



## Hymenochaetaceae from Paraguay: revision of the family and new records

Maubet Y<sup>1</sup>, Campi M<sup>1\*</sup> and Robledo G<sup>2,3,4</sup>

<sup>1</sup>Universidad Nacional de Asunción. Laboratorio de Análisis de Recursos Vegetales Área Micología-Facultad de Ciencias Exactas y Naturales

<sup>2</sup>BioTecA3 – Centro de Biotecnología Aplicada al Agro y Alimentos, Facultad de Ciencias Agropecuarias – Univ. Nac. de Córdoba, Ing. Agr. Félix Aldo Marrone 746 – Planta Baja CC509 – CP 5000, Ciudad Universitaria, Córdoba, Argentina

<sup>3</sup>CONICET, Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina

<sup>4</sup>Fundación Fungicosmos, www.fungicosmos.org, Córdoba, Argentina

Maubet Y, Campi M, Robledo G 2020 – Hymenochaetaceae from Paraguay: revision of the family and new records. Current Research in Environmental & Applied Mycology (Journal of Fungal Biology) 10(1), 242–261, Doi 10.5943/cream/10/1/24

### Abstract

A synopsis of species of Hymenochaetaceae from five departments of Paraguay (Alto Paraguay, Boquerón, Central, Cordillera and Paraguarí) is presented. Thirteen species from nine genera are reported, of which eleven are recorded for the first time. Descriptions and macro- and microscopic illustrations are presented for each species. Discussions on their taxonomy and ecology are provided.

**Key words** – fungal diversity – Hymenochaetales – neotropical polypores – taxonomy

### Introduction

Hymenochaetaceae was proposed by Donk (1948) and is characterized by the permanent xanthochroic reaction (a dark coloration in alkali), the lack of clamp connections and the presence of setae in some species (Donk 1948, Hibbett et al. 2014, Ryvarden 2004). Most of the species of this family were traditionally placed among two main genera: *Phellinus* s.l. (dimitic polypores) and *Inonotus* s.l. (monomitic polypores) (Fiasson & Niemelä 1984, Corner 1991, Wagner & Fischer 2001). Fiasson & Niemela (1984), based on morphological, cultural, chemical, and nuclear behavioral characteristics of European taxa segregated *Fomitiporia*, *Fulvifomes*, *Fuscoporia*, *Ochroporus*, *Phellinidium*, *Phellinus* s.s. and *Porodaedalea* from *Phellinus* s.l.; whilst *Inonotus* s.s., *Inocutis* and *Inonotopsis* were segregated from *Inonotus* s.l. The proposal was not widely followed and the wide concepts of *Phellinus* and *Inonotus* continued in use (Gilbertson & Ryvarden 1986–1987, Parmasto 1988, Larsen & Cobb-Pouille 1990, Ryvarden & Gilbertson 1993, 1994) until, based on molecular and morphological studies, confirmed the segregated taxa (Wagner & Fisher 2001, 2002). The hyphal system structure and basidiomata configuration are not enough for the separation at generic level within the Hymenochaetaceae. These studies, however, included only species mostly from temperate regions of the northern hemisphere, leaving the tropical and in particular neotropical areas unrepresented (Drechsler-Santos et al. 2016). Globally, the poroid Hymenochaetaceae have been less studied than other polypores (Baltazar & Gibertoni 2009, Baltazar et al. 2009, Gerlach et al. 2013). Recently phylogenetic studies on Neotropical taxa showed new species and genera (Valenzuela et al. 2011, Ferreira-Lopes et al. 2016, Drechsler-

Santos et al. 2016, Salvador-Montoya et al. 2020), suggesting that numerous taxa remain still undescribed for the neotropics and need further studies regarding their diversity and phylogenetic relationships with the taxa from temperate regions.

The study of fungal diversity in Paraguay has been neglected, in particular for polyporoid fungi. The contributions of Spegazzini (1883, 1884, 1888, 1889, 1891, 1919, 1922) were for several years the only records of the Paraguayan fungi. Later, Popoff & Wright (1998), did the first extensive revision of the wood-inhabiting fungi from Paraguay, considering mainly collections of mycologists C. Spegazzini and L. Romell. In their checklist, 8 species of Hymenochaetaceae were recorded: *Hymenochaete iodina* (Mont.) Baltazar & Gibertoni [as *Cyclomyces iodinus*], *Phellinus calcitratus* (Berk. & M.A. Curtis) Ryvardeen, *Phellinus conchatus* (Pers.) Quél., *Phellinus contiguus* (Pers.) Pat., *Phellinus fastuosus* (Lév.) S. Ahmad, *Fuscoporia gilva* (Schwein.) T. Wagner & M. Fisch. [as *Phellinus gilvus*], *Phellinus wahlbergii* (Fr.) D.A. Reid and *Phylloporia capucina* (Mont.) Ryvardeen. After these publications, a recent study of Hymenochaetaceae from South America, included some samples of *Fomitiporella umbrinella* (Bres.) Murrill from the Departments of Concepción and Cordillera (Salvador-Montoya et al. 2020).

Thirteen species representing nine genera are reported. Eleven species have never been recorded in the country, and the distribution of some species is extended. From these eleven species, two represent new records of a recently erected genus of Neotropical distribution: *Phellinotus* Drechsler-Santos, Robledo & Rajchenb. which comprises so far only two species from the Caatingas and Seasonally Dry Tropical Forests biome – SDTFs of Brazil and exhibit host specialization (Drechsler-Santos et al. 2016), the authors consider that it is important to mention that this genus is present in Paraguay in different ecoregions to respect of the species described so far and might comprise two new different taxa. Critical morphological studies complemented by DNA-based phylogenetic studies are still necessary to better circumscribe the different species from the Neotropical area. The aim of this work is to describe species of the Hymenochaetaceae family and thus contribute to the registration and knowledge of Funga from Paraguay.

## Materials and Methods

### Study area

Paraguay is divided into two distinct geographical regions, the eastern and the western, which are separated by the Paraguay River. The western region is also known as the Chaco and comprises three ecoregions: Humid Chaco, Dry Chaco and Pantanal (Dinerstein et al. 1995). The ecoregions of eastern Paraguay include in the Humid Chaco, Atlantic Forest and Cerrado (Dinerstein et al. 1995). The Pantanal in the Chaco region is characterized by wetlands and floodplains where the vegetation is composed of a low stratum of herbaceous and *Copernicia alba* Morong. forests adapted to periodic and prolonged flooding (Hamilton 1999). The studied materials were collected in four of these five ecoregions, Estación Biológica Tres Gigantes that comprises the Pantanal ecoregion (Alto Paraguay Department), an area of transition between the Atlantic Forest and Humid Chaco in Parque Nacional Ybycuí (Paraguarí Department); the ecoregion of Dry Chaco with two locations: Parque Nacional Teniente Enciso (Boquerón Department) and a forest remnant in the Montanía Country House (Boquerón Department); another two forest remnants in Los Agüero Country House (Cordillera Department) and La Lilia Country House (Paraguarí Department) both corresponding to the Humid Chaco ecoregion and lastly an anthropologically modified area in the University Campus, Universidad Nacional de Asunción (Central Department). Studied specimens are kept at the mycotheca of the Laboratorio de Análisis de Recursos Vegetales, Área Micología, Universidad Nacional de Asunción.

### Study of specimens

For the study of the specimens, macroscopic and microscopic observations were made on fresh and dried materials following Gómez-Montoya et al. (2017). Microscopic feature measurements and drawings were made from slide preparations rehydrated with KOH 3–5%,

stained with congo red, phloxine and melzer's reagent under light microscope. Measurements of basidiospores followed a standard sampling of thirty measurements ( $n = 30$ ). Facesoffungi numbers (FoF) were obtained as described in Jayasiri et al. (2015).

## Results and discussion

### Taxonomy

*Coltricia stuckertiana* (Speg.) Rajchenb. & J.E. Wright, Folia Cryptogamica Estonica 33: 119 (1998) Fig. 6i–l

Facesoffungi number: FoF08412

Description – Basidiomata annual,  $20\text{--}50 \times 5\text{--}0.15 \times 1\text{--}3$  mm, centrally stipitate, pileus circular centrally depressed, flat when fresh, convex and somewhat incurved when mature and dry, in small groups, sometimes with fused pileus, pileus up to 55 mm in diameter and 7 mm thick. Pileus surface brown to yellowish brown, finely velvety when young, glabrous and pale grayish brown when dry and mature. Margin entire, concolorous to the surface of the pileus, acute that is incurved upon drying. Pore surface golden brown to yellowish brown. Pores angular,  $4\text{--}5/\text{mm}$ , dissepiments entire. Context mostly homogeneous or heterogeneous, fibrous, golden brown, sometimes with a thin inconspicuous black line that arrives from the context of the stalk and disappears when it reaches the surface of the pileus, up to 5 mm thick. Tube layer up to 2 mm long. solid, up to 30 mm long and 5 mm in diameter near the base, slimming slightly towards the pileus, concolorous with pileus surface, velvety when fresh to glabrous when mature and dry. Hyphal system monomitic, generative hyphae simple septate, thin-walled, hyaline,  $2\text{--}3 \mu\text{m}$  diam.; yellowish, brown to yellowish chestnut hyphae of slightly to notoriously thickened walls and broad lumen dominating,  $3\text{--}5 \mu\text{m}$  diam. Cistidioles not observed. Hymenial setae absent. Basidia clavate,  $11\text{--}14 \times 4\text{--}5 \mu\text{m}$ , tetrasporic. Basidiospores ellipsoid, with a flattened side,  $4\text{--}4.5 \times 3\text{--}3.5 \mu\text{m}$ , smooth, yellow, thick-walled, IKI -, mostly collapsed and then flattened, concave to lenticular.

Habitat – Known parasite of living roots, growing on soil in fused groups. Found in the Dry Chaco ecoregion.

Known distribution – in Argentina for the provinces of Chaco, Salta, Córdoba, Tucumán (Rajchenberg & Wright 1998), in Paraguay the presence of *C. stuckertiana* becomes confusing, although Rajchenberg & Wright (1998) reported the species for Paraguay, they did not specify the material studied nor the collection area, other authors Aime et al. (2003) and Baltazar et al. (2010) make mention of this record, however we do not find accurate information about an official report of the species in Paraguay.

Material examined – PARAGUAY, Boquerón Department, Parque Nacional Agripino Enciso,  $21^{\circ}12'27.8''\text{S}$ ,  $61^{\circ}39'27.1''\text{W}$ , 24 October 2014, Y. Maubet 034 (FACEN 003441); Boquerón Department, Tte. Montanía Country House,  $21^{\circ}12'27.8''\text{S}$ ,  $61^{\circ}39'27.1''\text{W}$ , 22 February 2018, A. Weiler (FACEN 004509).

Notes – *Coltricia stuckertiana* was transferred to *Coltricia* Gray by Rajchenberg & Wright (1998) due to its terrestrial habit, stipitate basidiomata, monomitic hyphal system and yellowish basidiospores, later, Robledo (2009) confirms the parasitic habit on living roots and suggests a relationship with *Phylloporia*. Finally, Valenzuela et al. (2011) and Decock et al. (2013), using molecular data, grouped *Coltricia stuckertiana* in the *Phylloporia* clade. *C. stuckertiana* is characterized by its centrally stipitate basidiomata, with gray-brown and glabrous pileus when mature and dry, with pores  $4\text{--}5/\text{mm}$  (Robledo 2009). Morphologically and ecologically, it is similar to *Phylloporia spathulata* (Hook). Ryvardeen, both species are considered parasitic and exhibit profusely branched stipe forming underground rhizomorphs that are attached to small living roots (Robledo 2009); however, they differ in the shape of the pileus (spatulate), the size of the pores ( $8\text{--}9/\text{mm}$ ), and are smaller basidiospores in *P. spathulata* (Robledo 2009, Ferreira-Lopes et al. 2016).

