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ORIGINAL ARTICLE

Phellinus piptadeniae (Hymenochaetales: Hymenochaetaceae): taxonomy and host range of a species with disjunct distribution in South American seasonally dry forests

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Abstract *Phellinus piptadeniae* (Hymenochaetaceae, Hymenochaetales) as currently accepted is characterized by having applanate to ungulate basidiome with the pilear surface concentrically sulcate, radially cracked in old specimens, and a sinuous black line in the context. The species has been recorded in seasonally dry forests of different Brazilian domains, often associated with legume hosts. It occurs highly specifically associated with *Piptadenia gonoacantha* in semideciduous forest of the Atlantic Forest domain in southeastern Brazil. In the Caatinga dry woodlands, northeastern Brazil, *Phellinus piptadeniae* occurs as host recurrent of different *Piptadenia* species. During recent polypore surveys, specimens that are morphologically similar to the type were collected in seasonally dry tropical forests (SDTFs) of northwestern Peru also on legume hosts (*Libidibia glabrata* and *Pithecellobium excelsum*). In this paper, we discuss the morphological variation, host range, and distribution of *Phellinus piptadeniae* in the context of the historical biogeography of the neotropical SDTF biome. Some taxonomic implications that should be further investigated in a molecular phylogenetic framework are also addressed.

Keywords Atlantic Forest · Brazil · Caatinga · Peru · Polypore

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Introduction

The taxonomy of Hymenochaetales, the largest radiation of wood-decaying fungi (Floudas et al. 2012), has seen considerable advance in recent years (e.g., Larsson et al. 2006; Zhou and Dai 2011; He and Dai 2012; Amalfi and Decock 2013; Tian et al. 2013; Zhou and Qin 2013; Zhou 2014). However, poroid Hymenochaetales still remain under studied and under collected in the Neotropics, especially in the Seasonally Dry Tropical Forest (SDTF) biome (Drechsler-Santos et al. 2010, 2013). This is the case of the *Phellinus piptadeniae* Teixeira, a species herein shown to comprise widely disjunct populations that are largely confined to South American SDTF.

Teixeira (1950) pointed out that *P. piptadeniae* probably follows the geographical distribution of its highly specific host *Piptadeniae communis* (= *Pip. gonoacantha*), a common mimosoid legume distributed throughout the semideciduous forests of the Atlantic Forest and Cerrado domains in southern and central Brazil (Morim 2013). Sixty years after its original description, the species was rediscovered by Drechsler-Santos et al. (2010) during an ecological study in northeastern Brazil. As such, they expanded the

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distribution and host range of *P. piptadeniae* to different species of *Piptadenia* Benth., but also to species of *Senegalia* Raf. and *Mimosa* R.Br., in the Caatinga dry woodlands of Bahia, Ceará, Pernambuco, and Piauí states (Drechsler-Santos et al. 2010, 2013). Recently, during a survey of poroid Hymenochaetales in dry woodlands of northwestern Peru and in the Atlantic Forest of southeastern Brazil, we collected several specimens that were tentatively also determined as *P. piptadeniae*. These specimens unusually have basidiomata with a particular hyphal system in that the skeletal hyphae are restricted to the trama of tubes and the context is monomitic.

A critical comparison of the new collections from southeastern Brazil and Caatinga (Drechsler-Santos et al. 2010, 2013), and the widely disjunct population in Peru with the type of *P. piptadeniae* became necessary to establish a morphological circumscription of the species. We present a comparative morphological analysis of such collections and discuss the species and generic level taxonomy of *P. piptadeniae*. Its host specialization on legumes and apparent ecological predilection for neotropical seasonally dry forests are also commented.

Materials and methods

Study area and collections

Collections from Cabuyal ravine, Department of Piura, Northwest Peru, were made in 2012 in a lowland area of Seasonally Dry Tropical Forest (SDTF). In the Atlantic Forest of Brazil, collections were performed near the type locality, in São Paulo state, and in Santa Catarina state in 2013 and 2014. Specimens are kept at USM and FLOR herbaria (acronyms according to Thiers 2014, continuously updated).

