 2.0–2.5 mm in diameter, longitudinally striate, the younger ones sparsely lenticelate and lepidote. *Leaves* alternate, spirally arranged; stipules almost imperceptible and early deciduous, leaving a small rounded scar; petiole 0.7–4.0 cm long, terete, slightly canaliculated on adaxial surface, proximal and distal regions thickened; blade 9.5–17.0 cm long, 3.5–7.2 cm wide, elliptic or oblong to slightly obovate or oblanceolate, chartaceous, glabrous on adaxial surface, sparsely lepidote proximally on abaxial surface, especially near the midvein, when young with mixed scaly and hooked trichomes; apex acuminate, sometimes acute, base usually attenuate, sometimes cuneate, margin entire, slightly revolute; *venation* pinnate, midvein straight, prominent abaxially, impressed to slightly prominent adaxially; secondary veins 19–25 pairs, diverging from primary vein at smoothly increasing angles (from 55° to 65°) toward base, parallel, uniformly spaced, united into an intramarginal vein and separated by intersecondary veins slightly thinner than secondaries, tertiary veins parallel to secondaries, admedially dichotomizing. *Inflorescences* botryoid, axillary, usually restricted to the terminal portion of the branches, but sometimes cauliflorous below leaves, with 8–9 male flowers along its length and a single terminal female flower, which opens after the male ones; axis 1.0–3.7 cm long; floral bracts up to *c.* 5.0 mm long. *Flowers* unisexual, 1.0–1.5 cm in diameter, axillary to supra-axillary to the bracts; segments of perianth asymmetrically arranged; sepals 3, imbricate, united at base, distinct from the petals; petals 6, imbricate, 5.5–6.5 × 1.5–2 mm, free, without an adaxial basal scale; venation conspicuous on abaxial surface; disk glands absent; pedicel 2.0–12 mm long, articulated near base; bracteoles 2. *Male flowers* with petals reflexed at anthesis, stamens 14–22, filaments 4.0–4.5 mm long, free, glabrous; anthers oblong to linear, 2.5–3.0 mm long, dehiscence rimose; pistillode absent. *Female flowers* with petals erect at anthesis, staminodes present, *c.* 4.5 mm long, anthers linear, *c.* 2 mm long.; carpels 3, fused, *c.* 4.2 mm long, styles 3 *c.* 2 mm long, free, stigmas U-shaped, ovary smooth, 1-locular, placentas 3, parietal, ovules 2–4 per placenta, orthotropous. *Fruits* baccate, dry, indehiscent, 3.0–4.0 cm long, 2.8–3.0 cm wide, broadly ellipsoid to spheroid, smooth or sometimes longitudinally striate when dried, apex rounded, sometimes apiculate; pericarp woody, 1–2.5 mm thick, styles persistent, pedicel



**Figure 1.** *Kuhlmanniodendron apterocarpum*. A, flowering branch. B, leaf undersurface. C, bud. D, male flower, note the reflexed petals. E, sepal, abaxial view. F, petal, abaxial view. G, stamen, adaxial view. H, stamen, lateral view. I, female flower (one sepal and two petals removed), note the erect petals. J, ovary in cross-section. K, fruit, lateral view. L, ovule. (A–J & I: Fiaschi *et al.* 2000; K: Kollmann & Bausen 4295).

in fruit *c.* 1 cm long. Seeds 1–6, smooth, patelliform, flat adaxially, convex abaxially, 12–18 × 15–16 mm, endosperm copious. Embryo small, cylindrical, *c.* 3 mm long, cotyledons (Kuhlmann, 1935) broad-elliptic, base cordate, radicle cylindrical (Fig. 1).

*Additional collections examined:* Brazil, Espírito Santo. Colatina, Rio Doce, km 8 da antiga Estrada do Pancas, *Kuhlmann* 373, fr. ('paralectotype', RB). Linhares, 24.7 km E of Linhares on road to Povoação 19°30'26"S, 39°53'14"W, 15 m alt., 23.IV.2004,