***Fomitiporia neotropica*** Campos-Santana, Amalfi, R.M. Silveira, Robledo et Decock, Mycological Progress 13: 610 (2014) Fig. 1a–c

Facesoffungi number: FoF08413

Description – Basidiomata seasonal to bi-seasonal, resupinate, effused, following the substrate, adnate, extending up to  $150 \times 40 \times 1.5\text{--}7$  mm in the thickest part, with a corky consistency when fresh, drying hard corky, margin up to 0.5–2 mm wide, narrow, densely and very minutely velutinous, becoming slightly indurate on aging in imbricated specimens from outside–inside pale yellow to brownish orange, yellow ochre, to dark brown, pore surface in brown shade, commonly yellowish brown; pores small, round to ellipsoid at inclined parts, mostly 7–10/mm, dissepiments entire, thin to thick, with a greyish tint due to crystal deposit; subiculum 0.3–1 mm thick, densely fibrous, golden to light brown, homogeneous or with some denser, black, continuous or discontinuous thin lines; tube of one, two or more layers, indistinct or separated by a thin, slightly darker layer of sterile mycelium, 1.0–3.5 mm thick each, concolorous with the pore surface. Hyphal system dimitic, identical in the context and the trama of tube layer; generative hyphae hyaline to faintly yellow, thin-walled, sparsely branched, 2–3  $\mu\text{m}$  wide, skeletal hyphae pale yellow brown to golden brown, thick-walled, but with an open lumen, 3–4.5  $\mu\text{m}$  wide, tightly packed in the trama of tube layer, with sub-parallel orientation. Basidia not observed. Hymenial setae variably present on different collections, absent to abundant, fusiform to ventricose or lageniform, apex acute to rounded, 13–22 (–34)  $\times$  6–8 (–9.5)  $\mu\text{m}$ . Basidiospores subglobose to broadly obovoid, 5.0–7.0 (–7.5)  $\times$  4.5–7.0  $\mu\text{m}$ , thick-walled, hyaline, cyanophilous, strongly dextrinoid.

Habitat – Found on dead fallen or still attached branches, in Pantanal ecoregion.

Known distribution – Neotropical distribution, ranging from humid rainforest in French Guiana to southern Brazil, and subtropical, seasonally drier forests of northeast Argentina (Campos Santana et al. 2014). In Paraguay recorded from the Pantanal ecoregion from the Alto Paraguay Department and a forest remnant of the National University of Asunción, Central Department.

Material examined – PARAGUAY. Alto Paraguay Department, Bahía Negra City, Estación Biológica Tres Gigantes, 20°04'42.7"S, 58°09'47.8"W, 01 July 2017, M. Campi 253 (FACEN 004508); Central Department, San Lorenzo City, University Campus Universidad Nacional de Asunción, 25°19'39.9"S, 57°31'13.6"W, 31 July 2018, Y. Maubet 105 (FACEN 004513).

Notes – *Fomitiporia neotropica* is characterized by the combination of a resupinate, effused, seasonal to at least biseasonal basidiomata, a white to yellow margin when fresh, a brown (light to dark brown) pore surface, small pores 6–9 mm, the occasional presence of irregularly shaped setae, mostly located in the dissepiments, and basidiospores whose average size ranges from 5.4–6.3  $\times$  5.0–6.1  $\mu\text{m}$  (Campos Santana et al. 2014). The presence-absence of hymenial setae was reported as a variable character in this species (Campos Santana et al. 2014). Studied specimens also presented this variability in the presence-absence of the setae, specimens collected in Pantanal lack setae whereas specimens collected in the University Campus presented setae. *Fomitiporia maxonii* Murrill F., is a species related to *F. neotropica*, both species are very similar except for the presence of setae, which have never been reported in *F. maxonii* (Campos Santana et al. 2014).

*Fomitiporia neotropica* has a wide ecological range, from the humid forest in French Guiana to semideciduous Atlantic forest in southern Brazil and subtropical, seasonally drier forests of North East Argentina (Campos Santana et al. 2014). In Paraguay, samples from two different ecoregions have been collected, the one corresponding to the Pantanal and another corresponding to the University Campus of San Lorenzo, with ecological characteristics of humid Chaco (Olson et al. 2001).

***Fulvifomes rhytiphloeus*** (Mont.) Campos-Santana & Robledo, Cryptogamie Mycologie 36 (1): 54 (2015) Fig. 1d–f

Facesoffungi number: FoF08414

Description – Basidiomata annual to perennial, sessile, pileate, applanate, broadly attached, corky to woody, light in weight, imbricated, in small groups and/or fused laterally, up to  $160 \times 80 \times$

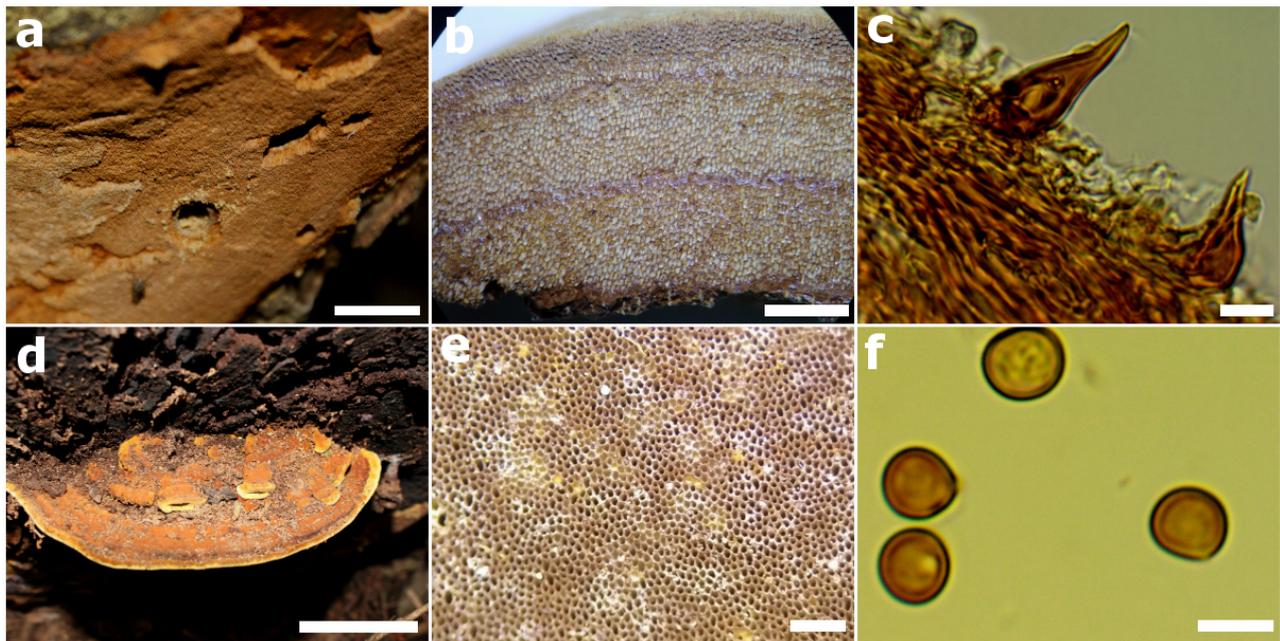
15 mm. Pileal surface concentrically and radially rough, tomentose and compressible, somewhat scrupulous and pruinose towards the base, reddish brown to dark reddish brown, with a contrasting yellowish brown golden and velutinous terminal band against the margin. Margin rounded, velvety, yellowish to golden brown. Pore surface dark brown to ocher, somehow yellowish towards the margin and notoriously yellow towards the base. Pores circular, 6–8/mm, invisible to the naked eye. Dissepiments entire. Context up to 10 mm thick, corky, golden to bright yellowish brown, first turning reddish in contact with KOH then darkening to black, with a thin black line at the top that separates it from a layer of dark ocher brown tomentum. Tube layers indistinctly stratified, up to 5 mm long. Hyphal system dimitic. Generative hyphae with simple septa, thin-walled, hyaline, with slightly thickened walls, 2–3  $\mu\text{m}$  diam. Dark reddish brown, thick walled skeletal hyphae dominating through the basidiomata, 3–4  $\mu\text{m}$  diam. reaching 6–7  $\mu\text{m}$  diam. in the context, with a relatively broad lumen. Basidia not observed. Basidiospores ellipsoid to broad ellipsoid, with a flattened side, 5.5–6  $\times$  4.5–5  $\mu\text{m}$ , smooth, dark brown to dark reddish brown, thick-walled, IKI-.

Habitat – growing on the base of standing living trees. Found on the Humid Chaco ecoregion.

Known distribution – neotropical species (Ryvarden 2004), previously recorded in Brazil and Venezuela. In Argentina recorded for the province of Córdoba (Robledo 2009).

Material examined – PARAGUAY. Paraguari Department, Pirayu City, La Lilia Country House, Fernando Diaz 013 (FACEN 003418); Central Department, San Lorenzo City, University Campus Universidad Nacional de Asunción, 25°19'40.4"S 57°31'14.8"W, 27 April 2016, Michelle Campi 078 (FACEN 004502).

Notes – The species is distinguished by its applanate basidiomata with the yellowish-brown context that reacts to red with KOH and with a thin black line at the top that separates it from a layer of thin brown tomentum (Campos Santana et al. 2015).



**Fig. 1** – a, b, c *Fomitiporia neotropica*. a Close up of the poroid hymenophore of the basidiomata. b Sectioned basidiomata in lateral view showing two tube layers. c Hymenial setae. *Fulvifomes rhytiphloeus*. d Basidiomata *in situ*. e Detail of the pore surface and hymenophore configuration. f Basidiospores. Scale bars: a = 10 mm, b = 2 mm, c = 5  $\mu\text{m}$ , d = 50 mm, e = 1 mm, f = 6  $\mu\text{m}$ .

*Fuscoporia gilva* (Schwein.) T. Wagner & M. Fisch., Mycologia 94 (6): 1013 (2002) Fig. 2a–h  
Facesoffungi number: FoF08415

Description – Basidiomata annual, to reviviscent and biannual, sessile, effused to effused-reflexed to pileate, flattened, mostly dimidiated and broadly attached, reniform or attenuated and contracted towards the base, alone or in overlapping groups, between 45–100  $\times$  40–50  $\times$  3–7 mm,

corky to woody, light, flexible to brittle when dry. Pileus surface variable, glabrous to velutinous, smooth to scrupulous or with numerous concentric grooves, tomentose to hispid when young, yellowish brown, ocher, reddish brown to dark brown. Margin acute to rounded. Pore surface grayish brown in active growth, darker and more concolorous to the pileal surface when mature. Pores circular, 5–7/mm. Dissepiments entire. Context homogeneous, dark golden brown, shiny to opaque, up to 5 mm thick. Tube layer, up to 2 mm long concolorous. Hyphal system dimitic. Generative hyphae simple septate, hyaline to yellowish, slightly thick walled, 2–3 µm diam., frequently are projected in the light of the tubes and accompanying hymenial setae and are inscrustated with small amorphous crystals. Skeletal hyphae dominating, 3–6 µm diam, dark reddish-brown, straight, walls uniformly thickened and with wide lumen. Hymenial setae ventricose to narrowly fusiform, mostly bi-radicated, 18–28 × 5–6.5 µm, thick-walled, dark reddish brown, abundant. Cystidioles absent. Basidia not observed. Basidiospores ellipsoid, 3.7–4.5 × 2.5–3 µm, smooth, hyaline, thin-walled, usually with an oily-looking refractive central gutule, IKI-.

Habitat – growing on dead branches of standing trees, on numerous groups. Found on the Pantanal ecoregion and the Parque Nacional Ybycuí, that is a transition between Atlantic Forest and Humid Chaco.

Known distribution – Pantropical extending to warm-temperate zones, very common in tropical America (Fidalgo & Fidalgo 1968, Ryvarde 2004). Brazil: States of Alagoas, Bahia, Paraíba, Paraná, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, São Paulo, Santa Catarina and Sergipe (Baltazar & Gibertoni 2009). Argentina: Mesopotamian Region in Buenos Aires (López 1988) and Misiones Provinces (Ibáñez 1998), Yungas Region in Montane forests of Catamarca and Jujuy Provinces (Robledo et al. 2003), and in *Polylepis australis* forests of Sierras Grandes, Córdoba Province. In Paraguay recorded from the departments of Central, Concepción, Paraguairí and Presidente Hayes [as *Phellinus gilvus*] (Popoff & Wright 1998).

Material examined – PARAGUAY, Alto Paraguay Department, Bahía Negra City, Estación Biológica Tres Gigantes, Jurumi Path, 20°04'42.7"S, 58°09'47.8"W, 02 July 2017, Michelle Campi 156 (FACEN 004505); Paraguairí Department, Ybycuí City, Parque Nacional Ybycuí, 26°04'20.3"S, 56°51'4.6"W, 23 September 2018, Michelle Campi 303 (FACEN 004504).

