

Inonotus s.l. (Hymenochaetales) in the Brazilian herbaria FLOR and SP

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Inonotus is a polyphyletic genus that has been variously accepted by different authorities. We reevaluated the indigenous *Inonotus* Brazilian specimens deposited in FLOR and SP, and confirmed the presence of material belonging to two species of *Inocutis* and three of *Inonotus*. *Inonotus porrectus* is reported for the first time from South America, and the combination *Inocutis porrecta* is proposed. *Inonotus patouillardii* and *I. radiatus* are reported for the first time from the states of Pernambuco and São Paulo, respectively. A checklist and a key to the accepted species of *Inonotus s.l.* from Brazil are provided.

Keywords: Mycodiversity, Hymenochaetales, polypores, taxonomy.

Inonotus P. Karst. was described in 1879 and included pileate polypores with colored basidiospores. Later, the concept of the genus was broadened to include species with a brown fibrous context, a xanthochroic reaction of the basidiome when exposed to KOH, and a monomitic hyphal system lacking clamp connections (Gottlieb *et al.* 2002, Martínez 2006). Pegler (1964), Gilbertson (1976), and Ryvarden (2005) have accepted the genus in this sense. Others have suggested, however, that *Inonotus s.l.* should be split into more natural and smaller genera, based on morphological and molecular data (Fiasson & Niemelä 1984, Wagner & Fischer 2001, 2002; Gottlieb *et al.* 2002, Dai & Yuan 2005, Martínez 2006).

Some of these genera are well delimited morphologically, such as *Inocutis* Fiasson & Niemelä, which is characterized by ellipsoid, non-dextrinoid, yellowish to brownish basidiospores, the lack of setae, and a distinct monomitic hyphal system (Wagner & Fischer 2002).

Fourteen *Inonotus s.l.* species have been so far recorded from Brazil (Table 1). Three of them (*Inonotus cuticularis*, *I. hispidus*, and *I.*

obliquus) have not been included in the key because they are temperate species and the Brazilian material might be wrongly identified.

The aim of this study is to review *Inonotus s.l.* species kept in Brazilian herbaria, starting with two important mycological collections: herbaria FLOR and SP.

Materials and Methods

A total of 35 Brazilian exsiccata kept in FLOR and SP (Holmgren & Holmgren 1998) under the name *Inonotus* (Table 2) were asked for loan and were examined macro- and microscopically, following Gil-

Tab. 1. – Checklist of *Inonotus s.l.* species recorded from Brazil.

Species	Localities and references
<i>Inocutis jamaicensis</i> (Murrill) A.M. Gottlieb, J.E. Wright & Moncalvo	Paraná (Rajchenberg & Meijer 1990); Rio Grande do Sul (Rajchenberg 1987)
<i>Inocutis porrecta</i> (Murrill) Baltazar	Santa Catarina (present study)
<i>Inonotus cuticularis</i> (Bull.) P. Karst.	Rio Grande do Sul and São Paulo (Rick 1960)
<i>Inonotus fulvomelleus</i> Murrill	Rio Grande do Sul (Silveira et al. 2008)
<i>Inonotus hispidus</i> (Bull.) P. Karst.	Rio Grande do Sul (Rick 1960)
<i>Inonotus micantissimus</i> (Rick) Rajchenb.	Paraná (Ryvarden & Meijer 2002); Rio Grande do Sul (Rajchenberg 1987)
<i>Inonotus obliquus</i> (Ach. ex Pers.) Pilát	Rio Grande do Sul (Rick 1960)
<i>Inonotus patouillardii</i> (Rick) Imazeki	Bahia (Góes-Neto 1999); Paraná (Ryvarden & Meijer 2002); Pernambuco (present study); Rio Grande do Sul (Rajchenberg 1987); São Paulo (Patouillard 1907); Santa Catarina (Rick 1960, Loguercio-Leite & Wright 1991, Campos-Santana & Loguercio-Leite 2008)
<i>Inonotus pseudoradiatus</i> (Pat.) Ryvarden	Paraná (Ryvarden & Meijer 2002)
<i>Inonotus radiatus</i> (Sowerby) P. Karst.	Bahia (Góes-Neto 1999); Rio Grande do Sul (Rick 1960); São Paulo (present study)
<i>Inonotus rickii</i> (Pat.) D.A. Reid	Brazil – state not indicated (Ryvarden 1983)
<i>Inonotus splitgerberi</i> (Mont.) Ryvarden	Bahia (Góes-Neto 1999); Paraná (Rajchenberg & Meijer 1990, Ryvarden & Meijer 2002); Pernambuco (Tavares 1939); Rio Grande do Sul (Theissen 1911); Santa Catarina (Theissen 1911)
<i>Inonotus tropicalis</i> (M.J. Larsen & Lombard) T. Wagner & M. Fisch.	Paraná (Meijer 2006); Rio Grande do Sul (Rick 1960); São Paulo (Bononi et al. 1981)
<i>Inonotus venezuelicus</i> Ryvarden	Rio Grande do Norte (Gibertoni et al. 2004)
<i>Inonotus xanthoporus</i> Ryvarden	Brazil – state not indicated (Ryvarden 2005)

Tab. 2. – Examined material from the mycological collections FLOR and SP.