Morphological studies

Size, shape, and color of basidiomata (pilear surface, context, tubes, pores, and dissepiment) as well as the pore surface (number of tubes strata and of pores per linear millimeter) were observed to describe seasonality. Colors were determined following Munsell Color Company (1975). Microscopical examination was achieved from freehand sections of specimens mounted in lactophenol (non-reaction), 3 % (v/w) KOH solution (xanthochroic), Melzer (dextrinoid or amyloid) and Cotton Blue (-cyanophilia) reagents to determine the presence or absence of reactions. All microscopic measurements ($n = 40$) and drawings were made in 3 % (v/w) KOH solution. When presenting the size range of the microscopic elements, 5 % of the measurements were excluded from each end and are

given in parentheses. The following abbreviations are used throughout the text: L = longitude, W = wide, Q = the ratio of length/width and avg. = average of basidiospores measurements.

Results

Phellinus piptadeniae grows mostly on living legume species (Table 1). In the semideciduous forests of the Atlantic Forest domain in southeastern Brazil, *P. piptadeniae* was found exclusively growing on *Piptadenia gonoacantha*; whereas in the Caatinga dry woodlands, it was found recurrently on *Piptadenia* spp., but also on *Mimosa* and *Senegalia*. We also found the species on *Libidibia glabrata* (Kunth) Castellanos & G.P.Lewis and *Pithecellobium excelsum* (Kunth) Mart. in seasonally dry forests of northwestern Peru. This greatly expands the geographic and host range of *P. piptadeniae* (Fig. 1).

The detailed analysis of type collection of *P. piptadeniae* as well as collections from Brazilian Caatinga and the newly collected specimens in southern Brazil and northwestern Peru revealed differences in the hyphal system and spore morphology when compared to the original species description. Hence, an updated detailed description is presented below.

Discussion

Morphology and taxonomic status

All the studied specimens presented a dimitic (generative and skeletal hyphae) hyphal system in the trama of tubes, but a monomitic context with generative hyphae only (Table 1; Fig. 3). This hyphal structure was not mentioned in the original description. Teixeira (1950) described two types of septate hyphae (branched and unbranched hyphae) in the basidiome structure. Skeletal hyphae restricted to the trama of the tubes were also not reported by Ryvarden (2004). We newly observed that the basidiospores are broadly ellipsoid to ellipsoid and present a xanthochroic reaction in KOH (Fig. 2). As such, *Phellinus piptadeniae* is recognized here in a wide sense, characterized by the combination of a perennial, triquetrous to ungulate basidiome, the upper surface of the pileus becoming rimose, with small scales, context layers between the tube strata, and a black line in the context (Fig. 2). Microscopically, it is characterized by a dimitic hyphal system in the trama of tubes, monomitic in the context, absence of setae, and ellipsoid to broadly ellipsoid, thick-walled, ventrally flattened, yellowish, and xanthochroic basidiospores.

Table 1 Comparison of morphological and eco-biogeographical features in specimens of the hymenochaetoid *Phellinus piptadeniae*

Specimens	Pore surface			Hyphae system		Spore		Substrata	Biomes
	Pore (mm)	Avg. Ø pore (μm)	Avg. Ø dissepiment (μm)	Context	Tubes	Avg. long (μm)	Avg. wide (μm)		
IAC 4365[a]	(3–) 4–5 (–6)	176.00	127.30	M	D	5.30	4.20	*Pip. gonoacantha*	AF-SP
FLOR 19926	3–4	369.00	88.00	M	D	5.00	3.50	*Pip. gonoacantha*	AF-SP
FLOR 30457	4–5	197.00	54.00	M	D	5.02	3.57	*Pip. gonoacantha*	AF-SP
FLOR 39430	4–5 (–6)	218.00	54.00	M	D	4.95	3.52	*Pip. gonoacantha*	AF-SP
FLOR 51449	4–5	227.00	58.00	M	D	5.05	3.60	*Pip. gonoacantha*	AF-SP
FLOR 51450	(3–) 4–5	272.00	57.00	M	D	4.85	3.60	Log or dead trunk	AF-SP
Variation of avg. and (Arithmetic mean of the individual avg.)						4.85–5.30 (5.02)	3.50–4.20 (3.66)		
FLOR 39571	5–6 (–7)	204.50	66.88	M	D	4.56	3.81	*Pip. gonoacantha*	AF-SC
FLOR 39572	5–6 (–7)	181.30	51.40	M	D	5.10	4.00	*Pip. gonoacantha*	AF-SC
FLOR 39573	5–6 (–7)	167.10	67.30	M	D	5.20	4.20	*Pip. gonoacantha*	AF-SC
FLOR 39574	5–6 (–7)	171.00	72.80	M	D	5.60	4.30	*Pip. gonoacantha*	AF-SC
FLOR 51451	5–6	193.00	46.00	M	D	4.95	3.70	Log or dead trunk	AF-SC
Variation of avg. and (Arithmetic mean of the individual avg.)						4.56–5.60 (5.11)	3.70–4.30 (4.07)		
URM 80322	4–5 (–6)	188.80	101.30	M	D	5.30	3.90	*Mimosa* sp.	CAA
URM 80345	(4–) 5–6 (–7)	215.00	63.00	M	D	5.00	3.60	*Senegalia* sp.	CAA
URM 80768	(4–) 5–6	215.50	53.80	M	D	5.20	3.80	*Piptadenia* sp.	CAA
Variation of avg. and (Arithmetic mean of the individual avg.)						5.00–5.30 (5.16)	3.60–3.90 (3.76)		
USM 250528	(4–) 5–6 (–7)	200.00	59.80	M	D	5.50	4.20	*Pit. excelsum*	PER
FLOR 16944	4–5 (–6)	214.30	66.00	M	D	5.60	4.50	*Libidibia glabrata*	PER
USM 258362	4–5 (–6)	241.00	65.50	M	D	5.80	4.60	*Libidibia glabrata*	PER
USM 258366	4–5 (–6)	213.30	66.50	M	D	5.60	4.20	*Libidibia glabrata*	PER
Variation of avg. and (Arithmetic mean of the individual avg.)						5.50–5.80 (5.62)	4.20–4.60 (4.37)		

