

A world key to the species of *Pyxine* with lichexanthone, with a new species from Brazil

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Abstract: A world key is given to the species of *Pyxine* with lichexanthone in the upper cortex. *Pyxine pustulata* Aptroot & Jungbluth is described as a new corticolous species of *Pyxine* from São Paulo State in Brazil, with lichexanthone in the cortex, upper surface K⁻, a yellow to ochraceous medulla and clusters of laminal polysidiangia. Brazil is clearly the centre of *Pyxine* diversity, with 34 out of c. 70 species known worldwide.

Key words: lichen, *Physciaceae*, São Paulo, systematics, taxonomy, tropical

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Introduction

The genus *Pyxine* is a predominantly tropical group in the *Physciaceae*, with c. 70 species currently accepted worldwide (Swinscow & Krog 1975; Aptroot 1987; Kalb 1987, 2002, 2004; Awasthi 1988; Elix 2009; Jungbluth & Marcelli 2011; Mongkolsuk *et al.* 2012; Nayaka *et al.* 2013). The majority of these species have atranorin as a cortical substance, but 20 species contain lichexanthone in the upper cortex. It therefore comprises the largest number of foliose species with lichexanthone as cortical pigment, a substance that is largely confined to some groups of tropical crustose lichens, chiefly pyrenocarps and *Graphidaceae*.

The genus *Pyxine* has been studied in Brazil for more than a century. Both Malme (1897) and Kalb (1987) started their series of publications on Brazilian lichens with the genus *Pyxine*. Recently, Jungbluth & Marcelli (2011)

and Jungbluth *et al.* (2011) described four additional species from Brazil. It has by far the highest number of known *Pyxine* species, with 34 species (out of c. 70 worldwide), seven of which, including the species described above, are so far only known from Brazil (Kalb 1987, 2004; Jungbluth *et al.* 2011; Jungbluth & Marcelli 2011).

Species with lichexanthone are even better represented in Brazil, with 14 out of the 21 species known worldwide being from Brazil. This agrees with the field observation that *Pyxine* species with lichexanthone are often in the majority in the Neotropics and Macaronesia, and species with atranorin are often in the majority in Africa, Australia and Asia. Brazil is clearly the centre of *Pyxine* diversity. The campus of the Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP-Botucatu) and the Botanical Garden of Botucatu in São Paulo State are rich in microfoliose *Physciaceae* that often grow in close contact with each other on trees planted along the roads and in parks, as well as on some remnants of the original forest preserved in the Botanical Garden. Species present there include *Dirinaria applanata* (Fée) D. D. Awasthi, *D. confluens* (Fr.) D. D. Awasthi, *D. purpurascens* (Vain.) B. J. Moore, *Heterodermia albicans* (Pers.) Swinscow & Krog, *H. diademata* (Taylor) D. D.

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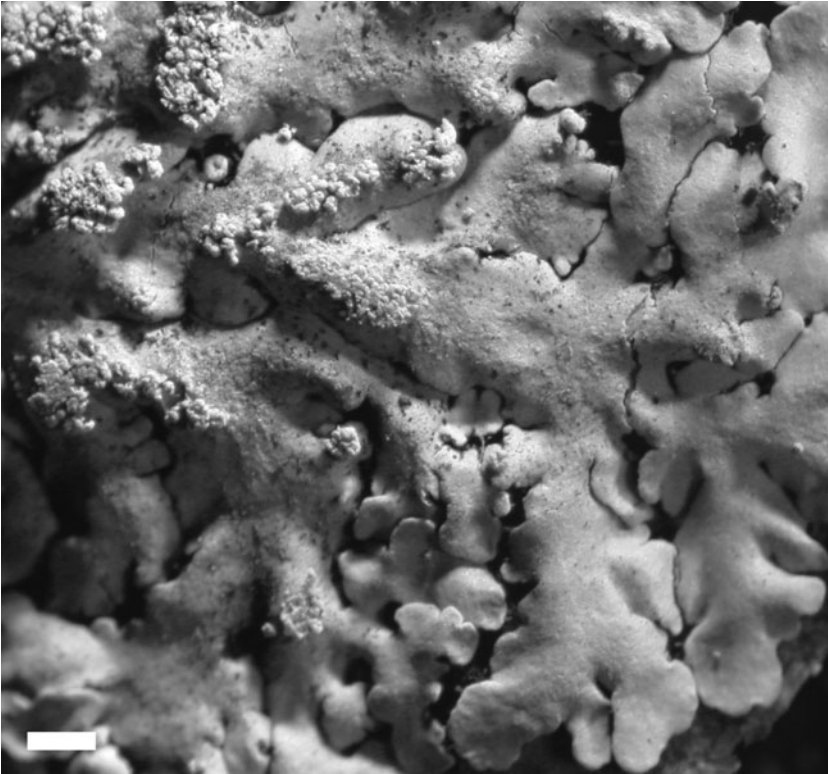