Notes – *Fuscoporia gilva* comprises a complex of species (Robledo 2009), it is characterized by annual to reviviscent, effuso-reflexed basidiomata, finely velutinous pileal surface, mostly dimidiate, with abundant ventricose hymenial setae and ellipsoid, hyaline, thin-walled basidiospores (Groposo et al. 2007, Robledo 2009, Raymundo et al. 2013, Campos Santana et al. 2015). *Fuscoporia callimorpha* (Lév.) Groposo, Log.-Leite & Góes-Neto, is a morphologically similar species, however it has 7–9 pores/mm, oblong-ellipsoid to sub-cylindrical basidiospores and smaller hymenial setae (Raymundo et al. 2013). Another related species is *Fuscoporia rhabarbarina*, but differs from *F. gilva* by presenting a black crust on the surface of the glabrous pileus. Another morphologically close species is *Fuscoporia atlantica* Motato-Vásquez, R.M. Pires & Gugliotta but differs by its dark brown crust at the pileus base, its golden yellow-ferruginous pore surface, its hooked setae, and its larger basidiospores (Pires et al. 2015).

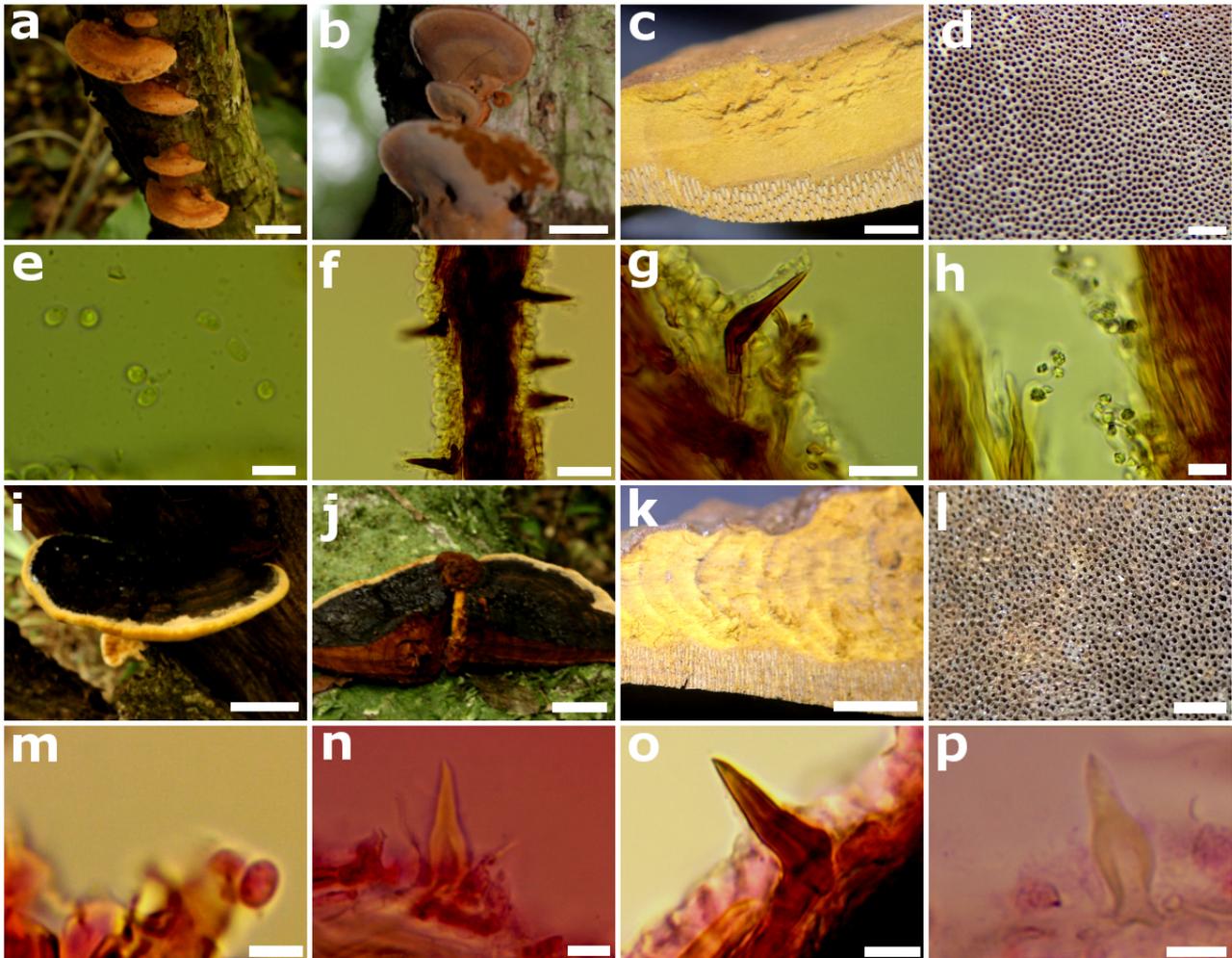
***Fuscoporia rhabarbarina*** (Berk.) Groposo, Log.-Leite & Góes-Neto, Mycotaxon 101: 61 (2007)

Fig. 2i–p

Facesoffungi number: FoF08416

Description – Basidiomata annual, sessile, pileate, flattened to convex when dry, dimidiate, semicircular to reniform or somewhat elongated, but adhered to the substrate by a narrow central portion, hard and rigid, fibrous to woody, solitary or in small groups, 300 × 150 × 20 mm. Pileal surface covered by a hard blackish crust, glabrous, radial and/or concentrically rough, typically tuberculated towards the base, yellowish brown near the margin. Margin rounded, smooth, slightly lobed and wavy in some specimens, finely velutinous, yellowish brown to golden brown and contrasting with the surface of the pileus. Pore surface yellowish brown to chestnut brown. Hymenial surface concolorous. Pores circular, 8–9/mm. Dissepiments entire. Context yellowish brown, sulphurous to dark golden brown, shiny, first reacting rapidly to red with KOH, in some

specimens with notorious white mycelium cords that are born from the base, with a black cuticle up to 5 mm thick at the top, up to 10 mm thick. Tube layer indistinctly stratified in perennial basidiomata, up to 10 mm thick. Hyphal system dimitic. Generative hyphae simple septate, in the context hyaline to slight yellowish, thick-walled, 1.5–2.5  $\mu\text{m}$  diam., skeletal hyphae dominating, golden brown 3–5 (–6)  $\mu\text{m}$  diam., dark reddish brown of noticeably thickened walls but with visible lumen. The upper cuticle of the pileus composed of a layer of hyphae of golden, dark golden brown to reddish brown walls, with a narrow lumen filled with a reddish substance, intertwined and embedded in yellowish matrix. Hymenial setae straight subulate to ventricose, mostly bi-radicated, 15.5–24  $\times$  4.5–5.5  $\mu\text{m}$ , reddish brown, thick-walled. Basidia not observed. Basidiospores ellipsoid, with a ventral flattened side, 3.5–4.5  $\times$  2.5–3  $\mu\text{m}$ , smooth, thin-walled, hyaline turning golden and slightly thick-walled at maturity, IKI-



**Fig. 2** – *Fuscoporia gilva*. a Basidiomata *in situ*. b Basidiome *in situ* showing the poroid hymenophore. c Section of the basidiome showing the context and tube layer. d Close up of the pore surface. e Basidiospores. f Hymenial setae in the trama of the tubes. g Detail of the crooked base of the setae. h Hyphae covered with crystals. *Fuscoporia rhabarbarina*. i, j Basidiome *in situ*. k Section of the basidiome. l Detail of the pore surface. m Basidiospore. n, o, p Hymenial setae. Scale bars: a, b = 20 mm, c = 2 mm, d = 1 mm, e = 10  $\mu\text{m}$ , f = 20  $\mu\text{m}$ , g = 10  $\mu\text{m}$ , h = 5  $\mu\text{m}$ , i, j = 50 mm, k = 10 mm, l = 1 mm, m, n, o, p = 5  $\mu\text{m}$ .

Habitat – Growing on standing trunk. Found in Parque Nacional Ybycuí, that is a transition between Atlantic Forest and Humid Chaco.

Known distribution – Species of alleged circumglobal distribution (Ryvarden 2004). In America it has been reported in Cuba, Mexico and Costa Rica [as *Phellinus rhabarbarinus* (Berk.)

G. Cunn.] (Ryvarden 2004). In Argentina [as *Fomes rheicolor* Lloyd] (Ryvarden & Johansen 1980) for the province of Córdoba (Robledo 2009). In Brazil in the states of Santa Catarina and Rio Grande do Sul (Groposo et al. 2007). In México in the state of Sonora (Raymundo et al. 2009). In Chile [as *Fomes rhabarbarinus* (Berk.) Sacc.] (Martínez & Valenzuela 2004).

Material examined – PARAGUAY, Paraguairí Department, Ybycuí City, Parque Nacional Ybycuí, 26°04'39.9"S, 56°50'53.7"W, 22 September 2018, Michelle Campi 298 (FACEN 004354).

Notes – This species is characterized by the glabrous pileus surface, radially sulcate, rough and tuberculous, covered by a hard blackish cuticle; pores of 6–9 per mm, yellowish monomitic context, hymenial setae of 20–30 × 4.8–7.2 µm, subulate and ellipsoid basidiospores 3.2–4 × 2–3 µm (Groposo et al. 2007, Robledo 2009, Raymundo et al. 2013). Related species are *F. callimorpha* and *F. gilva* for having thin, annual or biannual basidiomata, small spores and short hymenial setae; however, both are easily separated by the lack of crust covering the pileal surface (Groposo et al. 2007, Raymundo et al. 2013). Another morphologically similar species is *Fuscoporia atlantica* Motato-Vásquez, R.M. Pires & Gugliotta, that differs by its radially wrinkled and tomentose pileus, tiny pores, hooked hymenial setae, and broadly ellipsoid to ellipsoid basidiospores (Pires et al. 2015).

***Hymenochaete iodina*** (Mont.) Baltazar & Gibertoni, Journal of the Torrey Botanical Society 139 (4): 432 (2012) Fig. 3a–d

