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Studies on *Parmulariaceae* II. Re-examination of *Hysterostomella*, *Mintera*, *Rhipidocarpon* and *Viegasella*

DONG-QIN DAI[1,8], NALIN N. WIJAYAWARDENE[1,9], LI-ZHOU TANG[1,2,10,*], YE TIAN[3,11,*], ITTHAYAKORN PROMPUTTHA[4,5,12], D. JAYARAMA BHAT[6,13] & KEVIN D. HYDE[7,14]

[1] *Center for Yunnan Plateau Biological Resources Protection and Utilization, College of Biological Resource and Food Engineering, Qujing Normal University, Qujing, Yunnan 655011, People's Republic of China.*
[2] *State Key Laboratory of Genetic Resources and Evolution, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, Yunnan 650223, People's Republic of China.*
[3] *Innovation Startup College, Qujing Normal University, Qujing, Yunnan 655011, People's Republic of China.*
[4] *Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand.*
[5] *Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand.*
[6] *No. 128/1-J, Azad Cooperative Housing Society, Curca, P.O. Goa Velha 403108, India.*
[7] *Centre of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai 57100, Thailand.*
[8] *cicidaidongqin@gmail.com; https://orcid.org/0000-0001-8935-8807*
[9] *nalinwijayawardene@yahoo.com; https://orcid.org/0000-0003-0522-5498*
[10] *biologytang@163.com; https://orcid.org/0000-0002-6988-1876*
[11] *aleaktianye@126.com; https://orcid.org/0000-0003-3337-9806*
[12] *ppam118@gmail.com; https://orcid.org/0000-0003-3376-4376*
[13] *bhatdj@gmail.com; https://orcid.org/0000-0002-3800-5910*
[14] *kdhyde3@gmail.com; https://orcid.org/0000-0002-2191-0762*
**Corresponding authors: biologytang@163.com, aleaktianye@126.com*

Abstract

This is the second in a series of papers in which we examine the type species of genera in *Parmulariaceae*. Specimens of type species of *Hysterostomella*, *Mintera*, *Rhipidocarpon* and *Viegasella* are re-examined and their descriptions and illustrations are provided. *Hysterostomella* is characterized by large, black, circular or elliptical ascostromata, later becoming irregular, rather flat and opening by irregular fissures. Asci are subglobose, obovoid and bitunicate and ascospores are dark brown, ellipsoidal with a single septum. *Mintera* is similar to *Viegasella* in having radiating, loculate ascostromata forming on leaf surfaces. However, *Mintera* is distinguished by its appressoriate mycelium. *Rhipidocarpon* has carbonaceous, flattened ascostromata with ridges, irregularly radiating from centre to the outer rim, becoming a fan-shape, ridges containing elongated locules, which open by a longitudinal slit and contain numerous asci. Based on their morphological characters, the placement of the genera in *Parmulariaceae* is confirmed.

Keywords: Dothideomycetes, Parmulariales, pathogens, taxonomy, types

Introduction

The family *Parmulariaceae* E. Müll. & Arx ex M.E. Barr was introduced by Barr (1979) and comprises 34 genera (Hongsanan *et al*. 2020, Wijayawardene *et al*. 2020). Dai *et al*. (2018) introduced *Parmulariales* D.Q. Dai & K.D. Hyde, in *Dothideomycetes*, to accommodate *Parmulariaceae*. Members of *Parmulariaceae* are reported with biotrophic and pathogenic lifestyles and thus, the genera of this family are unculturable (Guatimosim *et al*. 2015). Direct extraction of DNA from fresh specimens is the best way to obtain some common loci, such as ITS and LSU sequences data (Guatimosim *et al*. 2015, Dai *et al*. 2019). Since most of the genera lack sequences in GenBank, the classification is still confused and problematic. For example, *Hemigrapha* and *Inocyclus* were transferred to *Asterinales* by Guatimosim *et al*. (2015) and Dai *et al*. (2018) based on morpho-molecular analyses. *Parmulariaceae* has various structures in ascomata types, asci and ascospores forms (Inácio & Cannon 2008, Dai *et al*. 2018). However, most of the genera in *Parmulariaceae* lack comprehensive studies. Our research provides the morphologic evidence for type species of

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each genera so that the revision of this family based on new collections followed by morpho-molecular analyses and epitypification can become possible in the future.

We are in the process of studying genera of *Parmulariaceae* in order to provide a natural classification of this large and important family (Hyde *et al*. 2013, Dai *et al*. 2018, Hongsanan *et al*. 2020). These studies involve examination of specimens of type species of the genera, provision of modern descriptions and illustrations or photomicrographs and, resulting with appropriate placement at the family and ordinal levels (Dai *et al*. 2014). In this study, we re-examined the type species of *Hysterostomella* Speg., *Mintera* Inácio & P.F. Cannon, *Rhipidocarpon* (Theiss.) Theiss. & Syd. and *Viegasella* Inácio & P.F. Cannon and confirm their family placement of *Parmulariaceae*.