Avg. average, *M* monomitic, *D* dimitic, *AF* semideciduous forest of the Brazilian Atlantic Forest domain, *CAA* Brazilian Caatinga dry woodland, *PER* Peruvian SDTF, *SP* São Paulo states, *SC* Santa Catarina, *Pip. Piptadenia*, *Pit. Pithecellobium*

[a] Type

Fig. 1 Disjunct distribution of *PheIllinus piptadeniae* (*red circles*) in the South American Seasonally Dry Tropical Forest (SDTF) biome. The northernmost points in Brazil fall within the limits of the Caatinga dry woodlands, whereas southernmost points come from semideciduous or deciduous forests within the limits of the Brazilian Atlantic Forest domain. The records in Peru are from lowland seasonally dry forests. The distribution of the SDTFs follows Särkinen et al. (2011a), who modeled the biome using georeferenced herbarium plant specimen data of SDTF habitat specialist species
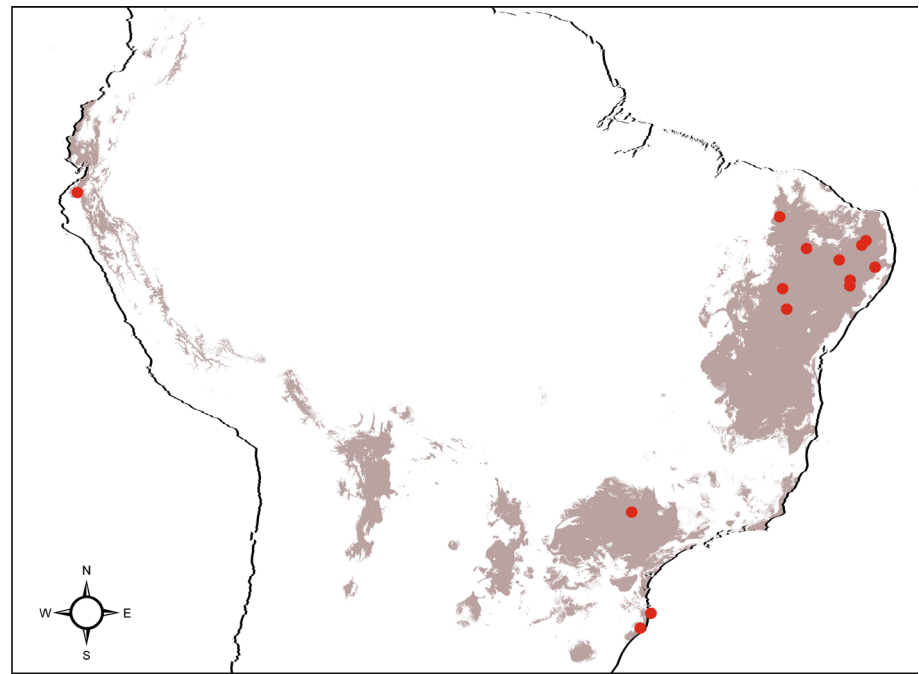
Although *P. piptadeniae* has been suggested to be conspecific with *P. rimosus* species complex (Ryvarden 2004), a recent study of morphology and ecology (Drechsler-Santos et al. 2010) revealed that these species are taxonomically distinct and have different ecological preferences, such as the host specialization on particular native plants. *Phellinus piptadeniae* frequently has a cracked pilear surface that is mostly glabrous and not deeply rimose when old (Fig. 2), in addition to the skeletal hyphae restricted to the tubes and a distinctive black line across the context (Fig. 2). These characters strongly support the identity of *P. piptadeniae* and clearly distinguish it from *P. rimosus* complex, which is widely recognized by the ungulate basidiome with a black and deeply rimose pilear surface, besides a dimitic hyphal system and rusty brown basidiospores (Kotlaba and Pouzar 1978).