Facesoffungi number: FoF08417

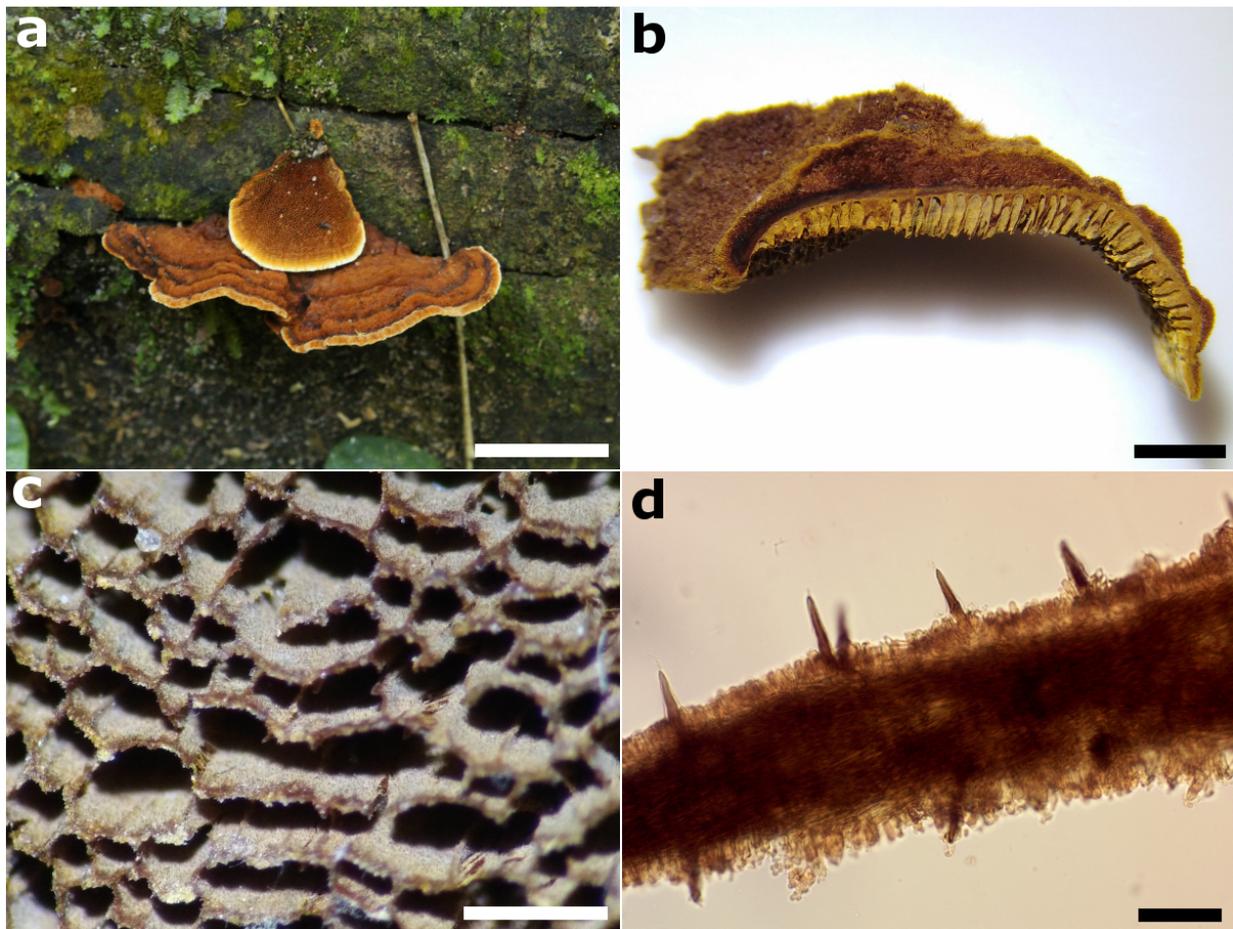
Description – Basidiomata annual, sessile, pileate, 20–41 × 20–32 × 2–3 mm, flattened, semicircular and widely adhered to substrate or flabelliform, sometimes pileus imbricated or fused laterally, rarely solitary, leathery and flexible when fresh, corky when dry. Surface of pileus tomentose to velutinous, concentrically sulcate, each groove ranging from light brown to dark reddish brown. Margin acute, very thin, slightly involute when dry. Pore surface dark brown turning yellow towards the margin. Pores angular, concentrically arranged, very variable in size, 3–4/mm, commonly fused laterally forming an elongated pore up to 2 mm long. Dissepiments entire, thin. Context heterogeneous, of fibrous consistency towards the surface, becoming compact towards the tubes, with a dark brown line in the transition from the fibrous to the compact layer, up to 1.5 mm thick. Tube layer concolorous up to 1 mm thick. Hyphal system monomitic. Generative hyphae simple septate, thin to thick-walled and wide lumen, yellowish, yellowish brown to reddish brown, 2.5–4.5 µm diam. Hymenial setae, abundant, straight, lanceolate, 30–55 × 4–6 µm, thick-walled, dark reddish brown; frequently accompanied by thin generative hyphae of 1 µm diam. that run parallel to the setae and/or surround them. Cystidia not observed. Basidia not observed. Basidiospores cylindrical to ellipsoid, 3–3.5 × 1.5–2 µm, smooth, hyaline, IKI–.

Habitat – Growing on dead standing trunk. Found in Parque Nacional Ybycuí, that is a transition between Atlantic Forest and Humid Chaco.

Known distribution – Neotropical (Ryvarden 2004). In Argentina recorded from the province of Catamarca and Salta (Robledo 2009). In Brazil, reported from the states of Bahia (Góes-Neto 1999), Espírito Santo (Vinha 1988), Paraná (Ryvarden & Meijer 2002), Pernambuco (Gibertoni et al. 2004), Santa Catarina (Gerber 1996), and São Paulo (Soares & Gugliotta 1998). In Paraguay reported for the department of Paraguairí [as *Cyclomyces iodinus* (Mont.) Pat.] (Popoff & Wright 1998).

Material examined – PARAGUAY, Paraguairí Department, Ybycuí City, Parque Nacional Ybycuí, 26°04'20.3"S, 56°51'4.6"W, 23 September 2018, Michelle Campi 364 (FACEN 004511).

Notes – The species is characterized by the flabelliform or semicircular basidiomata with a zonate, pileus surface, a distinguishable black line in the context and the abundant hymenial setae (Ryvarden 2004, Gomes-Silva et al. 2012). Based on molecular data of the type species of *Cyclomyces*, *C. fuscus* Fr. [now known as *Hymenochaete porioides* T. Wagner & M. Fischer], Wagner & Fischer (2002) suggested that *Cyclomyces* should be included within *Hymenochaete*. The species resembles *Hymenochaete porioides*, but the latter has smaller pores (almost invisible to the naked eye), slightly wider basidiospores and longer setae (Ryvarden 2004).



**Fig. 3** – *Hymenochaete iodina*. a Basidiomata *in situ*. b Longitudinal section of the basidiome showing the context and tube layer. c Close up of the pore surface showing anastomosed pores. d Hymenial setae. Scale bars: a = 20 mm, b = 2 mm, c = 1 mm, d = 40  $\mu$ m.

*Inonotus rickii* (Pat.) D.A. Reid, Kew Bulletin 12 (1): 141 (1957)

Fig. 4a–h

Facesoffungi number: FoF08418

Description – Basidiome annual, sessile, pileate, aplanate to triquetrous or obungulate, 215  $\times$  167  $\times$  44 mm, soft and fleshy consistency in fresh, corky when dry, solitary to imbricate. Pileal surface yellowish brown to reddish brown, slightly tomentose when young, glabrous when mature, becoming rimose when dry, powdery towards the base. Margin entire, rounded. Pore surface flat to concave, creamy to yellowish when young, grayish brown when dry, sometimes covered by a yellowish powder. Pores angular, 1–3/mm, dissepiments entire. Tube layer up to 19 mm thick, yellowish brown towards the surface, ferruginous brown towards the context. Context dark brown, lighter towards the margin, hard, fibrous, concentrically zonate, with a thin black towards the surface of the pileus. Hyphal system monomitic. Generative hyphae simple septate, thin-walled to thick-walled with large lumen, (3.8–) 5.5–8.5 (–10.7)  $\mu$ m diam., walls reaching 2  $\mu$ m, golden to yellowish. Setal hyphae abundant, cylindrical to lanceolate, uni- to bi-radicale, thick-walled to almost solid, brown to brown-ferruginous, with pointed apex, occasionally its apex appears in the hymenium. Setae ventricular to lanceolate, 15–20  $\times$  4–6  $\mu$ m, reddish brown to dark brown, with thickened walls up to 2  $\mu$ m, abundant. Basidia not observed. Basidiospores ellipsoid, 6.5–8.5 (–10.4)  $\times$  5.0–6.0 (–7.1)  $\mu$ m diam., yellowish, smooth, thick-walled, IKI-. Anamorph: semi spherical to spherical, soft and spongy, with velvety surface, yellowish brown to mustard when young, dark brown at maturity, turning from inwards in a dusty mass that disintegrates to the touch, formed by globose, subglobose to ellipsoidal chlamydospores, 8.9–17.6  $\times$  8–13.1  $\mu$ m, brown to reddish brown, smooth, thick-walled, with cylindrical appendix. Secondary mycelium in the form of a mustard yellow net growing at the sides.

Habitat – Growing on living trees *Delonix regia* (Bojer ex Hook.) Raf., in Central Department.

Known distribution – Pantropical distribution, known in Tropical America from southern United States (Gilbertson & Ryvardeen 1986) to central Argentina (Robledo & Urcelay 2009). In Argentina recorded in the provinces of Salta, Tucumán and Jujuy (Popoff 2000, Gottlieb et al. 2002, Robledo & Urcelay 2009).

Material examined – PARAGUAY, Central Department, San Lorenzo City, University Campus Universidad Nacional de Asunción, 25°33'15.8"S 57°52'50.8"W, 02 April 2016, basidiome and anamorph growing together in the substrate, Didier Spinzi 030 (FACEN 003643).

Notes – *Inonotus rickii* is characterized by annual and fleshy basidiomata, it is an easily recognizable species due to the production of chlamydospores on the surface of the pileus (forming a reddish powdery layer), on the hymenophore and context, both in vivo and in vitro (Gottlieb et al. 2002, Valenzuela et al. 2013), in addition to the presence of hyphal setae and hymenial hyphae and broadly ellipsoidal yellow-gold basidiospores (Stalpers 2000, Gottlieb et al. 2002, Ramos et al. 2008). *Ptychogaster cubensis* Pat. (Gilbertson & Ryvardeen 1996) is the anamorph of *I. rickii*, and corresponds to the asexual phase of fungus growth (Valenzuela et al. 2013), the basidiome can be completely transformed into a powdery mass of chlamydospores even after collected (Robledo 2009). A related species is *Inonotus glomeratus* (Peck) Murrill, both species have hymenial hyphae and hyphal setae, however, it presents smaller yellowish basidiospores and lacks chlamydospores (Valenzuela et al. 2013).

***Inonotus splitgerberi*** (Mont.) Ryvardeen, Norwegian Journal of Botany 19: 232 (1972) Fig.4i–p  
Facesoffungi number: FoF08419

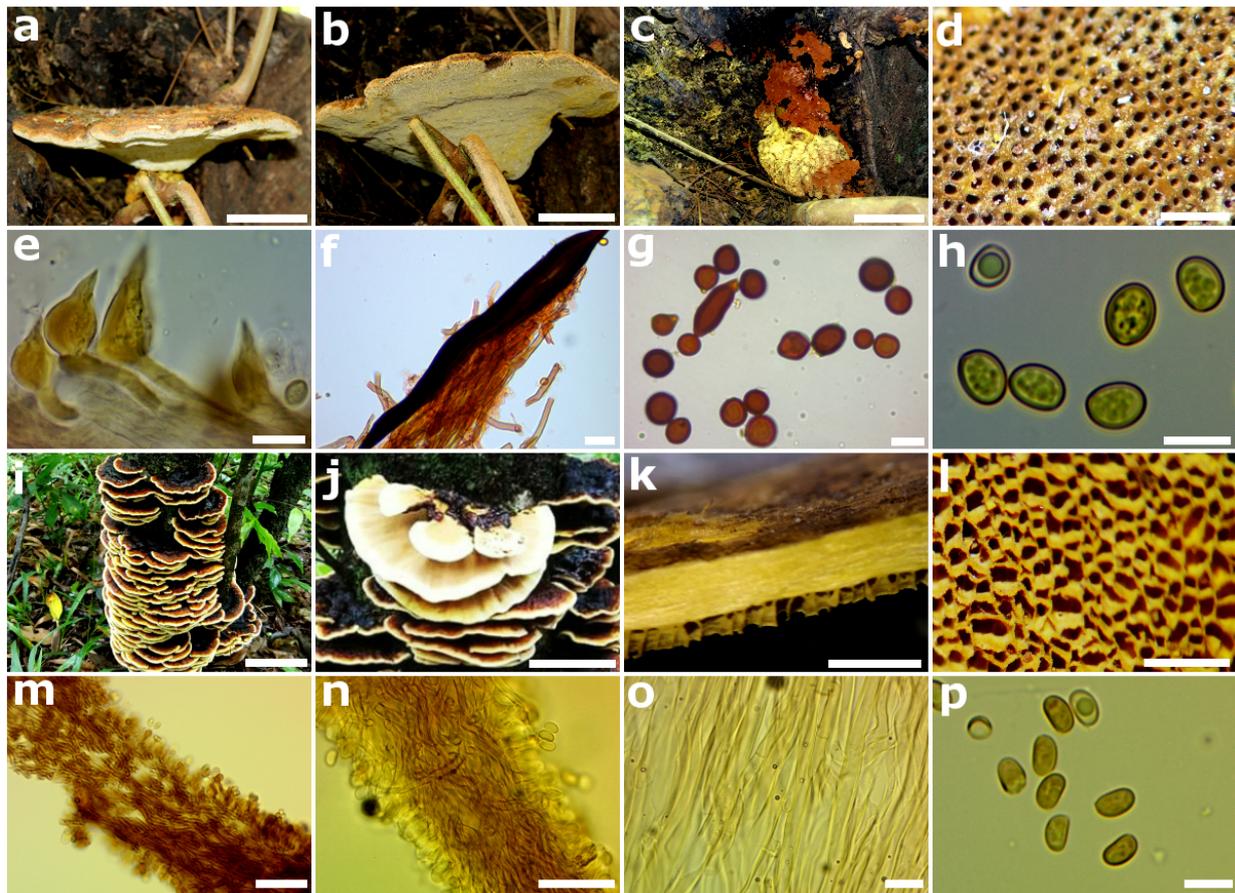
Description – Basidiomata annual, 20–50 × 15–30 × 1–5 mm, sessile pileate, flattened, demediated, reniform to flabelliform and then with a attenuate base looking , in overlapping groups, rigid to slightly flexible in fresh and brittle when dry. Pileal surface smooth, glabrous to slightly pubescent under the stereoscope, radially rough towards the base, with slight grooves and roughness and concentric zoning, ocher brown to reddish brown towards the base, yellowish brown to intense yellow towards the margin. Margin sharp and lobed, finely velutinose, yellowish, wavy when dry. Pore surface brown, yellowish towards the margin, glancing, turning brown-cinnamon when touched. Pores angular, 5–6/mm., dissepiments entire and thin. Context homogeneous, fibrous, sulfuric yellowish, which reacts markedly deep red with KOH, later darkening to black, up to 8 mm thick. Tube layer up to 4 mm thick. Hyphal system monomitic. Generative hyphae simple septate, in dissepiments thin-walled and hyaline, yellow, brown to reddish brown hyphae with slightly thick-walled walls and broad lumen hyphae dominating trough basidiome, 3–5 (–7) µm diam. Hymenial setae absent. Basidia clavate, 8–10 × 5–6 µm, tetrasporic. Basidiospores ellipsoid, 5–6 × (3–) 4–4.5 µm, smooth, hyaline, yellowish to golden yellow, IKI-.