Material and methods

Loaning and examination of specimens

Specimens of type species were obtained from herbaria *viz.* Royal Botanic Gardens (K), Universidad Nacional de La Plata (LPS) and Swedish Museum of Natural History (S) (abbreviations are according to Index Herbariorum 2020). The study methods followed are those reported in Dai *et al*. (2017). Fruiting bodies were rehydrated in water and/or 5% KOH prior to examination and sectioning. Hand sections of the ascomata were mounted in water or lactic acid for microscopic studies and photomicrography. The materials were examined by Zeiss Stereo Discovery V8 with AxioCam ERc 5 s and Nikon ECLIPSE 80*i* compound microscope and photographed by Canon 600D digital camera fitted to the microscope. Measurements were made with the Tarosoft (R) Image Frame Work program and images used for figures were processed with Adobe Photoshop CS5, Extended version 10.0 software (Adobe Systems Inc., USA). Index Fungorum (2020) numbers and Facesoffungi numbers (Jayasiri *et al*. 2015) are provided for genera and species.

Results

Taxonomy

Parmulariales D.Q. Dai & K.D. Hyde, Phytotaxa 369(2): 73(2018)
Type family: ***Parmulariaceae*** E. Müll. & Arx ex M.E. Barr, Mycologia 71(5): 944 (1979)

The order *Parmulariales* was introduced by Dai *et al*. (2018) with a single family *Parmulariaceae*. *Parmulariales* is phylogenetically and morphologically distinct from *Asterinales* (Dai *et al*. 2018, Hongsanan *et al*. 2017, 2020), however close to *Alysidiellaceae* (Hongsanan *et al*. 2020). Only the type species of *Parmularia*, *P. styracis* Lév. was sequenced by Guatimosim *et al.* (2015). *Parmulariaceae* has a typical biotrophic lifestyle. Genera of this family are usually pathogens growing on living plants, especial leaves, in tropical areas (Inácio & Cannon 2008).

Hysterostomella Speg., Anal. Soc. cient. argent. 19(6): 260 (1885)
Index Fungorum number: IF 2476; *Facesoffungi number*: FoF 02313

Parasitic on living leaves. **Sexual morph**: *Internal stromata* presence. *Ascostromata* solitary, scattered or gregarious, superficial, circular or elliptical, becoming irregular, flat, black, opening by irregular fissures, with multi locules. *Upper wall of ascostromata* comprising several black layers. *Hamathecium* composed of hyaline, septate, filamentous pseudoparaphyses. *Asci* 8-spored, bitunicate, subglobose, obovoid, clavate, apedicellate, thick-walled, smooth, with a large apical chamber. *Ascospores* irregularly arranged, ellipsoidal, 1-septate, with larger upper cell and shorter lower cell, brown to dark brown when mature. **Asexual morph**: Undetermined.

Notes:—*Hysterostomella* was introduced by Spegazzini (1885) and typified by *H. guaranitica* Speg. with has 24 morphological species (Hongsanan *et al*. 2020, Index Fungorum 2020). This genus is usually parasitic on palm leaves and widely distributed in tropical areas. *Hysterostomella* is characterized by large, black, circular or elliptical ascostromata becoming irregular and rather flat, opening by irregular slits, subglobose, obovoid asci and dark brown, ellipsoidal ascospores with a single septum (Inácio & Cannon 2008).

Theissen & Sydow (1915) erected a new genus *Hysterostomina* Theiss. & Syd. which resembles *Hysterostomella* and was placed in *Polystomellaceae* Theiss. & P. Syd. Doidge (1948) regarded that *Hysterostomina* is not morphologically distinct from *Hysterostomella*, and thus, the former was synonymized under *Hysterostomella*.

Type species: ***Hysterostomella guaranitica*** Speg., Anal. Soc. cient. argent. 19(6): 260 [no. 305] (1885)

Hysterostomella guaranitica Speg., Anal. Soc. cient. argent. 19(6): 260 [no. 305] (1885)

Index Fungorum number: IF 197988; *Facesoffungi number*: FoF 02314, Fig. 1, 2

Holotype:—LPS 1329

Isotype:—S F20987

Parasitic on upper surface of living leaves. **Sexual morph**: *Internal stromata* immersed under the leaf surface, dark brown. *Ascostromata* 1–2 mm diam., 100–200 µm high, solitary, scattered or gregarious, superficial, circular or elliptical, becoming irregular shape, flat, black, with opening by irregular fissures, internal part of ascostromata thick and contenting multi locules, with a thin dark brown tissue under the loculate layer, reaching leaf surface, composed of dark brown cells of *textura angularis*. *Upper wall of ascostromata* comprising 8–10.5 µm thick, dark brown to black layer of cells of *textura prismatica*. *Wall between locules* 10–25 µm thick, composed of light brown to hyaline cells of *textura angularis*. *Locules in vertical section* 200–300 × 80–150 µm, immersed under the upper wall of ascomata. *Hamathecium* composed of hyaline, septate, 2–4 µm wide, filament pseudoparaphyses above the asci. *Asci* 40–60 × 20–40 µm ($\bar{x}$ = 49.5 × 30.5 µm, n = 20), 8-spored, bitunicate, subglobose, obovoid, clavate, with rounded apex, apedicellate, thick-walled, smooth, with a large apical chamber. *Ascospores* 25–31 × 15–16.5 ($\bar{x}$ = 30.5 × 16 µm, n = 20), irregularly arranged, ellipsoidal, 1-septate, constricted at septum, thin-walled, with larger upper cell and shorter lower cell, hyaline, becoming brown to dark brown, smooth. **Asexual morph**: Undetermined.

Material examined:—PARAGUAY, Mbatobí, on leaves of *Euphorbiaceae*, July 1883, B. Balansa 3849 (LPS 1329, **holotype**); *Ibid*. (S F20987, **isotype**); *Ibid*. (K 180638, **isotype**).