Our concept of *P. piptadeniae* led us to include the 14 specimens newly collected during the polypore surveys in Peru and Brazil. Although the *P. piptadeniae* population from Peruvian lowland seasonally dry forests has strong morphological ties with the Brazilian Caatinga and Atlantic Forest populations, some differences between them are highlighted here (Table 1). For example, basidiospores of Brazilian specimens are slightly smaller (5–5.5 × 3.5–4 μm) than those of Peruvian specimens (5.5–6 × 4–4.5 μm). In fact, the average size of the basidiospores, but in combination with geography and molecular data, has been taxonomically relevant to differentiate morphologically similar species, as outstandingly exemplified with the cryptic speciation of *Fomitiporia* Murrill in the Neotropics (Decock et al. 2007). Despite some

morphological and ecological (e.g. distinct legume hosts) discontinuities among the allopatric populations of *P. piptadeniae* are clearly recognized, for the time being we maintain a wide taxonomic concept for the species, until further molecular studies are conducted.

The generic classification of *P. piptadeniae* in the new phylogenetic scenario of the *Phellinus* s.l. and *Inonotus* s.l. (Fiasson and Niemellä 1984; Wagner and Fischer 2002; Larsson et al. 2006) remains uncertain and should be further investigated. The combination of macro- and microcharacters of *P. piptadeniae* suggest that the species does not belong to *Phellinus* s.s., which is characterized by having dimitic hyphal system, hymenial setae, and hyaline to pale yellowish basidiospores (Wagner and Fischer 2002). The shared ellipsoid and colored basidiospores of *P. piptadeniae*, *Fomitiporella* Murrill, and *Inocutis* Fiasson & Niemelä have long been used to indicate their close affinity (Teixeira 1992). When combining *P. piptadeniae* in *Fomitiporella*, Teixeira (1992) did not give any reason for the placement in this genus. He overlooked the black line in the context of *P. piptadeniae* as a taxonomically important character. Even in his later publication "Genera of Polyporaceae" (Teixeira 1994), the genus *Fomitiporella*, including *P. piptadeniae*, is described as having context without dark lines. We are convinced that *P. piptadeniae* does not belong to *Fomitiporella* because this genus traditionally comprises resupinate species, with strictly dimitic hyphal system and small basidiospores (Fiasson and Niemelä 1984; Wagner and Fischer 2002). *Inocutis*, on the other hand, has a monomitic hyphal system throughout the basidiome. Preliminary molecular phylogenetic

evidence (Drechsler-Santos et al., unpublished data) show *P. piptadeniae* within a clade together with species of *Fulvifomes*, *Fomitiporella*, *Inocutis*, and *Phylloporia* Murrill, all of which characterized by lacking setae and having ellipsoid, flattened, thick-walled, and colored basidiospores (Fiasson 1982; Fiasson and Niemelä 1984; Wagner and Fischer 2002). That *P. piptadeniae* most likely will not be placed in *Phellinus* is becoming true. Notwithstanding, the phylogenetic relationship of *P. piptadeniae* in the context of the taxonomy of *Phellinus* s.l. and *Inonotus* s.l. is still far from being solved. Several changes are taking place in specific and generic classical concepts of the poroid Hymenochaetales, and many tropical species/lineages have not yet been included in molecular phylogenetic analyses (e.g., Wagner and Fischer 2002; Larson et al. 2006; Decock et al. 2007; Tian et al. 2013). Given that the phylogenetic analyses still poorly resolved lineages that could be equated to genera (Niemelä et al. 2001; Zhou and Qin 2013), we refrain to generate new combinations until robust molecular evidence is available. As such, we prefer to keep *P. piptadeniae* in its current generic classification to avoid proliferation of new scientific names (Murrill 1914; Fiasson 1982; Fiasson and Niemelä 1984).