Habitat – On trunk of living tree, in the Humid Chaco.

Known distribution – Neotropical, from México to Brazil (Ryvardeen 2004). In Argentina, from the states of Tucumán (Robledo & Rajchenberg 2007, Robledo 2009). In Brazil, for the states of Paraná (Rajchenberg & Meijer 1990, Ryvardeen & Meijer 2002, Meijer 2006); Pernambuco, Rio Grande do Sul and Santa Catarina (Gibertoni et al. 2015). In Costa Rica (Ruiz-Boyer 1999), and in México (Raymundo & Valenzuela 2003).

Material examined – PARAGUAY, Cordillera Department, Atyra City, Los Agüero Country House, 25°20'45.2"S 57°11'19.0"W, 24 March 2016, Michelle Campi 049 (FACEN 004374).

Notes – The species is distinguished by its bright colored basidiomata, a rusty brown coloration, the reddish brown pileal surface and with the yellowish context that turns intense red with KOH, the size of the pores that turn brown to cinnamon to the touch, the total absence of hymenial setae and small hyaline to yellowish basidiospores (Ryvardeen 2004, Robledo 2009, Westphalen et al. 2010, Valenzuela et al. 2013).



**Fig. 4** – *Inonotus rickii*. a, b Basidiome *in situ*. c Basidiome covered with chlamydospores (anamorph). d Close up of the pore surface. e Hymenial setae in NaOH. f Hyphal setae in the trama of the tubes. G Chlamydospores. h Basidiospores. *Inonotus splitgerberi*. i Basidiome *in situ*. j Pore surface when fresh. k Section of the basidiome. l Detail of the pore surface. m, n Trama of the pore layer. o Generative hyphae. p Basidiospores – Bars: a, b, c = 50 mm, d = 2 mm, e, p = 5  $\mu$ m, f = 20  $\mu$ m, g = 10  $\mu$ m, h = 8  $\mu$ m, i = 50 mm, j = 20 mm, k = 3 mm, l = 1 mm, m, n = 25  $\mu$ m, o = 15  $\mu$ m.

***Phellinotus* sp. 1**

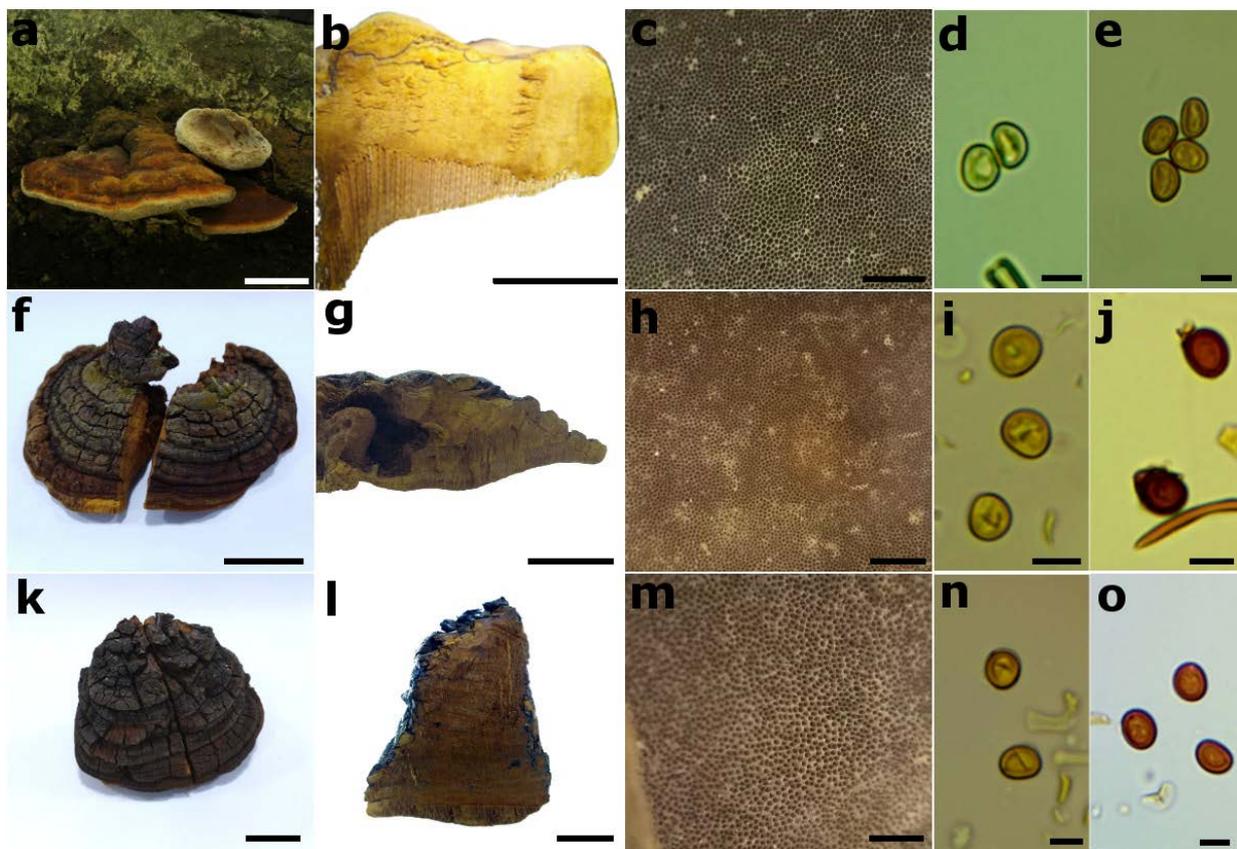
Fig. 5a–e

Description – Basidiomata annual, 30–77  $\times$  17–42  $\times$  13–35 mm, effused-reflexed to broadly attached, semicircular, flattened to triquetrous, lateral pilei arising from the margins or below. Pileus surface glabrous forming a thin hardened cover with age, cracked or not, zonate but concolorous, rugose, light brown to yellowish brown when newly developed, as the surface hardens it turns ferruginous brown to orange brown; margin rounded, 4–5 mm thick, paler than the rest of the pileus. Pore surface dark brown, shifting to light brown in lateral view, not shiny; pores roundish to angular, 5–6/mm, dissepiments entire. Context 4 mm thick, golden brown to chocolate brown, with a very thin black line composed of sclerified hyphae, sometimes disappearing towards the pileus surface. Tubes up to 7 mm long. Hyphal system dimitic in the hymenium. Generative hyphae septate, 2–3  $\mu$ m diam, thin to thick walled, wide lumen, hyaline to light brown, up to 5.5–7.5  $\mu$ m diam, showing bifurcations in the context, skeletal hyphae restricted to the hymenium, 5.3–8  $\mu$ m, thick-walled, golden yellow to brown, lacking septa completely. Basidia ellipsoid to broadly clavate, 8–11.5  $\times$  5.5–7  $\mu$ m, hyaline, thin-walled, with four sterigmata. Setoid elements absent. Basidiospores broadly ellipsoid to ellipsoid, 4.5–5.2  $\times$  3.5–4  $\mu$ m diam, straight lateral side, thick-walled, hyaline to yellowish in water, golden brown in 5% KOH, IKI-.

Habitat – Growing on living trunk. Pantanal ecoregion.

Material examined – PARAGUAY. Alto Paraguay Department, Bahía Negra City, Estación Biológica Tres Gigantes, Ariraí Path, 20°04'35.4"S, 58°09'22.5"W, Michelle Campi 190 (FACEN 004512).

Notes – The genus *Phellinotus* Drechsler-Santos, Robledo & Rajchenb is characterized by a pileate basidiomata often with a rimose pileus, a dimitic hyphal system with skeletal hyphae only present in the trama of the tube layer, and adaxially flattened, ellipsoid, thick-walled, pale yellow basidiospores that turn chestnut brown in KOH solution (Drechsler-Santos et al. 2016). Two species have been described for the genus: *Phellinotus neoaridus* Drechsler-Santos & Robledo and *Phellinotus piptadeniae* (Teixeira) Drechsler-Santos & Robledo, both are distributed in the South American Seasonally Dry Tropical Forest (SDTF) biome in Brazil and Peru (Drechsler-Santos et al. 2016). The samples from Pantanal differ from these previously described species in the presence of a crust in the surface of the pileous and a granular core in the black line of the context, furthermore the samples from Paraguay are recorded from the ecoregion of Pantanal (Dinerstein et al. 1995) that comprises a totally different vegetation than that of the Brazilian Atlantic Forest and Caatingas, hence we believe that the Paraguayan samples could be a different species of *Phellinotus*. Further information of its phylogenetic relations is needed to confirm its identity and relation within the *Phellinotus* clade.



**Fig. 5** – *Phellinotus* sp. 1 (M. Campi 190). a Basidiome in situ. b Section of the basidiome showing a black line. c Pore surface. d Basidiospores in water. e Basidiospores in KOH (5%). *Phellinotus* sp. 2 (Y. Maubet 109). f Basidiome. g Section of the basidiome. h Pore surface. i Basidiospores in water. j Basidiospores in KOH (5%). *Phellinotus* sp. 2 (F. Diaz 010). k Basidiome. l Section of the basidiome. m Pore surface. n Basidiospores in water. o Basidiospores in KOH (5%). Scale bars: a = 30 mm, b = 10 mm, c, h, m = 2 mm, d, e, i, j, n, o = 4  $\mu$ m, f = 50 mm, g = 30 mm, k, l = 20 mm.

***Phellinotus* sp. 2**

Fig. 5f–o

Description – Basidiomata perennial, 80–90 × 60–65 × 60–70 mm, sessile, pileate, unguulate to triquetrous, broadly attached to the substrate, hard, woody, and solitary. Surface of the pileus, concentrically and radially sulcate, deeply cracked, strongly rimose, dark brown to greyish brown. Margin rounded, finely velutinous, golden brown. Pores surface yellowish brown, pores rounded to angular, 3–4/mm. Dissepiments entire, thin. Context generally underdeveloped of 5 mm, golden

brown, with age it turns dark reddish brown to blackish against the surface of the pileus as it cracks deeper, towards the new tube layers it is confused with the older layers that a yellowish mycelium fills up. Tubes occupying practically the entire thickness of the pileus, between 3–5 mm long each layer, indistinguishable towards the base for being completely filled with mycelium. Hyphal system dimitic, skeletal hyphae restricted to the trama of the tube layer. Contextual generative hyphae pale yellow to dark reddish brown, thin to thick-walled, (3–)4–6(–7)  $\mu\text{m}$  wide, regularly simple-septate with ramifications, then becoming sclerified and septa in some portions of thick-walled hyphae destroyed, sometimes forming secondary septa; trama of tube layer composed of septate generative and skeletal hyphae; generative hyphae hyaline to yellowish or chestnut, thin to thick-walled, 2–3  $\mu\text{m}$  wide, branched, each branch forming terminal, dark reddish brown skeletal hyphae, 4–4.5(–5)  $\mu\text{m}$ , with adventitious septa. Basidia clavate, 4 sterigma, 11–15  $\times$  6–7. Basidiospores broadly ellipsoid to ellipsoid, 5.5–6.5  $\times$  4.5–5.5  $\mu\text{m}$ , adaxially flattened, smooth, thick-walled, yellow turning to chestnut brown in KOH, weakly cyanophilous, IKI-

Habitat – On living standing tree.