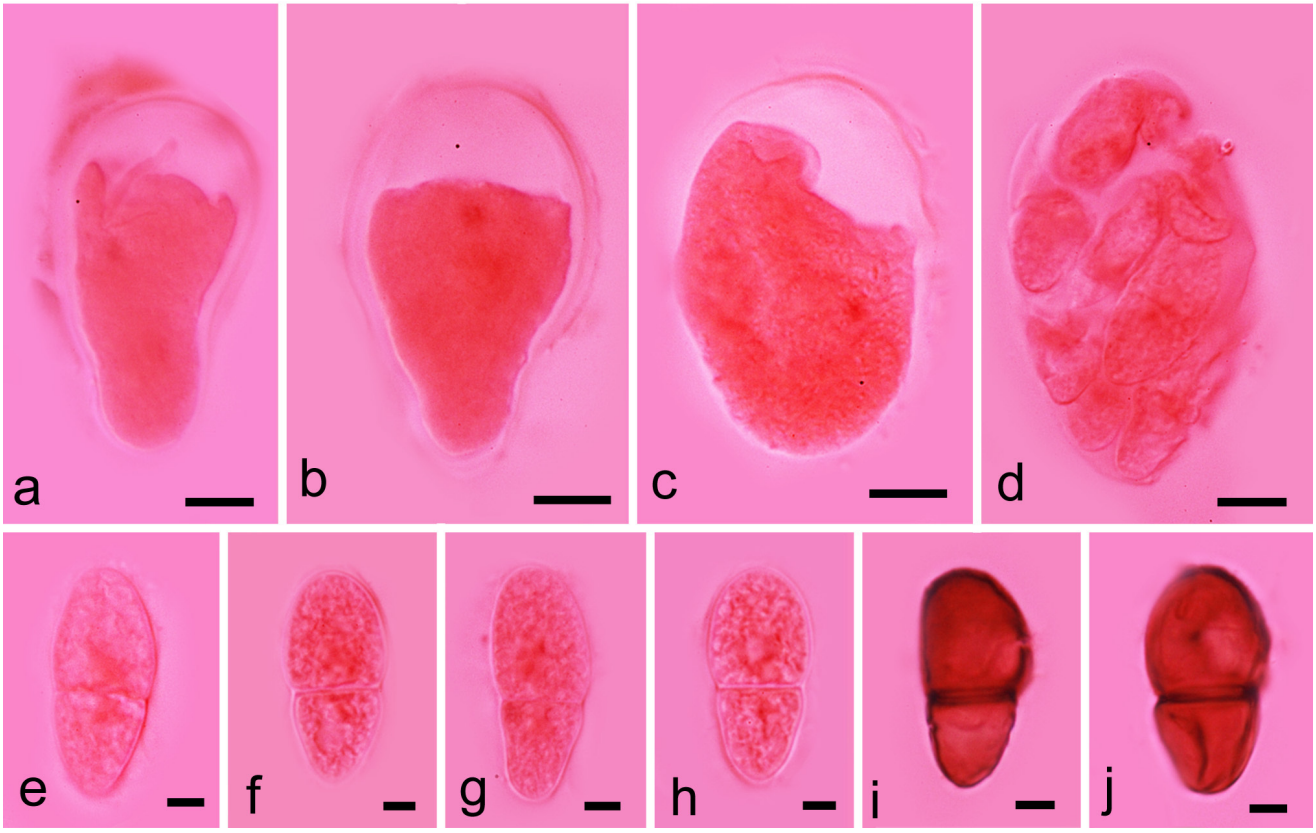

FIGURE 1. Asci and ascospores of ***Hysterostomella guaranitica*** strained in Congo Red (LPS 1329, **holotype**). a–c. Immature asci. d. Asci with ascospores. e–j. Ascospores. Scale bars: a–d = 10µm, e–j = 5 µm.