FIG. 1. *Pyxine pustulata*, isotype, habitus. Scale = 0.5 mm.

Awasthi, *H. japonica* var. *reagens* (Kurok.) J. N. Wu & Z. G. Qian, *H. obscurata* (Nyl.) Trevis., *H. pseudospeciosa* (Kurok.) W. Culb., *H. speciosa* (Wulf.) Trevis., *Hyperphyscia cochlearis* Scutari, *H. granulata* (Poelt) Moberg, *H. isidiata* Moberg, *H. syncolla* (Nyl.) Kalb, *Physcia alba* (Fée) Müll. Arg., *P. atrostriata* Moberg, *P. crispa* Nyl., *P. erumpens* Moberg, *P. krogiae* Moberg, *P. pachyphylla* Müll. Arg., *P. poncinsii* Hue, *P. solediosa* (Vain.) Lynge, *P. undulata* Moberg, *Pyxine astridiana* Kalb, *P. berteriana* (Fée) Imshaug, *P. katen-dei* Swinscow & Krog, *P. petricola* Nyl., *P. simulans* Kalb and *P. subcinerea* Stirt. (all collected on 13 September 2012 by M. Cáceres & A. Aptroot; specimens in ABL). As it is, it is one of the richest areas in the world for microfoliose *Physciaceae*, and provides a unique opportunity to study many, some-

times very similar-looking, species in close contact in the field. While doing so, we came across one undescribed *Pyxine* species. It is described below and a world key to all currently accepted *Pyxine* species with lichexanthone is given.

Materials and Methods

Identification and descriptive work was carried out in the Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP-Botucatu) and in Soest using an Olympus SZX7 stereomicroscope and an Olympus BX50 compound microscope with interference contrast, connected to a Nikon Coolpix digital camera. Sections were mounted in tap water, in which all measurements were also taken. The specimens from this study are preserved in SP and ABL. The chemistry of the type specimen was investigated by UV, spot reactions and TLC (solvent A, Orange *et al.* 2001).

The New Species

Pyxine pustulata Aptroot & Jungbluth sp. nov.

Mycobank No.: MB 808448

Pyxine with lichexanthone in the cortex, a yellow to ochraceous medulla with negative reaction to spot tests, and clusters of laminal polysidiangia.

Type: Brazil, São Paulo, Botucatu, Botanical Garden on campus, alt. 850 m, 22°53'09"S, 48°29'56"W, on bark of tree in park, 13 September 2012, *M. Cáceres & A. Aptroot* 13638 (SP—holotype; ABL—isotype).

(Fig. 1)

Thallus appressed foliose, corticate, shiny, pale grey. Lobes irregularly linear, much dissected and not confluent or overlapping, quite regularly *c.* 0.7–1.2 mm wide throughout. Lobe tips mostly rounded, with few, irregular, linear, white maculae, without pruina. Lobes convex, in older parts with laminal, thallus-coloured pustules *c.* 0.1–0.3 mm wide and *c.* 0.2–0.6 mm high. Poly-

sidiangia clustered in generally large groups *c.* 0.3–1.5 mm wide, corticate when young and at the sides, becoming ecorticate above, when old inside with few granular soredia, occasionally exposing the yellow medulla. *Medulla* bright yellow to ochraceous above, white below. Lower surface black, shiny, with regularly dispersed, simple, black rhizines.