W.W. Thomas *et al.* 13980, fr. (CEPEC); idem, estrada para o Pontal do Vale, 8.1 km após o viaduto, 16.7 km do ramal à direita para Povoação, 19°30'22.5"S, 39°53'5.7"W, 30–35 m alt., 3.III.2004, P. Fiaschi, J.L. da Paixão & T.S. Santos 2000, fl. (CEPEC, CVRD, ESA, F, K, MBM, MBML, NY, RB, SP, SPF); idem, Vale do Rio Doce, 26.III.1971, T.S. Santos 1464, fl., fr. (CEPEC); idem, T.S. Santos 1467, male fl. (CEPEC); idem, estrada da Povoação ao Leste, 29.III.1971, T.S. Santos 1497, fl., fr. (CEPEC); idem, Povoação, 27.II.1992, V. de Souza 311, fl. (CVRD, SPF); idem, Reserva Goytacazes, 26.X.2000, D.A. Folli 3725, fr. (CVRD, SPF); idem, Reserva Goytacazes, estrada Jataípeba, 25.XI.2000, D.A. Folli 3749, fl. (CVRD, SPF); 22.XI.2002, D.A. Folli 4422, fl. (CVRD, SPF). Santa Teresa, Rio Saltinho, 9.VIII.2001, L. Kollmann & E. Bausen 4295, fr. (CEPEC, MBML); idem, estrada para Goiapaba-açu, terreno do Tranhago, 350 m alt., 29.VIII.2001, L. Kollmann & E. Bausen 4396, fr. (CEPEC, MBML); Nova Lombardia, Reserva Biológica Augusto Ruschi, 10.IV.2003, R.R. Vervloet *et al.* 2196, fl. (CEPEC, MBML); São Sebastião, Propriedade Djalma Novelli, 26.IX.2000, V. Demuner & E. Bausen 1414, fr. (CEPEC, MBML); 25 de Julho, 28.III.2000, V. Demuner & W. Pizziolo 866, fl. (CEPEC, MBML); idem, terreno do Casoti, 450 m alt., 24.VI.1999, L. Kollmann & E. Bausen 2692, fl. fr. (CEPEC, MBML).

**Phenology:** This species has been collected during several months throughout the year, but predominantly in March, with fruits in March, April, June and August to October.

**Distribution and habitat:** The species is, so far, only known in the rainforests of Espírito Santo state, south-eastern coastal Brazil. It can be found both at northern sea-level forests (locally called 'matas de tabuleiro', Peixoto & Gentry, 1990; Peixoto, Rosa & Joels, 1995; Delprete, 1999) as well as in the more interior montane and submontane forests of the vicinities of Santa Teresa and Colatina (for further information concerning these forests refer to Thomaz & Monteiro, 1997).

**Local names:** camboatá-branco (Folli 4422), camboatá-bravo (Folli 3749, 3725).

## DISCUSSION

*Kuhlmanniodendron apterocarpum* can be placed in the Afro-American tribe Lindackerieae of Achariaceae (*sensu* Chase *et al.*, 2002) on the basis of the following morphological characteristics: ovary unilocular, placentas parietal, flowers with sepals and petals asymmetrically arranged and distinct from each other, sepals 3, imbricate, petals more numerous and larger

than sepals, lacking an adaxial basal scale, disk glands absent, stamens many, and anthers more or less linear. Although the fruits of *Kuhlmanniodendron* do not bear the wings, bristles or spines typical of many Lindackerieae, some longitudinal ribs can be seen in dried material (Fig. 1k). In the Appendix, we provide an emended key to the Neotropical genera of Lindackerieae, including *Kuhlmanniodendron* (modified from Sleumer, 1980).

The smooth, indehiscent fruits of *Kuhlmanniodendron apterocarpum* are noteworthy among neotropical Lindackerieae, *Carpotroche* Endl., being either winged or crested (although sometimes barely so in *C. amazonica*), *Mayna* Aubl. aculeate or bristly, and *Lindackeria* C. Presl bristly or verrucose/tuberculate. Smooth fruits are found in some of the African Lindackerieae, for example in the dehiscent *Caloncoba* Gilg (Sleumer, 1974a) and indehiscent *Camptostylus* Gilg, but in each case floral morphology serves to differentiate these genera from *Kuhlmanniodendron*.

*Kuhlmanniodendron* has three free styles. In the neotropical Lindackerieae, only *Mayna* has species with three styles, but the fruits are covered with bristles, as discussed above. American *Lindackeria* have a single stylar column, while *Carpotroche* has 4–8 styles, rarely 10. Additionally, the stamen filaments in *Carpotroche* and *Mayna* are hairy, while in *Kuhlmanniodendron* they are glabrous. Among African Lindackerieae the style column is single, the one notable exception being *Lindackeria poggei* (Gürke) Gilg, which has 3–4 styles that are generally fused below but can be almost free (see Sleumer, 1974b).

The leaves in *Kuhlmanniodendron apterocarpum* are also distinct from those of other Neotropical Lindackerieae. They have *Clusia*-like venation, characterized by the secondary veins separated by conspicuous intersecondary veins that join the first ones along a marginal vein (the rarity of this feature in Neotropical Flacourtiaceae *s.l.* motivated its exclusion from *Carpotroche* by Sleumer, 1980). Also noteworthy, but in need of further study, is the fact that its tertiary veins are randomly reticulate and seem to be admedially dichotomizing, while species of other genera of Neotropical Lindackerieae are characterized by tertiary veins more similar to the alternate percurrent category. The presence of small scaly (lepidote) trichomes on the leaves is also remarkable, but shared with species of *Lindackeria* and *Caloncoba* (from Africa).