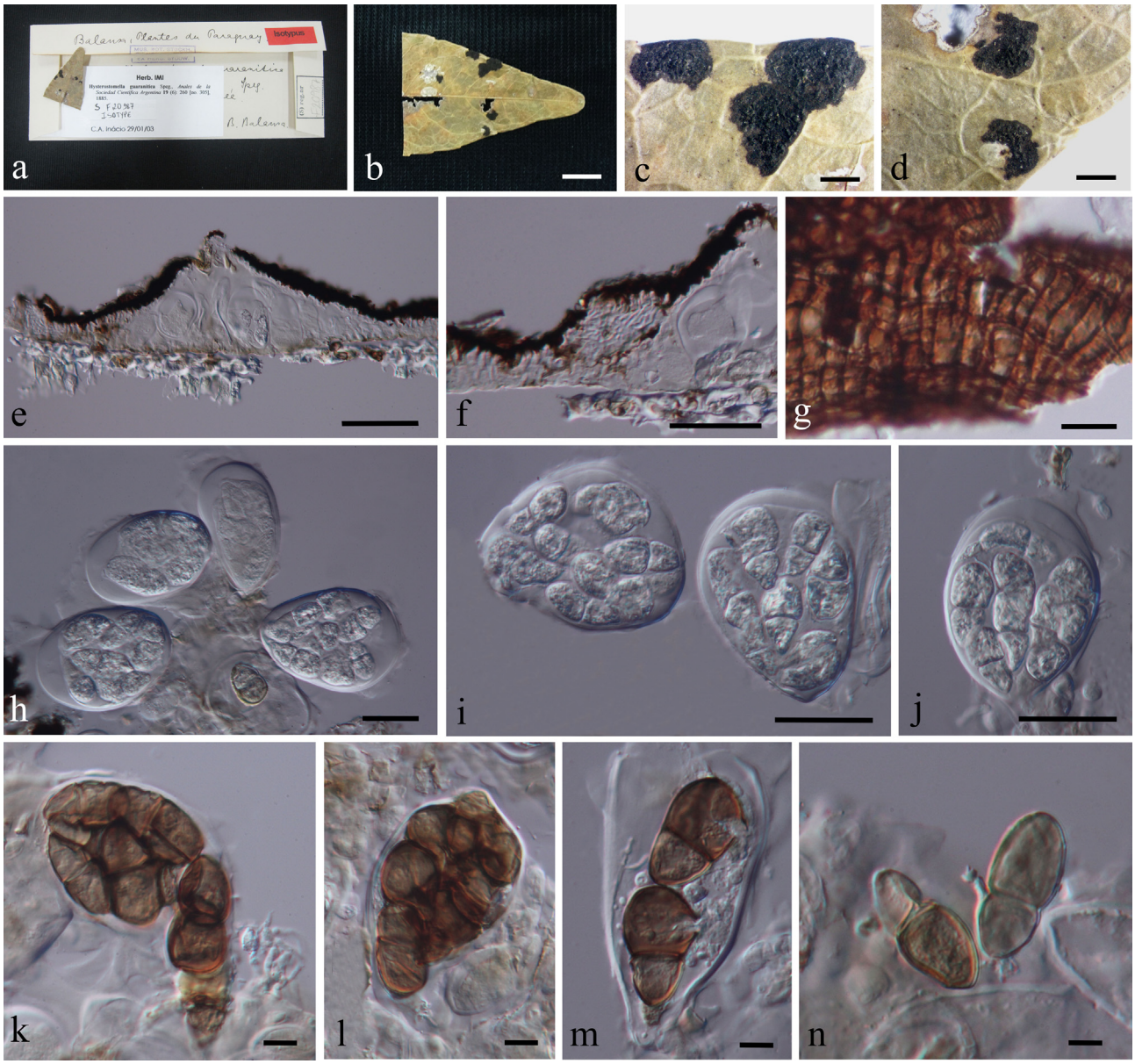

FIGURE 2. ***Hysterostomella guaranitica*** (S F20987, **isotype**). a. Herbarium material and envelop. b. Herbarium material. c, d. Black ascostromata on the leaf host. e, f. Vertical sections of ascostromata with dark brown internal stroma. g. Ascostroma wall. h–j. Immature ascospores inside asci. k–m. Asci containing matured ascospores. n. Ascospores. Scale bars: b = 1 cm, c, d = 2 mm, e, f, h–j = 50 µm, g = 5 µm, k–n = 10 µm.

Mintera Inácio & P.F. Cannon, Mycol. Res. 107(1): 86 (2003)

Index Fungorum number: IF28710; *Faceoffungi number*: FoF02317

Parasitic on living leaves. *Mycelium* composed of septate, branched hyphae. *Hyphae* dark brown, septate, branched, with appressoria. **Sexual morph**: *Internal stromata* presence. *Ascostromata* gregarious, in groups, superficial, black, coriaceous, several locules radiating grouped into a chrysanthemum-like shape, flattened, easily removable. *Locules* immersed in ascostromata, opening by a longitudinal slit. *Upper wall of ascostromata* comprises several dark layers. *Hamathecium* composed of filamentous pseudoparaphyses. *Asci* 8-spored, bitunicate, cylindric-clavate to subglobose, with an ocular chamber. *Ascospores* irregularly arranged, occasionally overlapping, hyaline, becoming brown to dark brown, ellipsoid, 1-septate, smooth-walled. **Asexual morph:** Undetermined.

Notes:—Inácio & Cannon (2008) re-examined the holotype of *Parmularia reticulata* Starbäck (Starbäck 1905) and regarded that this species is not congeneric with *Parmularia sensu stricto*. Hence, Inácio & Cannon (2008) introduced *Mintera* to accommodate *Parmularia reticulata* and introduced a new combination, *Mintera reticulata* (Starbäck) Inácio & P.F. Cannon. *Mintera* resembles *Viegasella* and *Parmularia* in having radiating, loculate ascomata forming on

the leaf surfaces. However, *Mintera* is distinguished from other genera by appressoriate mycelium (Inácio & Cannon 2008).

Type species: ***Mintera reticulata*** (Starbäck) Inácio & P.F. Cannon, Mycol. Res. 107(1): 86 (2003)

Mintera reticulata (Starbäck) Inácio & P.F. Cannon, Mycol. Res. 107(1): 86 (2003)