Distribution, host range, and taxonomic implications

Phellinus piptadeniae was originally described from the Atlantic Forest of the Brazilian state of São Paulo (Teixeira 1950). After extensive field works in other neotropical seasonally dry forests, its geographic distribution is now considerably extended (Fig. 1). Although the Atlantic Forest is largely known to harbor wet forests, many enclaves of seasonally dry semideciduous or deciduous forests are scattered throughout. These enclaves of seasonally dry forests have floristic affinities with the SDTF biome (e.g. Amorim et al. 2005; Cardoso and Queiroz 2008; Oliveira-Filho et al. 2006, 2013). The modeled SDTF map of Särkinen et al. (2011a) gives a more realistic distribution of the biome in South America, clearly showing patches of seasonally dry forests within the limits of the Atlantic Forest domain. Therefore, *P. piptadeniae* might represent a new example of species with high ecological predilection for SDTF (Fig. 1).

Phellinus piptadeniae was supposed to grow exclusively on *Piptadenia gonoacantha* (Teixeira 1950), but here we have also expanded its host range (Table 1; Drechsler-Santos et al. 2010). The emerging pattern is that *P. piptadeniae* is remarkably often associated with SDTF-inhabiting legume species. There exist many other potential angiosperm hosts in this biome (Drechsler-Santos et al. 2010) but why *P. piptadeniae* seems to prefer the legumes remains an open question. Leguminosae is the most

species-rich plant family in the neotropical SDTFs (Lewis et al. 2006; Queiroz 2006; Linares-Palomino et al. 2011), where its diversification history date back from at least 20 Myr (Pennington et al. 2004, 2010; Lavin 2006; Queiroz and Lavin 2011; Särkinen et al. 2012). An interesting hypothesis to be addressed in the light of a molecular dating analysis of both hymenochaetoid and legume phylogenies is whether the legumes opened an ideal ecological niche for the establishment and evolution of *P. piptadeniae* geographically confined in the South American SDTFs.

The geographically isolated populations of *P. piptadeniae* in SDTFs matches with the general distribution pattern observed in bees (Zanella 2000), lizards (Werneck and Colli 2006), and myriad other species or clades of different plant families (e.g. Prado and Gibbs 1993; Prado 2000; Taylor and Zappi 2004; Lewis et al. 2006; Caetano et al. 2008; Pastore et al. 2010; Cardoso and Queiroz 2011; Carvalho-Sobrinho and Queiroz 2011; De-Nova et al. 2011; Govindarajulu et al. 2011; Oliveira et al. 2013; Cardoso et al. 2014). Prado and Gibbs (1993), Prado (2000) and Pennington et al. (2000) advocated that most plant speciation and geographical disjunction in the island-like distributed SDTFs were driven by the fragmentation of this once more widespread biome during wetter periods of the Pleistocene. However, new insights on the historical assembly of the SDTF have been revealed by time-calibrated phylogenies of geographically structured clades, which show the importance of phylogenetic niche conservatism, multiple dispersal events, and persistence of lineages for evolutionary periods that greatly transcend the Pleistocene (Pennington et al. 2004, 2009, 2010; Lavin 2006; De-Nova et al. 2011; Govindarajulu et al. 2011; Queiroz and Lavin 2011; Särkinen et al. 2012). Undoubtedly, a dated phylogeny of the hymenochaetoid clade of *P. piptadeniae* is required for reconstructing its historical biogeography in South American SDTFs and to evaluate the impact of Pleistocene fluctuations in its present-day distribution.