Material examined – PARAGUAY, Paraguari Department, Pirayu City, La Lilia Country House, 25°29'59.4"S 57°08'45.3"W, 24 August 2015, Y. Maubet 109 (FACEN 004503); Paraguari Department, Pirayú City, La Lilia Country House, 25°29'57.8"S 57°08'47.5"W, 24 August 2015, F. Díaz 010 (FACEN 003414).

Notes – This species resembles morphologically to the two known species of *Phellinotus* sharing a rimose pileal surface, a dimitic hyphal system with skeletal hyphae restricted to the trama of the tubes and adaxially flattened yellowish basidiospores that turn chestnut in KOH solution (Drechsler-Santos et al. 2016). Because of the rimose aspect of the pileus the species could also be confused with *Phellinus rimosus*, but the latter is known predominantly from Southern Europe, Mediterranean Region, the Caucasus, and Middle Asia (Ryvarden & Melo 2014). The samples from *Phellinotus* sp. 1 and *Phellinotus* sp. 2 differ in some characteristics, the pileal surface is strongly rimose in *Phellinotus* sp. 2 and, on the other hand, for *Phellinotus* sp. 1 a chestnut crust can be distinguished covering the surface of the pileus. Another difference is the presence of a granular core in the black line of the context of *Phellinotus* sp. 1 and the ecology of both species suggest they could comprise two different lineages, *Phellinotus* sp. 1 was collected in the Paraguayan Pantanal, whilst *Phellinotus* sp. 2 is recorded from the Humid Chaco (Dinerstein et al. 1995), although further phylogenetic studies are necessary to clarify the relation of these two species within the *Phellinotus* clade.

***Phylloporia chrysites*** (Berk.) Ryvarden, Norwegian Journal of Botany 19: 235 (1972) Fig. 6a–d  
Facesoffungi number: FoF08420

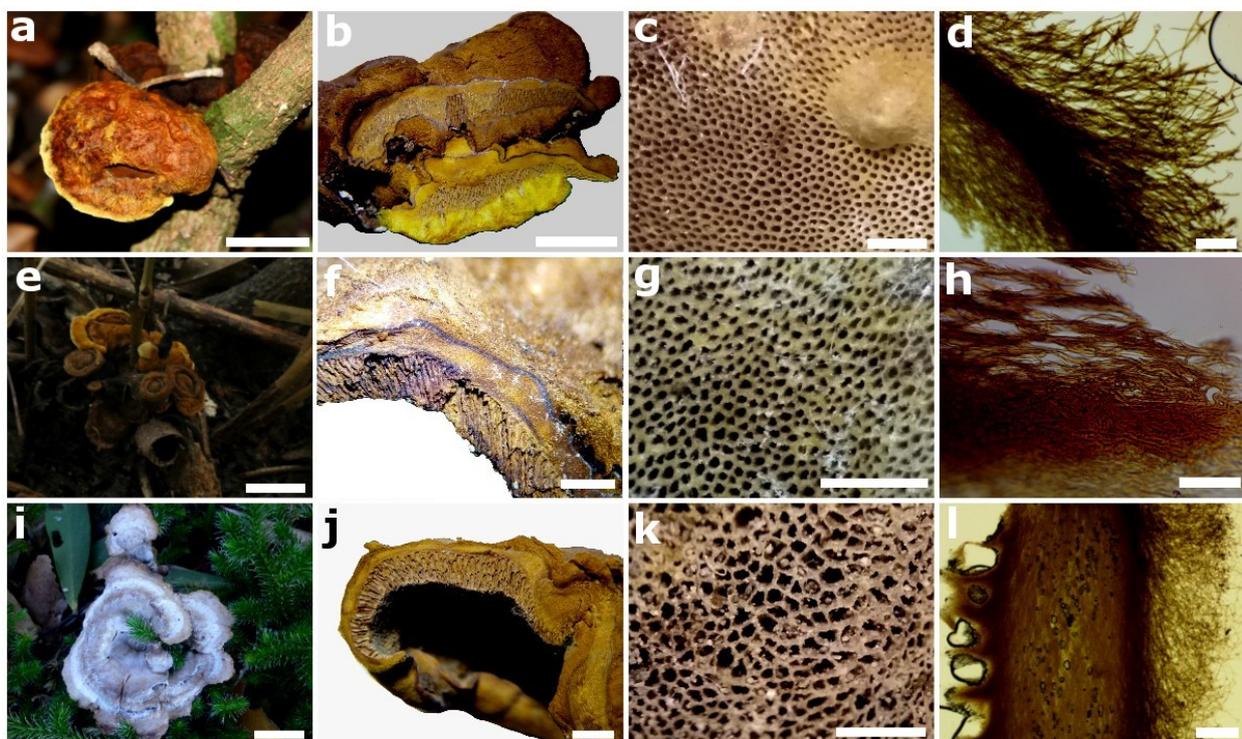
Description – Basidiomata annual, pileate, dimidiate to semicircular, amplexant, wrapping the branch, 21–32  $\times$  20  $\times$  10–16 mm thick, reviving from old basidiomata, of spongy and soft consistency, pileal surface velutinose, azonated, yellowish golden brown to yellowish brown, turning dark brown to dark brown in old specimens; margin rounded, sterile, golden yellow; surface of pore yellowish to golden brown or ocher, pores 6–8/mm, rounded, dissepiments entire; tube layer of 1–1.5 mm, concolorous to the pore surface; context double separated by a dark line, spongy upper portion of 5–10 mm; dense and thin lower portion, 1–2 mm, slightly darker and golden than the upper section. Hyphal system dimitic, with skeletal hyphae restricted to the tube layer; generative hyphae of the hymenium simple septate, 2–3  $\mu\text{m}$ , thin to thick-walled, hyaline to yellowish in KOH, in the from the context 3.5–5  $\mu\text{m}$ , straight, yellow to brown in KOH, thin to thick-walled; skeletal hyphae, 3–5  $\mu\text{m}$ , yellow to golden brown, with adventitious septa. Basidia not observed. Cystidioles hyaline to yellowish, lageniform to ventricose, 8–12  $\times$  3–4.5  $\mu\text{m}$ ; basidiospores subglobose to broadly ellipsoid, yellowish to golden in KOH, thin-walled, smooth, 2.8–3.6  $\times$  2.2–2.9  $\mu\text{m}$ , IKI-, mostly collapsed and then flattened and concave to lenticular.

Habitat – Parasite of living stems of lianas, amplexant. Found in Parque Nacional Ybycuí, that is a transition between Atlantic Forest and Humid Chaco. Regarding the ecology, samples were found at the foot of shrubs in the Pantanal.

Known distribution – From Florida, USA to Brazil (Wagner & Ryvarden 2002, Valenzuela et al. 2011).

Material examined – PARAGUAY, Paraguari Department, Ybycuí City, Parque Nacional Ybycuí, 26°04'6.3''S, 56°50'58''W, 14 May 2019, Michelle Campi 365 (FACEN 004506).

Notes – *Phylloporia chrysites* is characterized by the soft and spongy pileus, velvety pileus surface, small pores (6–8 per mm) and relatively small basidiospores (2.5–3.5 µm in diam.) (Wagner & Ryvarden 2002, Gomes-Silva et al. 2013). The specimen samples share certain macromorphological characteristics with *P. chrysites* sharing the consistency of the surface of the pileus and amplexant habit; however, this species differs in the lack of a duplex context, the strictly monomitic hyphal system and distinctly globose basidiospores (Ryvarden & Johansen 1980, Wagner & Ryvarden 2002, Valenzuela et al. 2011). *Phylloporia frutica* differs in having larger pores, 3–5/mm, lacks a black line separating the duplex-context and larger basidiospores (Valenzuela et al. 2011). Both species are morphologically variable and represent a species complexes (Robledo 2009), hence further phylogenetic studies are needed in order to determine its accurate identity.



**Fig. 6** – *Phylloporia chrysites*. a Basidiome *in situ*. b Section of the pileus. c Pore surface. d Pileus section. *Phylloporia nodostipitata*. e Basidiome *in situ*. f Section of the pileus showing a black line. g Detail of the pore surface. h Pileus section showing the tomentum in the upper portion. *Coltricia stuckertiana*. i Basidiome *in situ* (Y. Maubet 034). j Section of the pileus. k Close up of the pore surface. l Pileus section. Scale bars: a = 10 mm, b = 8 mm, c, f, g, k = 1 mm, d, h = 60 µm, e = 30 µm, i = 5 mm, j = 2 mm, l = 150 µm.

*Phylloporia nodostipitata* Ferreira-Lopes & Drechsler-Santos, Phytotaxa 257 (2): 142 (2016)

Fig. 6e–h

Facesoffungi number: FoF08421

Description – Basidiomata seasonal to reviving, stipitate, caespitose with multiple s arising from a nodose mass; pileus circular to fan-shaped, flat to infundibiliform, up to 60–70 × 30–40 mm, some pilei compose of lateral growth of new pilei arising directly from the older pilei; pileus surface cottony, bright when young, zonate, sulcate, brownish yellow becoming darker with age, tomentum yellowish brown in section, up to 1–2 mm thick, with a dark line separating it from the

context; context compact, yellow up to 1 mm thick; tube layer up to 0.8 mm, concolorous with the context, margin rounded, entire to lobed, yellowish when fresh, becoming brown and involute; hymenophore yellowish brown becoming light olive brown when mature, completely dark when dry; pores inconspicuous, circular to angular, 8–10/mm, dissepiments entire to slightly lacerated. attached to living roots, mostly prostrate on soil, several s entirely fused, eccentric to lateral, with a contracted base, strongly flexuous, nodose, uneven, up to 20 mm wide at the base and 50 mm high; surface as a compressible tomentum, becoming hard and adpressed velutinate to scrupose with age, a thin dark line separating it from the context; context compact, shiny, similar to the context of the pileus in colour and texture. Hyphal system monomitic. Generative hyphae septate, slightly to moderately thick-walled, with wide lumen, pale to golden yellow or chestnut, more frequent on the context of pileus and 3.5–5  $\mu\text{m}$  wide; at the tomentum loosely interwoven, straight, mostly unbranched. Basidia 4-sterigmate, 11–15.5  $\times$  4–5  $\mu\text{m}$ , cylindrical to broadly clavate, thin-walled, hyaline in KOH. Basidioles spherical to barrel-shaped, thin-walled, hyaline in KOH, shorter. Cystidia difficult to find, 12.5–17  $\times$  3.5–5  $\mu\text{m}$ , lageniform to cylindrical, hyaline in KOH, thin-walled. Basidiospores broadly ellipsoid to ellipsoid in equatorial lateral view sometimes with either one flattened side on the equatorial or in the polar view, or in both; pale yellow in KOH, thick-walled, smooth, 3–3.5(–4)  $\times$  2–3  $\mu\text{m}$  IKI-, collapsed in dried specimens, flattened and concave to lenticular when dehydrated.

Habitat – Parasite in roots of lianas, growing on the ground in clusters. Pantanal ecoregion.

Known distribution – reported in Brazil for the state of Santa Catarina (Ferreira-Lopes et al. 2016).

Material examined – PARAGUAY, Alto Paraguay Department, Bahía Negra City, Estación Biológica Tres Gigantes, Ariraí Path, 20°04'39.8"S, 58°09'35.6"W, 26 June 2017, Y. Maubet 059 (FACEN 004507).

Notes – *Phylloporia nodostipitata* is characterized by presenting stipitate basidiomata, seasonal to reviving, with brownish yellow pileus, tomentose pileal surface, knotted and irregularly flexuous, 8–10(–12) pores p/mm and broadly ellipsoid basidiospores [2.5–3.5  $\times$  2–3(–3.5)  $\mu\text{m}$ ] (Ferreira-Lopes et al. 2016). *Phylloporia elegans* Ferreira-Lopes, Robledo & Drechsler-Santos is a similar species, both share similar pore sizes and basidiospores size, but mainly differ in the pileal surface: the pileal surface of *P. nodostipitata* is a tomentum formed by loosely interwoven hyphae of undefined growth whereas in *P. elegans* the pileal surface consists of short and anticlinal hyphae, here referred to as a plagiotrichoderm (Ferreira-Lopes et al. 2016). Another related species is *Phylloporia verae-crucis* (Berk.) Ryvar den, which also has stipitate basidiomata but mainly differs from *P. nodostipitata* by being strictly seasonal, a laterally short-stipitate (or pseudo-stipitate), and by the presence of elongate to cylindrical basidiospores which are larger [4–5  $\times$  2–3(–3.5)  $\mu\text{m}$ ] (Ferreira-Lopes et al. 2016).