Index Fungorum number: IF 373774; *Faceoffungi number*: FoF 02318, Fig. 3

Basionym: *Parmularia reticulata* Starbäck 1905

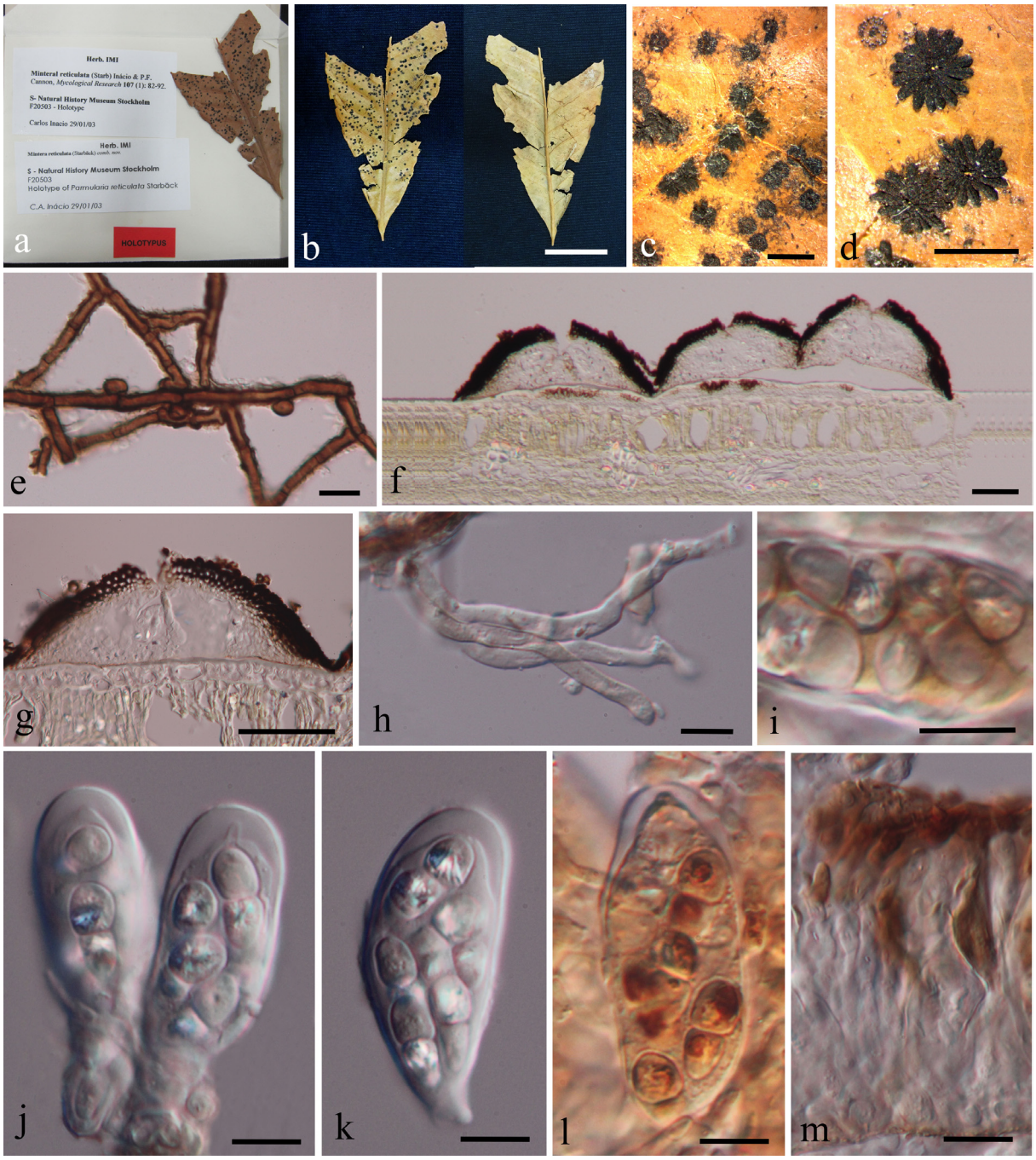

FIGURE 3. ***Mintera reticulata*** (S F20503, **holotype**). a. Herbarium material and envelop. b. Herbarium materials. c, d. Black ascostromata on the host. e. Mycelium with appressoria. f, g. Vertical sections of ascostromata and locules. h, m. Pseudoparaphyses. i. Ascospores. j, k. Immature ascospores in asci. l. Mature ascospores in asci. Scale bars: b = 2 cm, c, d = 500 µm, e, h, i–m = 10 µm, f, g = 50 µm.

Parasitic on upper surface of living leaves. *Mycelium* septate, branched, radiating, surrounding the ascomata. *Hyphae* 2.5–4.5 µm wide, dark brown, septate, branched, straight to sinuous, with 6–7 × 4.5–5 µm, subglobose, dark brown, thick-walled appressoria. **Sexual morph**: *Internal stromata* superficial to immersed, pale brown to hyaline. *Ascostromata* 1–1.7 mm diam., superficial, circular, black, coriaceous, containing 10–17 radiating locules grouping

into a chrysanthemum-like shape, flattened, each locule opening by a longitudinal slit, easily removable. *Locules* 150–220 µm wide, 200–600 µm long, 45–70 µm high, gregarious, in groups, immersed in ascostromata, oblong, semicircle from a vertical section. *Upper wall of ascostromata* 7–16 µm thick, comprises of several black layers, composed of dark brown to black cells of *textura angularis* to *prismatica*. *Wall between locules* 5–15 µm wide, composed of light brown to hyaline cells of *textura angularis*. *Hamathecium* composed of a few brown, unbranched, 2.5–4.5 µm wide, filamentous, septate, pseudoparaphyses with dark brown pigment at the tips. *Asci* 40–55 × 17–24 µm ($\overline{x}$ = 48.5 × 21 µm, n = 20), 8-spored, bitunicate, clavate to cylindric-clavate, subglobose, with an ocular chamber and a short pedicel. *Ascospores* 14–18 × 5–8.5 µm ($\overline{x}$ = 15.5 × 7 µm, n = 20), irregularly arranged, occasionally overlapping, hyaline to becoming brown and dark brown, ellipsoid, 1-septate, with large upper cell, narrow at lower cell, smooth-walled becoming verrucose, pigmented. **Asexual morph**: Undetermined.