As evident in the diagnosis and in the discussion above, *Kuhlmanniodendron* is not defined by having unique character states, but a unique set of character states, as is true for many genera in the tribe (see Table 1 for a summary of the main diagnostic features of the allied genera). In fact, Hul & Breteler (1997)

**Table 1.** Comparison between some diagnostic characters in *Kuhlmanniodendron*, other Neotropical genera of Lindackeriaceae

Characters	Taxa			
	<i>Kuhlmanniodendron</i>	<i>Carpotroche</i>	<i>Lindackeria</i>	<i>Mayna</i>
Scaly trichomes	Present	Absent	Present	Absent?
Filaments	Glabrous	Hairy	Hairy	Hairy
Styles	3	4–8 (–10)	1 (rarely 3–4)	(2–) 3–4 (–5)
Fruit surface	Smooth, sometimes with vertical ribs when dried	Smooth or with vertical ridges or wings	Verrucose, tuberculate or echinate	Covered with bristles
Fruit dehiscence	Indehiscent	Tardily dehiscent	Tardily dehiscent	Indehiscent or just distally dehiscent
Distribution	South America	Central and South America	Central and South America	Central and South America, tropical Africa
Number of species	1	11	13	6

placed *Caloncoba*, *Carpotroche*, *Lindackeria* and *Mayna* (besides the African *Camptostylus* Gilg and *Xylothea* Hochst.) under *Oncoba* Forssk. (four African species), arguing that the generic division proposed by Gilg (1925) based on characteristics of the fruits (smooth or spiny, etc.), typology and size of the inflorescences, and shape of placentas, was unsatisfactory. Thus, according to the circumscription of Hul & Breteler (1997), we should place the new combination under *Oncoba*. However, according to Chase *et al.* (2002), *Oncoba* belongs to Salicaceae *s.l.*, thus justifying that the above-cited genera must be reinstated, and supporting *Kuhlmanniodendron* as a separate genus. Phylogenetic studies with these genera are necessary to clarify if the generic circumscriptions within this group are congruent with the principle of monophyly. A detailed discussion on the tribal classification of Achariaceae is available in Chase *et al.* (2002).

Many, although not all, Lindackeriaceae plants are andromonoecious or dioecious, developing both unisexual and bisexual flowers together, or either one of these floral types individually. In *Kuhlmanniodendron*, the plants are monoecious, only unisexual flowers being produced, the male ones bearing no pistillodes and the female ones with staminodes. The position of the flowers in the inflorescence (male flowers along the axis and just one female flower at the apex), is characteristic of *Kuhlmanniodendron* and, as well as the monoecious condition, is also found in species of *Lindackeria*, such as *L. latifolia* Benth. In *Mayna*, the plants are dioecious, while in *Carpotroche* they can be either andromonoecious, dioecious or androdioecious, with male and female (or bisexual) flowers occurring in different plants.

Chase *et al.* (2002) have described pollen morphology and wood anatomy of Achariaceae as largely unspecialized. A preliminary analysis of *Kuhlmanniodendron* also supported this pattern, as both pollen grains and wood anatomy did not show satisfactory diagnostic features.

*Etymology:* The generic name *Kuhlmanniodendron* honours the Brazilian botanist João Geraldo Kuhlmann (1882–1958), who first collected this species and, despite having only fruiting materials, placed it correctly in an achariaceae genus (*sensu* Chase *et al.*, 2002) of the family Flacourtiaceae (Kuhlmann, 1935, 1938).

*Conservation status:* although not so uncommon in the rainforests from both the mountain region and the coastal plain of Espírito Santo state, *Kuhlmanniodendron apterocarpum* should be considered vulnerable, given the rapid destruction of the Brazilian Atlantic rainforests (Morellato & Haddad, 2000).

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## APPENDIX

Emended key to the Neotropical genera of Lindackerieae (Achariaceae *s.l.*), based on Sleumer (1980). Note: Sleumer treated *Lindackeria*, *Carpotroche* and *Mayna* as Oncobeeae.

- 1** Style 1 ..... *Lindackeria*  
**1** Styles (2–) 3–8 (–10) ..... **2**.  
**2** Inflorescences with both male and female flowers. Stamen filaments glabrous. Female flowers with staminodes. Fruit surface smooth, without bristles, vertical ridges or wings ..... *Kuhlmanniodendron*  
**2** Male and female flowers on different inflorescences. Stamen filaments hairy. Female flowers without

- staminodes. Fruit surface covered with bristles, vertical ridges or wings (rarely smooth).....3.
- 3** Styles (2-) 3 or 4 (rarely 5). Fruit baccate, generally with a thin pericarp, indehiscent or dehiscent only distally, never winged, all over set with slender bristles.....*Mayna*
- 3** Styles (4-) 6 or 7 (-8). Fruit capsular, with a thick pericarp, may be tardily dehiscent to 3-5 (-7) valves, provided with up to 16 vertical (very rarely much reduced) wings, the latter entire, crenate or lacerate .....*Carpotroche*