Ascomata and *pycnidia* not observed.

Chemistry. Thallus cortex UV+ yellow, K–. Thallus medulla (both layers) UV–, P–, K–. TLC: lichexanthone, terpenoids and pigment.

Ecology and distribution. On smooth bark of trees. Known only from Botucatu, Brazil.

Discussion. This species is close to *P. caesiopruinosa* (Nyl.) Imshaug and *P. physciiformis* (Malme) Imshaug. However, the upper medulla of *Pyxine physciiformis* is K+ faint reddish orange, while *P. caesiopruinosa* has a K+ purple upper medulla.

World key to the species of *Pyxine* with lichexanthone

- | | | |
|-------|--|---|
| 1 | Thallus with isidia, dactyls, pustules or soredia | 2 |
| | Thallus without isidia, dactyls, pustules or soredia, usually with apothecia | 12 |
| 2(1) | Thallus with corticate isidia | 3 |
| | Thallus with at least partly ecorticate dactyls, polysidiangia or soredia | 4 |
| 3(2) | Medulla white; Africa | P. lyei Swinscow & Krog |
| | Medulla yellow; India | P. punensis Nayaka & Upreti |
| 4(2) | Thallus with soredia | 5 |
| | Thallus with dactyls or polysidiangia | 9 |
| 5(4) | Medulla white. | 6 |
| | Medulla yellow, ochraceous or salmon | 7 |
| 6(5) | Soredia mainly marginal, granular, irregular; pantropical. | P. cocoes (Sw.) Nyl. |
| | Soredia laminal, farinose originating as dots on flat lobes; Africa | P. katendei Swinscow & Krog |
| 7(5) | Soredia mainly marginal, medulla K–; pantropical | P. subcinerea Stirt. |
| | Soredia laminal, medulla at least partly K+ purplish or K+ yellow > red. | 8 |
| 8(7) | Medulla partly K–, partly K+ purplish. | P. albovirens (G. Meyer) Aptroot |
| | Medulla partly K+ purplish, partly K+ yellow > red | P. jolyana Jungbluth <i>et al.</i> |
| 9(4) | Medulla K+ purplish; neotropical | P. caesiopruinosa (Nyl.) Imshaug |
| | Medulla K– | 10 |
| 10(9) | Thallus with dactyls that do not become sorediate; Africa | P. lilacina Swinscow & Krog |
| | Thallus with dactyls or pustules that become sorediate | 11 |

- 11(10) Thallus with discrete lobes with numerous minute pustules; Brazil
 **P. pustulata** Aptroot & Jungbluth
 Thallus with overlapping lobes with irregular, large and often sparse dactyls;
 pan-tropical **P. physciiformis** (Malme) Imshaug
- 12(1) Medulla white 13
 Medulla yellow, ochraceous or salmon 15
- 13(12) Apothecium margin grey, thalline; neotropical **P. astridiana** Kalb
 Apothecium margin black, not thalline 14
- 14(13) Thallus lobes at the margin > 1 mm wide; pantropical **P. petricola** Nyl.
 Thallus lobes at the margin < 1 mm wide; pantropical **P. microspora** Vain.
- 15(12) Apothecium margin grey, thalline 16
 Apothecium margin black, not thalline 17
- 16(15) Thallus lobes at the margin > 1 mm wide; pantropical **P. simulans** Kalb
 Thallus lobes at the margin < 1 mm wide; neotropical **P. nana** Kalb
- 17(15) Apothecia without clear stipe. Neotropical **P. pyxinoides** (Müll. Arg.) Kalb
 Apothecia with stipe 18
- 18(17) Apothecium stipe orange, K+ purplish, medulla orange 19
 Apothecium stipe white, ochraceous or salmon; medulla (partly) yellow 20
- 19(18) Medulla K+ purplish; Africa **P. endocrocea** Kalb
 Medulla K-; pantropical **P. cognata** Stirt.
- 20(18) Medulla uniformly yellow; Asia and Australia **P. australiensis** Kalb
 Medulla only yellow in upper layers; pantropical
 **P. berteriana** (Fée) Imshaug

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