Material examined:—PARAGUAY, Colonia Risso. Pr. Rio Apa, on upper of leaves, 30 September 1893, Gust. A: n Malme, (S F20503, **holotype**).

Rhipidocarpon (Theiss.) Theiss. & Syd., Annls mycol. 13(3/4): 197 (1915)
Index Fungorum number: IF 4703; *Facesoffungi number*: FoF 02337

Parasitic on living leaves. **Sexual morph**: *Internal stromata* presence. *Ascostromata* solitary to gregarious, superficial, circular, elliptical to irregular, black, carbonaceous, flattened, with ridges irregularly radiating from the centre to the outer rim; ridges containing elongated locules, which open by a longitudinal slit and contain numerous asci. *Locules* immersed in ascomata. *Upper wall of ascostromata* comprises several black layers. *Hamathecium* of hyaline, septate, filamentous, pseudoparaphyses. *Asci* 8-spored, thick-walled, bitunicate, broadly cylindrical to clavate, subglobose, with an ocular chamber. *Ascospores* 2–3-seriate, or irregularly arranged in asci, ellipsoidal, dark brown. **Asexual morph**: Undetermined.

Notes:—The monotypic genus *Rhipidocarpon* was introduced by Theissen & Sydow (1915) with *R. javanicum* (Pat.) Theiss. & Syd. as the type species. In morphology, this genus is similar to *Parmularia* in having the black ascostromata with ridges radiating from the centre to the outer rim. This character is typical feature of members in family *Parmulariaceae*. However, in morphology, *Rhipidocarpon* differes from *Parmularia* in circular, elliptical to irregular ascostromata with ridges irregularly radiating from centre, whereas, these in *Parmularia* are shield-like, rounded and regularly radiating from centre. Moreover, *Rhipidocarpon* has subglobose to clavate asci and verrucose ascospores, nevertheless, these in *Parmularia* are broadly cylindrical and smooth-walled.

Type species: *Rhipidocarpon javanicum* (Pat.) Theiss. & Syd., Annls mycol. 13(3/4): 197 (1915)

Rhipidocarpon javanicum (Pat.) Theiss. & Syd., Annls mycol. 13(3/4): 197 (1915)
Index Fungorum number: IF 195038; *Facesoffungi number*: FoF 02338, Fig. 4

Parasitic on upper surface of living leaves. **Sexual morph**: *Internal stromata* presence, immersed under the leaf surface. *Ascostromata* 0.5–3.5 mm long, 0.4–3 mm wide, solitary to gregarious, superficial, circular, elliptical to irregular, black, carbonaceous, flattened, with ridges irregularly radiating from the centre to the outer rim, becoming a fan-shape; ridges containing elongated locules, which open by a longitudinal slit and contain numerous asci, easily removable. *Locules* in vertical section: 85–150 µm diam., 80–120 µm high, subglobose, immersed in ascomata. *Upper wall of ascostromata* 10–15 µm thick, comprises of several black layers, composed of dark brown cells of *textura prismatica*. *Cells between locules* composed of brown to hyaline cells of *texture angularis*. *Hamathecium* of hyaline, septate, filamentous, 1.5–2.5 µm pseudoparaphyses. *Asci* 35–50 × 15–30 µm ($\overline{x}$ = 41.5 × 23.5 µm, n = 20), 8-spored, thick-walled, bitunicate, broadly cylindrical to clavate, subglobose, with an ocular chamber. *Ascospores* 20–22.5 × 9–12 µm ($\overline{x}$ = 22 × 10.5 µm, n = 20), 2–3-seriate, or irregularly arranged in asci, ellipsoidal, 1-septate, constricted at septum, sometimes with larger upper cell, hyaline and becoming dark brown when mature, verrucose. **Asexual morph**: Undetermined.

Material examined:—PHILIPPINES, Taytay, Palawan, on leaves of *Nypa fruticans* Wurmb, 28 May 1913, E. D. Merrill. (S, F21036).

Notes:—The holotype of *Rhipidocarpon javanicum*, collected on *Nypa fruticans* in 1894 from Indonesia, and deposited in FH However, was said to be lost (Inácio & Cannon 2008). No other type is designated for this species until now. We re-examined a specimen of the species from S which however was in good condition.