***Tropicoporus drechsleri*** Salvador-Montoya & Popoff, Phytotaxa 338 (1): 80 (2018) Fig. 7a–d  
Facesoffungi number: FoF08422

Description – Basidiomata perennial, 90–146  $\times$  38–66  $\times$  25–40 mm, sessile, pileate, solitary, hard and woody, widely attached, pileous triquetrous to unguulate, pileate surface rimose resembling hard wood with concentric and radial cracks, dark brown, golden chestnut in the new basidiome to almost black when dry. Margin entire, steril, finely velutinose, golden brown paler than the rest when developing, dark and rimose when dry. Pore surface golden brown when young to dark brown when old, pores 4–6/mm, round to angular, dissepiments entire. Context relatively thin on mature samples, 5 mm thick, golden brown to ferruginous brown, sometimes thin threads of new pale to whitish mycelium can be seen in the context going towards the old tubes. Tube layers numerous, darker than context, with or without a very thin line of context separating each layer. Hyphal system dimitic in context and tubes. Generative hyphae simple septate, 2–3  $\mu\text{m}$  diam., hyaline to yellowish, thin-walled to slightly thick-walled, branched. Skeletal hyphae golden brown to brown, 3.5–4.5  $\mu\text{m}$  diam, thick-walled, unbranched. Hymenial setae abundant, ventricose, uniradicated, 20–30.5 (–37)  $\times$  6.5–8  $\mu\text{m}$ , brown to ferruginous brown, thick-walled. Basidia not

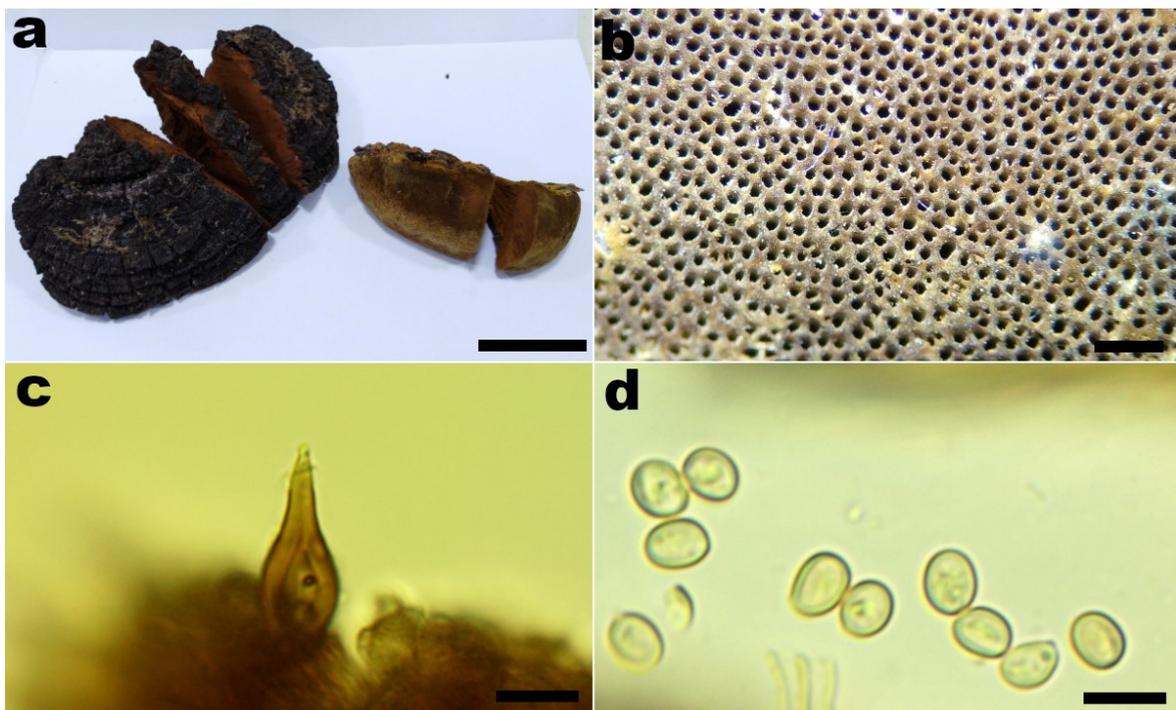
observed. Cystidia clavate with rostrate apex to ventricose, hyaline, thin-walled,  $13.5\text{--}23 \times 5.5\text{--}7.2$   $\mu\text{m}$ . Basidiospores ellipsoid, with a flattened side,  $5\text{--}6 \times 4\text{--}4.5$   $\mu\text{m}$ , thick-walled, smooth, hyaline to yellowish in water, to light golden brown in KOH, IKI-.

Habitat – Growing, so far, exclusively on standing living trees of *Cordia americana* (L.) Gottschling & J.S. Mill. (Salvador-Montoya et al. 2018), in Pantanal ecoregion.

Known distribution – So far recorded in Argentina for the provinces of Chaco, Corrientes, Formosa and Misiones (Salvador-Montoya et al. 2018).

Material examined – PARAGUAY, Alto Paraguay Department, Bahía Negra City,  $20^{\circ}25'27.8''\text{S}$   $58^{\circ}25'17.8''\text{W}$ , 7 August 2019, in *Cordia americana*, Y. Maubet 114, (FACEN 004510).

Notes – *Tropicoporus drechsleri* is characterized by applanate to unguulate, imbricate, basidiomata, a rimose pileal surface, a duplex context with a black line and relatively large pores (Salvador-Montoya et al. 2018). Macroscopically resembles *Phellinus chaquensis* (Iaconis & J.E. Wright) J.E. Wright & J.R. Deschamps, however, *Phellinus chaquensis* has ellipsoid to broadly ellipsoid or subglobose without a flattened side (Drechsler-Santos et al. 2016) and grows exclusively on *Schinopsis* spp. (Anacardiaceae) (Rajchenberg & Robledo 2013). The mature basidiomata of *T. drechsleri* also resembles *T. sideroxylicola* (Vlasák & Y.C. Dai) L.W. Zhou, Y.C. Dai & Vlasák and *T. dependens* (Murrill) L.W. Zhou, Y.C. Dai & Vlasák but both species differ in the absence of a duplex cortex, the size of the pores (2–3 pores/mm and 5–7 pores/mm respectively) and a dimitic hyphal system throughout (Salvador-Montoya et al. 2018).



**Fig. 7** – *Tropicoporus drechsleri*. a Basidiomata. b Detail of the pore surface. c Hymenial setae. d Basidiospores in water. Scale bars: a = 40 mm, b = 1 mm, c = 8  $\mu\text{m}$ , d = 6  $\mu\text{m}$ .

## Conclusion

Thirteen species of Hymenochaetaceae are reported in this work. Eleven common Neotropical species such as *Fomitiporia neotropica* (Campos Santana et al. 2014) and *Fuscoporia gilva* (Fidalgo & Fidalgo 1968, Ryvarden 2004) are recorded for the first time in Paraguay, evidencing the lack of surveys in the country.

*Phellinotus* Drechsler-Santos, Robledo & Rajchenb. was recently described (Drechsler-Santos et al. 2016) including pathogenic species commonly on living members of the family Fabaceae, and so far, endemic to the Neotropic. Two unidentified *Phellinotus* spp. reported in this

work do not match with *Phellinotus* species described until now. In addition, host trees species could not be identified and further studies integrating morphological and ecological studies, along with DNA-based phylogenetic analyses, are necessary to determine the taxonomical status of the studied specimens. *Tropicoporus drechsleri* was recently described species from the argentinian Chaco, host specific on *Cordia americana* (Salvador-Montoya et al. 2018). The new record from Paraguay was found on the same substrate.

It has been suggested that the ratio of endemic species in *Phellinus* s. l. and *Inonotus* s. l. is high in southern South America (Ryvarden 1991, 1996), and it has been hypothesised that the high proportion of regional endemism in this group could be attributed, at least in part, to their capacity to decay wood on living trees in the particular flora of South America, and that the distributions of facultative parasite polypores might be closely related to host plant distributions (Robledo et al. 2006). These ideas have been consolidated with recent phylogenetic studies describing many taxa, species and genera, with host specificity (Valenzuela et al. 2011, Ferreira-Lopes et al. 2016, Drechsler Santos et al. 2016, Salvador-Montoya et al. 2018, 2020).

The results of this work suggest that the knowledge of Hymenochaetae diversity in the Ecoregions of Paraguay is largely underestimated, and that studies of this important group of pathogenic fungi are necessary.

### Acknowledgments

Financial support to this study was provided by Fungi Paraguay, Fundación Fungicosmos and FONCYT (PICT 0830 to G. Robledo). Authors thank Professor Maria Vera and MSc. Claudia Mancuello for field assistance. Dr. Valéria Ferreira-Lopes is kindly acknowledged for her valuable comments on the identity of *Phylloporia* species. Anonymous reviewers are kindly acknowledged for discussions and comments that improved the manuscript. MSc. Andrew Cervantes is acknowledged for the revision of the manuscript's English and for the valuable contribution to the writing. The assistance of FACEN - Universidad Nacional de Asunción, the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) and the Universidad Nacional de Córdoba, institutions which supported facilities used in this project, are also acknowledged.

### References

- Aime MC, Henkel TW, Ryvarden L. 2003 – Studies in neotropical polypores 15: new and interesting species from Guyana. *Mycologia* 95(4), 614–619.
- Baltazar JM, Gibertoni TB. 2009 – A checklist of the aphyllorphoroid fungi (Basidiomycota) recorded from the Brazilian Atlantic Forest. *Mycotaxon* 109(1), 439–442.
- Baltazar JM, Trierweiler-Pereira L, Loguercio-Leite C, Ryvarden L. 2009 – Santa Catarina Island mangroves 3: a new species of *Fuscoporia*. *Mycotaxon* 101(6), 859–863.
- Baltazar J M, Ryvarden L, Gibertoni TB. 2010 – The genus *Coltricia* in Brazil: new records and two new species. *Mycologia* 102(6), 1253–1262.
- Campos Santana M, Amalfi M, Robledo G, Da Silveira RB, Decock C. 2014 – *Fomitiporia neotropica*, a new species from South America evidenced by multilocus phylogenetic analyses. *Mycological progress* 13(3), 601–615.
- Campos Santana M, Robledo G, Decock C, Da Silveira RMB. 2015 – Diversity of the Poroid Hymenochaetae (Basidiomycota) from the Atlantic Forest and Pampa in Southern Brazil. *Cryptogamie Mycologie* 36(1), 43–79.
- Corner EJH. 1991 – Ad Polyporaceas VII. *Beihefte zur Nova Hedwigia* 101, 1–175.
- Decock C, Amalfi M, Robledo G, Castillo G. 2013 – *Phylloporia nouraguensis*, an undescribed species on Myrtaceae from French Guiana. *Cryptogamie Mycologie* 34(1), 15–28.
- Dinerstein E, Olson DM, Graham DJ, Webster A et al. 1995 – Una Evaluación del Estado de Conservación de las Eco-regiones Terrestres de América Latina y el Caribe. Banco Mundial, Washington, DC.