A densely sampled molecular phylogeny including multiple accessions certainly would also shed light whether the allopatric and morphologically relatively distinct populations of *P. piptadeniae* comprise three different species or just a widely distributed species with morphological variation in response to different hosts (Taylor et al. 2000). Studies in geographically disjunct SDTF plant clades have successfully identified cryptic species in the Brazilian Caatinga (Queiroz and Lavin 2011), Peruvian inter-Andean dry valleys (Pennington et al. 2011; Särkinen et al. 2011b), and Mesoamerican dry forests (Duno-de-Stefano et al. 2010; Govindarajulu et al. 2011). There is no study on speciation of fungi in SDTF, but the few examples from inter-continental disjunctions in closely related species have shown cryptic speciation followed by long-
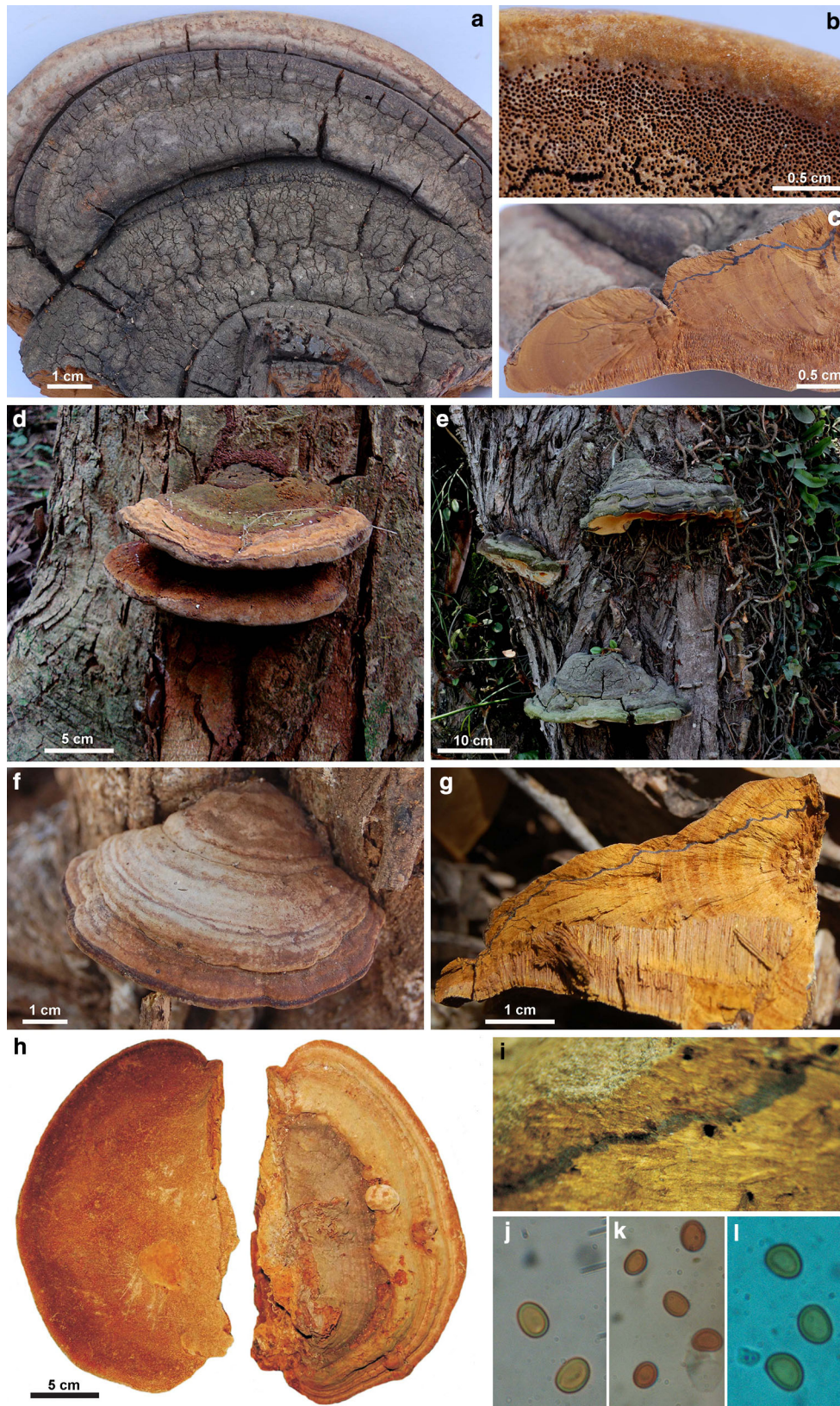
distance dispersal and geographical isolation (Halling et al. 2008; Moncalvo and Buchanan 2008; Liu et al. 2009). We expect that a revisit of *P. piptadeniae* based on phylogenetic analyses of DNA sequence variation will contribute to understand its biogeography and taxonomy and the diversification processes in the SDTF biome.