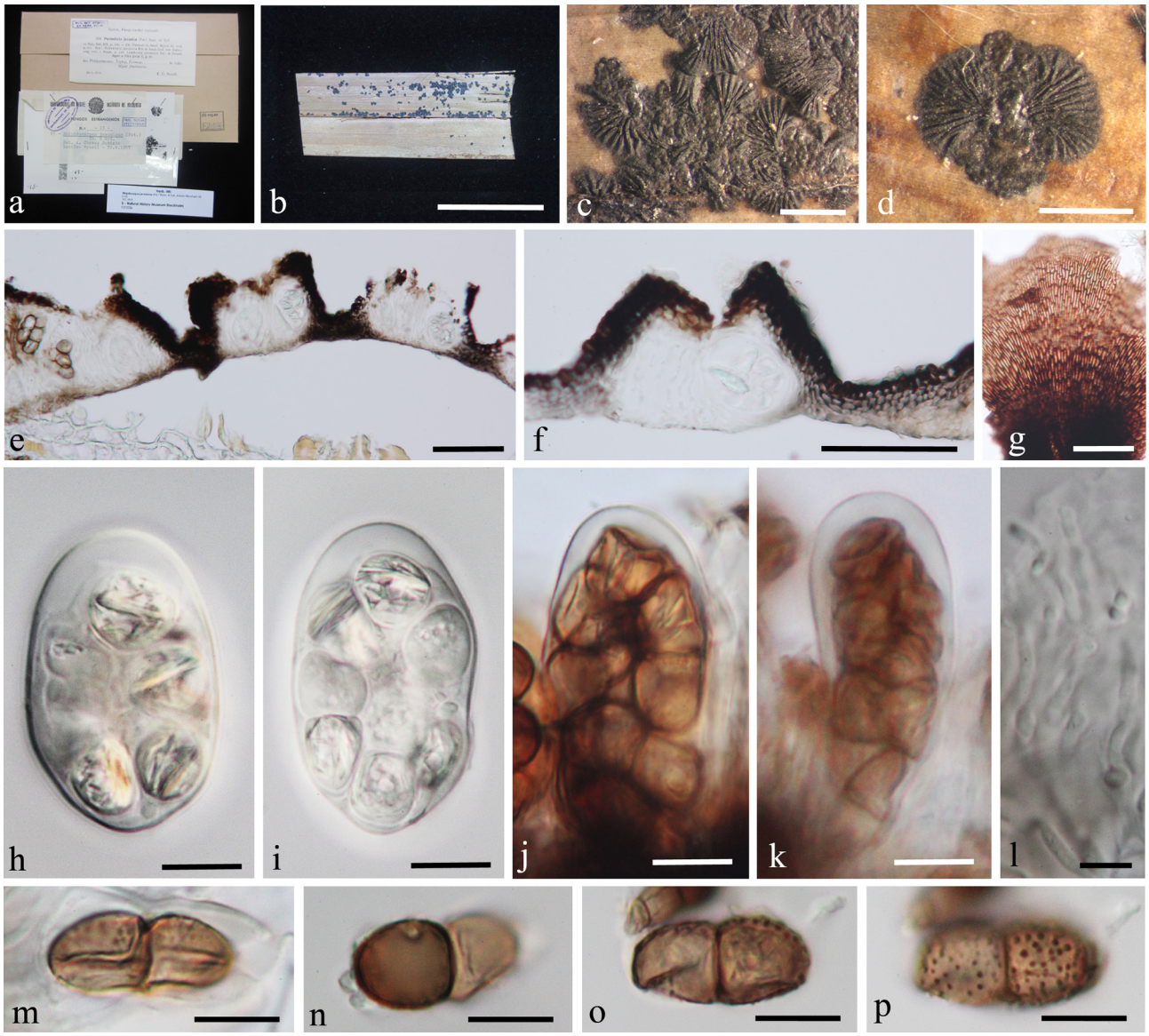

FIGURE 4. ***Rhipidocarpon javanicum*** (S, F21036). a. Envelop of herbarium materials. b. Herbarium material. c, d. Black ascostromata on the host. e, f. Vertical sections of ascostroma containing locules. g. Upper wall of ascostroma. h, i. Asci with immature ascospores. j, k. Asci with matured ascospores. l. Pseudoparaphyses. m–p. Ascospores. Scale bars: b = 50 mm, c, d =1 mm, e–g = 50 µm, h–k, m–p = 10 µm, l = 5 µm.

Viegasella Inácio & P.F. Cannon, Mycol. Res. 107(1): 82 (2003)

Index Fungorum number: IF 28709; *Facesoffungi number*: FoF 02343

Parasitic on living leaves. **Sexual morph**: *Internal stromata* and *haustoria* presence. *Ascostromata* gregarious to solitary, black, coriaceous, shiny, with multi-locules gregarious as star-shape. *Locules* gregarious, immersed in ascostromata, oblong, opening by longitudinal splits. *Upper wall of ascostromata* composed of several black layers. *Hamathecium* composed of brown, unbranched, filamentous, septate pseudoparaphyses. *Asci* 8-spored, bitunicate, clavate to cylindrical, with a short, furcate pedicel, apically rounded, with an ocular chamber. *Ascospores* irregularly arranged, occasionally overlapping, brown to dark brown, ellipsoid, 1-septate, with large upper cell, narrow at lower cell, smooth-walled to verrucose. **Asexual morph**: Undetermined.

Notes:—The monotypic genus *Viegasella* was introduced by Inácio & Cannon (2003) with *V. pulchella* (Speg.) Inácio & P.F. Cannon as the type species. *Viegasella pulchella* is characterized by black, star-shaped, ascostromata opening by longitudinal splits. In morphology, *Viegasella* resembles *Parmularia* but differs in having star-shaped ascostromata. *Parmularia* has shield-like and circular ones. *Viegasella* is similar to *Mintera* in having black, gregarious, star-shaped ascostromata. However, *Mintera* has dark brown hyphae with appressoria, forming under the ascostromata,

and such character is not observed in *Viegasella*. We tentatively treat them as two distinct genera. Nevertheless, DNA sequence data are needed to clarify their natural classification.