- Donk MA. 1948 – Notes on Malesian fungi. I. Bulletin of the Botanical Gardens Buitenzorg. 17, 473–482.
- Drechsler-Santos ER, Robledo GL, Lima-Junior NC, Malosso E et al. 2016 – *Phellinotus*, a new neotropical genus in the Hymenochaetaceae (Basidiomycota, Hymenochaetales). Phytotaxa 261(3), 218–239.
- Ferreira-Lopes VF, Robledo GL, Reck MA, Neto AG, Drechsler-Santos ER. 2016 – *Phylloporia spathulata* sensu stricto and two new South American stipitate species of *Phylloporia* (Hymenochaetaceae). Phytotaxa 257(2), 133–148.
- Fiasson JL, Niemelä T. 1984 – The Hymenochaetales: a revision of the European poroid taxa. Karstenia 24, 14–28.
- Fidalgo O, Fidalgo M. 1968 – Polyporaceae from Venezuela. I. Memoirs of the New York Botanical Garden 17, 1–34.
- Gerber AL. 1996 – Fungos xilófilos poróides (Aphyllorphorales) no Morro da Lagoa da Conceição, Ilha de Santa Catarina, SC, Brasil. Insula 25, 3–68.
- Gerlach ACL, Campos Santana M, Gutjahr M, Loguercio Leite C. 2013 – Wood-decaying Agaricomycetes (Basidiomycota, Fungi): new records for the state of Santa Catarina, Brazil. Acta Botanica Brasilica 27(2), 460–464.
- Gibertoni TB, Gomes-Silva AC, Chikowski RS, Lira CRS et al. 2015 – Hymenochaetales in Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB17>. (Accessed 24 Jun 2019).
- Gibertoni T, Ryvarde L, Cavalcanti MAQ. 2004 – Poroid fungi (Basidiomycota) of the Atlantic rain forest in Northeast Brazil. Synopsis Fungorum 18, 33–43.
- Gilbertson RL, Ryvarde L. 1986–1987 – North American Polypores. 2 vols. Fungiflora, Oslo.
- Gilbertson RL, Ryvarde L. 1996 – North American Polypores. Fungiflora, Oslo, Norway I.
- Góes-Neto A. 1999 – Polypore diversity in the state of Bahia, Brazil: a historical review. Mycotaxon 72, 43–56.
- Gomes-Silva AC, Baltazar JM, Gibertoni TB. 2012 – *Coltricia* and *Hymenochaete* (Hymenochaetaceae) from the Amazonia and the Atlantic Forest, Brazil: One new combination and new records. The Journal of the Torrey Botanical Society 139(4), 428–437.
- Gomes-Silva AC, Ryvarde L, Gibertoni TB. 2013 – *Inonotus amazonicus* sp. nov., *I. calcitratus* comb. nov. and notes on *Phylloporia* (Hymenochaetaceae, Agaricomycetes) from the Brazilian Amazonia. Mycoscience 54(2), 116–121.
- Gómez-Montoya N, Drechsler-Santos ER, Ferreira Lopes V, Tomšovský M et al. 2017 – New insights on *Trametopsis* Tomšovský (Polyporales Gäum) based on phylogenetic evidences and morphological analyses of neotropical species. Phytotaxa 311(2), 155–167.
- Gottlieb AM, Wright JE, JM Moncalvo. 2002 – *Inonotus* s.l. in Argentina - morphology, cultural characters and molecular analyses. Mycological Progress 1, 299–313.
- Groposo C, Loguercio-Leite C, Goes-Neto A. 2007 – *Fuscoporia* (basidiomycota, Hymenochaetales) in Southern Brazil. Mycotaxon 101(1), 55–63.
- Hamilton SK. 1999 – Potential effects of a major navigation project (Paraguay – Paraná Hidrovía) on inundation in the Pantanal floodplains. Regulated Rivers: Research & Management 15, 289–299.
- Hibbett DS, Bauer R, Binder M, Giachini AJ et al. 2014 – 14 Agaricomycetes. In: Systematics and evolution. Springer Berlin Heidelberg.
- Ibáñez C. 1998 – Contribución al estudio de hongos xilófagos en la provincia de Misiones. Argentina. (Basidiomycetes, Aphyllorphorales) II. Polyporaceae. Boletín de la Sociedad Argentina de Botánica 33, 157–169.
- Jayasiri C, Hyde KD, Ariyawansa H, Bhat J et al. 2015 – The Faces of Fungi database: fungal names linked with morphology, phylogeny and human impacts. Fungal diversity 74(1), 3–18.
- Larsen MJ, Cobb-Pouille LA. 1990 – *Phellinus* (Hymenochaetaceae). A survey of the world taxa. Fungiflora, Oslo.

- López S. 1988 – Sucesión fúngica en madera de *Eucalyptus viminalis* (Myrtaceae) II. Basidiomycetes sobre toe ones. Boletín de la Sociedad Argentina de Botánica 25, 425–447.
- Martínez O, Valenzuela E. 2004 – Aphyllophorales citados para Chile. Boletín Micológico 19, 103–110.
- Meijer AAR. 2006 – Preliminary list of the macromycetes from the Brazilian state of Paraná. Boletim do Museu Botânico Municipal 68, 1–55.
- Olson DM, Dinerstein E, Wikramanayake ED, Burgess ND et al. 2001 – Terrestrial Ecoregions of the World: A New Map of Life on Earth A new global map of terrestrial ecoregions provides an innovative tool for conserving biodiversity. BioScience 51(11), 933–938.
- Parmasto E. 1988 – What is *Ochroporus ossatus* (Hymenochaetaceae)? Mycotaxon 32, 219–222.
- Pires RM, Motato-Vásquez V, De Gugliotta AM. 2015 – *Fuscoporia atlantica* sp. nov., a new polypore from the Brazilian Atlantic Rainforest. Mycotaxon 130(3), 843–855.
- Popoff OF. 2000 – Novedades sobre “Corticoides” y “Políporos” (Basidiomycetes) xilófilos del nordeste Argentino. Tesis Doctoral. Universidad Nacional de Córdoba.
- Popoff O, Wright J. 1998 – Fungi of Paraguay I. Preliminary checklist of wood-inhabiting polypores (Aphyllophorales, Basidiomycota). Mycotaxon 67, 323–340.
- Rajchenberg M, De Meijer AAR. 1990 – New and noteworthy polypores from Paraná and São Paulo states, Brazil. Mycotaxon 38, 173–185.
- Rajchenberg M, Robledo G. 2013 – Pathogenic polypores in Argentina. Forest Pathology 43(3), 171–184.
- Rajchenberg M, Wright JE. 1998 – Two interesting polypore species (Hymenochaetales) from Argentina. Folia Cryptogamica Estonica 33, 119–122.
- Raymundo T, Valenzuela R. 2003 – Los poliporáceos de México VI. Los hongos poliporoides del estado de Oaxaca. Polibotánica 16, 79–112.
- Raymundo T, Valenzuela R, Esqueda M. 2009 – The family Hymenochaetaceae from México 4. New records from Sierra de Álamos–Río Cuchujaqui biosphere reserve. Mycotaxon 110(1), 387–398.
- Raymundo T, Valenzuela R, Bautista-Hernández S, Esqueda M, Cifuentes C, Pacheco L. 2013 – El género *Fuscoporia* (Hymenochaetales, Basidiomycota) en México. Revista mexicana de biodiversidad 84, S50–S69.
- Ramos AP, Caetano MF, Melo I. 2008 – *Inonotus rickii* (Pat.) Reid: an important legnicolous basidiomycete in urban trees. Revista de Ciências Agrárias 31(2), 159–167.
- Robledo GL. 2009 – Hongos degradadores de la madera de las Yungas argentinas. Diversidad de Políporos (Aphyllophorales, Basidiomycota) (Doctoral dissertation, Doctoral thesis, Universidad Nacional de Córdoba).
- Robledo GL, Rajchenberg M. 2007 – South American polypores: first annotated checklist from Argentinean Yungas. Mycotaxon 100, 5–9.
- Robledo G, Urcelay C. 2009 – Hongos de la Madera en árboles nativos del centro de Argentina. Editorial Universidad Nacional de Córdoba, Argentina.
- Robledo G, Urcelay C, Dominguez L, Rajchenberg M. 2006 – Taxonomy, ecology, and biogeography of polypores (Basidiomycetes) from Argentinian *Polylepis* woodlands. Canadian Journal of Botany, 84(10), 1561–1572.
- Robledo G, Urcelay C, Rajchenberg M. 2003 – New species causing decay on living *Polylepis australis* in Córdoba, central Argentina. Mycologia, 95(2), 347–353.
- Ruiz-Boyer A. 1999 – *Inonotus splitgerberi* (Hymenochaetaceae): un nuevo registro para Costa Rica. Brenesia 52, 73–74.
- Ryvarden L. 1991 – Genera of polypores, nomenclature and taxonomy. Synopsis Fungorum Vol. 5. FungiFlora Oslo, Norway.
- Ryvarden L. 1996 – Biodiversity in polypore fungi: A comparison between tropical Africa and America. Revista de Biología Tropical 44, 125–129.
- Ryvarden L. 2004 – Neotropical Polypores 1. Synopsis Fungorum 19, 1–229.

- Ryvarden L, De Meijer AAR. 2002 – Studies in Neotropical polypores 14 – new species from the state of Parana, Brazil. *Synopsis Fungorum* 15, 34–69.
- Ryvarden L, Gilbertson RL. 1993 – European polypores. Vol 1. *Fungiflora*, Oslo, Norway.
- Ryvarden L, Gilbertson RL. 1994 – European polypores 2. *Meripilus– Tyromyces*. *Synopsis Fungorum* 7. *Fungiflora*, Oslo.
- Ryvarden L, Johansen I. 1980 – A preliminary polypore flora of East Africa. *Fungiflora*, Oslo.
- Ryvarden L, Melo I. 2014 – Poroid fungi of Europe. Oslo.
- Salvador-Montoya CA, Costa-Rezende DH, Ferreira-Lopes V, Borba-Silva MA, Popoff OF. 2018 – *Tropicoporus drechsleri* (Hymenochaetales, Basidiomycota), a new species in the “*Inonotus linteus*” complex from northern Argentina. *Phytotaxa* 338(1), 75–89.
- Salvador-Montoya CA, Popoff O, Góes-Neto A, Drechsler-Santos E. 2020 – Global phylogenetic and morphological reassessment of *Fomitiporella* sl (Hymenochaetales, Basidiomycota): taxonomic delimitation of *Fomitiporella* ss and segregation of *Rajchenbergia*, gen. nov. *Plant Systematics and Evolution*, 306(2), 1–27.
- Soares SCS, Gugliotta AM. 1998 – Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. *Fungos 7: Aphyllophorales (Hymenochaetaceae)*. *Hoehnea* 25(1), 11–31.
- Spegazzini CL. 1883 – Fungi Guaranitici. *Pugillus* I. *Anales de la Sociedad Científica Argentina* 16 (6), 272–284.
- Spegazzini CL. 1884 – Fungi Guaranitici. *Pugillus* 1. *Anales de la Sociedad Científica Argentina* 17, 69–96, 119–134; 18, 263–284.
- Spegazzini CL. 1888 – Fungi Guaranitici. *Pugillus* 2. *Anales de la Sociedad Científica Argentina* 26 (1), 5–74.
- Spegazzini CL. 1889 – Fungi nonnulli Paraguariae et Fuegiae. *Revue Mycologique Toulouse* 11 (42), 93–95.
- Spegazzini CL. 1891 – Fungi Guaranitici nonnulli novi vel critici [part 1]. *Revista Argentina de Historia Natural* 1(2), 101–111.
- Spegazzini CL. 1919 – Reliquiae mycologicae tropicae. *Boletín de la Academia Nacional de Ciencias Córdoba* 23, 365–541.
- Spegazzini CL. 1922 – Fungi Paraguayenses. *Anales del Museo Nacional de Historia Natural de Buenos Aires* 31, 355–450.
- Stalpers JA. 2000 – The genus *Ptychogaster*. *Karstenia* 40, 167–180.
- Valenzuela R, Raymundo T, Cifuentes J, Castillo G et al. 2011 – Two undescribed species of *Phylloporia* from Mexico based on morphological and phylogenetic evidence. *Mycological progress* 10(3), 341–349.
- Valenzuela R, Raymundo T, Cifuentes J. 2013 – El género *Inonotus* sl (Hymenochaetales: Agaricomycetes) en México. *Revista mexicana de biodiversidad* 84, 70–90.
- Vinha PC. 1988 – Fungos macroscópicos do estado do Espírito Santo depositados no Herbário Central da Universidade Federal do Espírito Santo, Brasil. *Hoehnea* 15, 57–64.
- Wagner T, Fischer M. 2001 – Natural groups and a revised system for the European poroid Hymenochaetales (Basidiomycota) supported by nLSU rDNA sequence data. *Mycological Research* 105, 773–782. Doi: 10.1017/S0953756201004257
- Wagner T, Fischer M. 2002 – Proceedings towards a natural classification of the worldwide taxa *Phellinus* sl and *Inonotus* sl, and phylogenetic relationships of allied genera. *Mycologia* 94(6), 998–1016.
- Wagner T, Ryvarden L. 2002 – Phylogeny and taxonomy of the genus *Phylloporia* (Hymenochaetales). *Mycological Progress* 1, 105–116.
- Westphalen MC, Reck MA, Silveira RMBD. 2010 – Polypores from Morro Santana, Rio Grande do Sul, Brazil. *Hoehnea* 37(3), 647–662.