Taxonomic treatment

Phellinus piptadeniae Teixeira, Bragantia 10: 118. 1950. Figs. 1, 2, 3.

≡*Fomitiporella piptadeniae* (Teixeira) Teixeira, Revista Brasil Bot 15: 126. 1992.

Basidiome perennial, sessile, dimidiate, applanate, triquetrous to occasionally ungulate, solitary, up to 230 mm long, 190 mm wide and 83 mm thick, woody hard; pilear surface first pubescent and dark brown (HUE 7.5YR, 4/6), soon glabrous and dark grayish brown (HUE 2.5Y, 4/2) to olive gray (HUE 5Y, 4/2); concentrically wavy when young, latter turning sulcate with deep furrows delimiting wide lobes (mainly at the margin) and when well developed and mature present a regular, shallow, and radially concentric cracked (small scales like), occasionally some scrupose zones at the base are observed; margin entire, round to obtuse, pubescent and dark yellowish brown (HUE 10YR, 4/6) in the young or in active growth, when drying dark grayish brown (HUE 2.5Y, 4/2); pore surface dark brown (HUE 7.5YR, 3/4); pores round, regular, (3–)4–6(–7) per mm, (170–)180–310(–340) μm diam., dissepiments entire, (30–)40–181(–200) μm thick; context up to 23 mm thick at the base in well-developed specimens, heterogeneous with a sinuous (following the relief of the pilear surface) black line that runs from the base to the margin, the basal layer dark yellowish brown (HUE 10YR, 4/6) and the upper one slightly darker; tubes indistinctly to distinctly stratified with a thin context layer, up to 15 mm long, dark brown (HUE 7.5YR, 3/4).

Hyphal system, monomitic in the context and dimitic in the trama of tubes; context dominated by generative
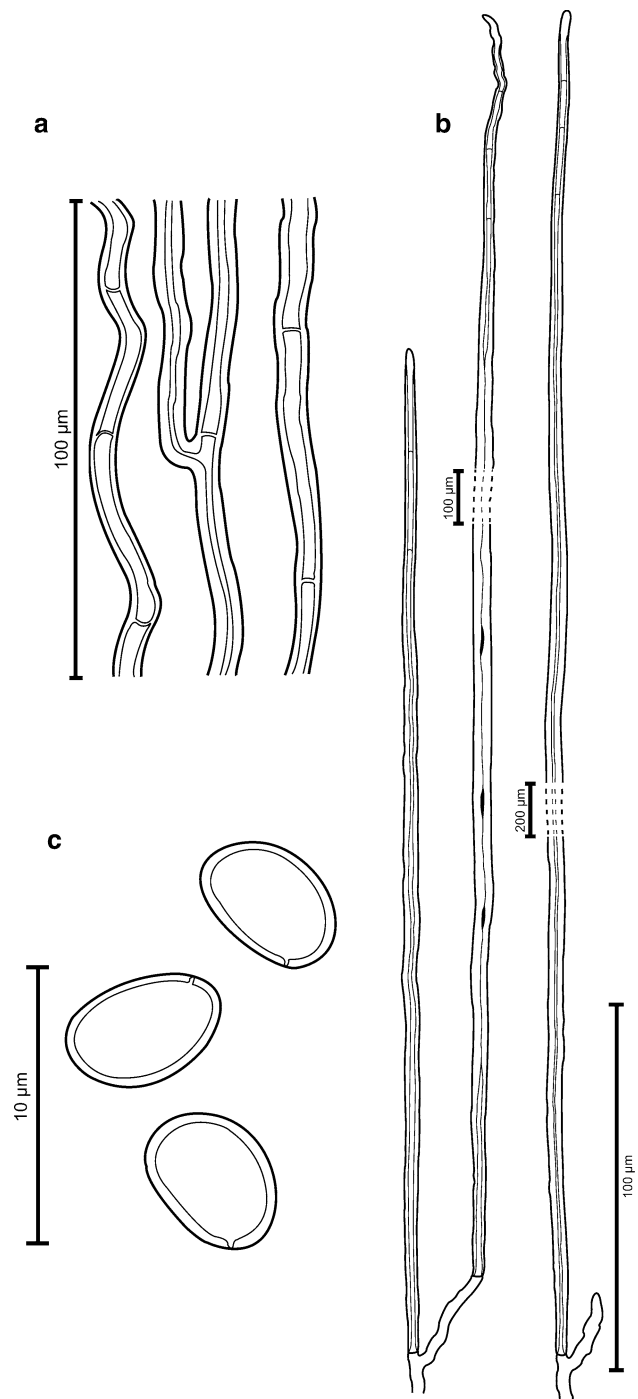
Fig. 3 Microscopical features of *Phellinus piptadenniae*: **a** Generative hyphae of the context with thick-walled; **b** skeletal hyphae of tubes, **c** basidiospores ellipsoid