Type species: ***Viegasella pulchella*** (Speg.) Inácio & P.F. Cannon, Mycol. Res. 107(1): 83 (2003)

Viegasella pulchella (Speg.) Inácio & P.F. Cannon, Mycol. Res. 107(1): 83 (2003)

Index Fungorum number: IF 373406; *Facesoffungi number*: FoF 02344, Fig. 5

Basionym: *Schneepia pulchella* Speg. 1888

FIGURE 5. ***Viegasella pulchella*** (S F21320) a. Envelop of herbarium specimen. b. Herbarium materials. c. Black ascostromata grow on upper surfaces of leaves. d. Star-shape ascostromata. e, f. Section of ascostroma and locules with haustoria. g. Wall of ascostroma and locule. h, i. Immature asci contain immature hyaline ascospores. j, k. Mature asci contain mature ascospores. l. Pseudoparaphyses with septum. m–q. Dark brown ascospores. Scale bars: b = 30 mm, c=1 mm, d = 500 µm, e–g = 50 µm, h–l = 10 µm, m–q = 5 µm.

Parasitic on upper surface of living leaves. **Sexual morph**: *Internal stromata* immersed under the leaf surface, visible as a thin layer comprising of hyaline cells, with dark brown cells connecting with ascostromata. *Haustoria* immersed, dark brown, connecting ascostroma and host leaf. *Ascostromata* 0.7–1.5 mm in diam., gregarious to solitary, black, coriaceous, shiny, with 6–10 locules gregarious as star-shape. *Locules* 300–600 µm long, 100–200 µm wide, 65–100

μm high, gregarious, immersed in ascostromata, oblong, opening by a longitudinal split. *Upper wall of ascostromata* 6–18 μm thick, comprises of several black layers, composed of dark brown to black cells of *textura angularis* to *prismatica*. *Cells between locules* 6–15 μm thick, composed of brown to hyaline cells of *texture angularis*. *Hamathecium* composed of a few brown, unbranched, 1.5–3 μm wide, filamentous, septate, pseudoparaphyses with slightly swollen and verrucose tips. *Asci* 50–80 × 12–20 μm ($\overline{x}$ = 60.5 × 17.5 μm, n = 20), 8-spored, bitunicate, clavate to cylindrical, with a short and furcate pedicel, apically rounded, with an ocular chamber. *Ascospores* 15.5–20 × 6.5–8 μm ($\overline{x}$ = 18 × 7 μm, n = 20), irregularly arranged, occasionally overlapping, hyaline to brown and dark brown, ellipsoid, 1-septate, constricted at septum, with large upper cell, narrow at lower cell, smooth-walled, becoming verrucose and pigmented. **Asexual morph**: Undetermined.

Material examined:—BRAZIL, Rio Grande do Sul, São Leopoldo, on leaves of *Chrysophyllum gonocarpum* (Mart. & Eichler ex Miq.) Engl., April 1906, Rick 68 (S F21320).

Notes:—Holotype of *Viegasella pulchella* was collected in 1883 from Guarapi, Paraguay, and deposited in herbarium LPS under no. 4084. However, Inácio & Cannon (2008) mentioned that they did not trace it. We tried to obtain the isotype of *Schneepia pulchella* Speg. from K, however, we couldn't get it. A specimen in good condition was however loaned from S and re-examined in this study.

Discussion

The order *Parmulariales* was included within *Dothideomycetes*, according to molecular and morphologic analysis (Dai *et al*. 2018, Hongsanan *et al*. 2020), and presently contains a single family *Parmulariaceae*. *Parmulariaceae* includes numerous genera (Hyde *et al*. 2013, Hongsanan *et al*. 2020) and has various types in morphology, especially in ascostromata (Inácio & Cannon 2008, Dai *et al*. 2018). This family was introduced to accommodated taxa growing on living leaves, with biotrophic and pathogenic life-styles. In *Parmulariaceae*, the ascostromata have obvious characters, which are black, shield-like, rounded to irregular, containing multi locules, which open by longitudinal to irregular slits or open by irregular, complete or incomplete rings or Y-shaped to rugose fissures (Inácio & Cannon 2008, Hyde *et al*. 2013, Dai *et al*. 2018).

The four examined genera *Hysterostomella*, *Mintera*, *Rhipidocarpon* and *Viegasella* mentioned in this article have typical characters of *Parmulariaceae*. They were found to be pathogenic on living leaves in tropical regions, *viz.* Brazil, Paraguay and the Philippines. Their ascostromata accord with family circumscription of *Parmulariaceae*. In *Hysterostomella*, ascostromata are black, flat, containing multi locules, with opening by irregular fissures. *Mintera* and *Viegasella* have black, coriaceous ascostromata with 6–17 locules gregarious as star-shape or chrysanthemum-like shape. Locules are oblong and open by longitudinal slits. *Rhipidocarpon* has black, flat ascostromata with ridges irregularly radiating from the centre, becoming a fan-shape. Each ridge contains elongated locules, which open by a longitudinal slit.

In morphology, *Hysterostomella*, *Mintera*, *Rhipidocarpon* and *Viegasella* more or less resemble *Parmularia*, hence, they are proposed to place in this family. However, it is essential to get fresh collections followed by extracting DNA and carrying out phylogenetic analyses, epitypification. Furthermore, it will be helpful to confirm the phylogenetic placements of these genera in Parmulariaceae.

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