hyphae, (2–)3–8(–10) μm diam, regularly septate, branched, thin-walled, gradually thick-walled, occasionally portions with few septa (skeletal-like hyphae) are observed; trama of tubes dimitic with thin- to slightly thick-walled generative hyphae, simple septate, branched, and unbranched skeletal hyphae, thick-walled with a visible

lumen to almost solid, (230–)290–640(–750) μm long × (3–)4–9(–10) μm diam. (L avg. = 403 μm, W avg. = 5.1 μm), tapering to the apex where the wall is almost thin and three to four adventitious septa are present; setae absent; basidia not observed; basidiospores broadly ellipsoid to ellipsoid, with the ventral side flattened, (4–)4.5–6(–7) × (3–)3.5–4.5(–5) μm (L avg. = 5.3 μm, W avg. = 4.1 μm), Q = 1.1–1.5 (Q avg. = 1.3), thick-walled, smooth, pale yellow in lactophenol, showing a xantochroic reaction in KOH and basidiospores turning chestnut to ferruginous brown in KOH (KOH+), CB−, IKI−.

Specimens examined—Brazil. São Paulo, Campinas, Município de Botucatu, trilha Ecológica Casa da Natureza, Fazenda Experimental do Lajeado, 30 Jan 2013, on live trunk of *P. gonoacantha*, *M. Fernandes* 7 (FLOR 19926), *M. Fernandes* 8 (FLOR 30457), 4 Jul 2013, on live trunk of *P. gonoacantha*, *M. Fernandes* 26 (FLOR 39430), *M. Fernandes* 27 (FLOR 51449), on log trunk of *P. gonoacantha*, *M. Fernandes* 29 (FLOR 51450); Santa Catarina, Florianópolis, Campus Universitário/UFSC, 25 Jan 2011, on live trunk of *P. gonoacantha*, *M. A. Borba-Silva 106* (FLOR 39571), *M. A. Borba-Silva 107* (FLOR 39572), 14 Apr 2011, on live trunk of *P. gonoacantha*, *M. A. Borba-Silva 135* (FLOR 39573), *M. A. Borba-Silva 136* (FLOR 39574), *ibid.* Tubarão, Fazenda Lunard, trilha do rio, 14 Nov 2012, on log trunk of *P. gonoacantha*, *A. G. Silva-Filho 48* (FLOR 51451). Peru. Piura, Las Lomas, 7 Dec 2011, on live trunk of *Pithecellobium excelsum*, *C. A. Salvador-Montoya 377* (FLOR 7554, USM 250528), 28 Aug 2012, on live trunk of *Libidibia glabrata*, *C. A. Salvador-Montoya 454b* (FLOR 16944), *C. A. Salvador-Montoya 457b* (FLOR 16945, USM 258362), *C. A. Salvador-Montoya 461b* (FLOR 16946, USM 258366).

Additional specimens examined—Phellinus piptadeniae: Brazil. São Paulo, Campinas, Bosque dos Jequitibás, on *Piptadenia communis*, 12 Oct 1943, *A. R. Teixeira & P. R. Santos s.n.* (IAC 4365, paratype); Pernambuco, Estação Experimental do IPA, Caruaru, 10 Dec 2008, on *Mimosa* sp., *E. R. Drechsler-Santos 109PE* (URM 80322), on *Senegalia* sp., *E. R. Drechsler-Santos 110PE* (URM 80345); *ibid.* Triunfo, 26 Nov 2009, on dead standing *Piptadenia* sp., *Robledo 1981* (CORD); *ibid.* Serra Talhada, 5 Mar 2009, on *Piptadenia* sp., *E. R. Drechsler-Santos 139PE* (URM 80768).

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