Herbarium number	Name registered	Correct name	Collection locality (Brazilian State)
FLOR 10192	<i>Inonotus patouillardii</i>	<i>I. patouillardii</i>	Santa Catarina
FLOR 11189	<i>Inonotus splitgerberi</i>	<i>I. splitgerberi</i>	Paraná
FLOR 11191	<i>Inonotus jamaicensis</i>	<i>Inocutis jamaicensis</i>	Paraná
FLOR 11491	<i>Inonotus</i> sp.	<i>Phellinus calcitratus</i> (Berk. & M.A. Curtis) Ryvarden	Paraná ^a
FLOR 11499	<i>Inonotus</i> sp.	<i>Inonotus patouillardii</i>	Paraná
FLOR 11789	<i>Inonotus</i> sp.	<i>Phellinus undulatus</i> (Murrill) Ryvarden	Santa Catarina
FLOR 31422	<i>Inonotus</i> sp.	<i>Phellinus</i> sp. ^b	Santa Catarina
FLOR 31423	<i>Inonotus</i> cf.	<i>Phellinus</i> sp. ^b	Santa Catarina
FLOR 31424	<i>Inonotus</i> sp.	<i>Phellinus</i> sp. ^b	Santa Catarina
FLOR 31425	<i>Inonotus</i> sp.	<i>Phellinus</i> sp. ^c	Santa Catarina
FLOR 31426	<i>Inonotus</i> cf.	<i>Phylloporia pectinata</i> (Klotzsch) Ryvarden	Santa Catarina
FLOR 31427	<i>Inonotus</i> cf.	<i>Phellinus</i> sp. ^b	Santa Catarina
FLOR 31428	<i>Inonotus</i> cf.	<i>Fomitiporella umbrinella</i> (Bres.) Murrill	Santa Catarina
FLOR 32139	<i>Inonotus porrectus</i>	<i>Inocutis porrecta</i>	Santa Catarina ^a
FLOR 32140	<i>Inonotus porrectus</i>	<i>I. porrecta</i>	Santa Catarina ^a
FLOR 32209	<i>Inonotus splitgerberi</i>	<i>I. splitgerberi</i>	Santa Catarina
SP 22833	<i>Inonotus splitgerberi</i>	<i>I. splitgerberi</i>	Rio Grande do Sul
SP 33768	<i>Inonotus capucinus</i> (Mont.) Ryvarden	<i>P. pectinata</i>	Rio Grande do Sul
SP 33785	<i>Inonotus radiatus</i>	<i>I. radiatus</i> var. <i>resupinatus</i> (Bourdote & Galzin) Donk	Rio Grande do Sul
SP 49994	<i>Inonotus</i> cf. <i>patouillardii</i>	<i>I. patouillardii</i>	Rio Grande do Sul
SP 60382	<i>Inonotus</i> sp.	<i>F. umbrinella</i>	Rio Grande do Sul
SP 61513	<i>Inonotus splitgerberi</i>	<i>Inonotus</i> sp. ^b	Mato Grosso
SP 62209	<i>Inonotus patouillardii</i>	<i>I. patouillardii</i>	Rio Grande do Sul
SP 91178	<i>Inonotus patouillardii</i>	<i>I. patouillardii</i>	Santa Catarina
SP 103109	<i>Inonotus</i> sp.	<i>Phylloporia chrysita</i> (Berk.) Ryvarden	São Paulo
SP 107250	<i>Inonotus</i> cf. <i>patouillardii</i>	<i>I. patouillardii</i>	Pernambuco ^a
SP 177406	<i>Inonotus corrosus</i> Murrill	<i>P. chrysita</i>	São Paulo
SP 211480	<i>Inonotus</i> sp.	<i>P. chrysita</i>	Rondônia
SP 211806	<i>Inonotus</i> sp.	<i>P. chrysita</i>	Bahia
SP 213143	<i>Inonotus radiatus</i> var. <i>cephalanthi</i>	<i>I. radiatus</i> var. <i>cephalanthi</i> (Overh.) Pegler	São Paulo ^a
SP 250586	<i>Inonotus</i> sp.	<i>Daedalea aethalodes</i> (Mont.) Rajchenb.	Mato Grosso do Sul ^a
SP 250612	<i>Inonotus ludovicianus</i> (Pat.) Murrill	<i>D. aethalodes</i>	Mato Grosso do Sul
SP 250653	<i>Inonotus</i> cf. <i>subiculosus</i> (Peck) J. Erikss. & Å. Strid	<i>D. aethalodes</i>	Mato Grosso do Sul
SP 250654	<i>Inonotus ludovicianus</i>	<i>D. aethalodes</i>	Mato Grosso do Sul

a New record from the respective state.

b Material young or deteriorated.

c Additional material needed for identification.

bertson & Ryvar den (1986). One exsiccate (FLOR 10709) was not found.

Basidiomata were cut by hand for microscopical study and sections were mounted in 5 % KOH with 1 % aqueous phloxine solution or Melzer's reagent (Singer 1986). Whenever possible, at least 30 elements of each microstructure were measured (hyphae, hymenial setae, basidia, and basidiospores). Colors are according to Munsell (1975).

Taxonomy

Inocutis jamaicensis (Murrill) A.M. Gottlieb, J.E. Wright & Moncalvo, Mycol. Progr., 1(3): 308. 2002.

Basionym. – *Inonotus jamaicensis* Murrill, Bull. Torr. Bot. Club, 31: 597. 1904.

Description. – Gottlieb *et al.* (2002) and Ryvar den (2005).

Distribution. – Argentina, Jamaica, USA, Uruguay and Venezuela (Gottlieb *et al.* 2002); Brazil.

Material examined. – BRAZIL, Paraná, General Carneiro, Fazenda São Pedro, on dead branch, 31 May 1989, *leg.* A. Meijer 1260 (FLOR 11191).

Inocutis jamaicensis is characterized by a blackish and wrinkled pileus surface with a thin crust. It is consistent with the concept of *Inocutis* and its place in the genus is supported by molecular data (Gottlieb *et al.* 2002, Wagner & Fischer 2002). The granular core, a structure found in many members of *Inocutis*, is absent in *I. jamaicensis*, as previously described by Dai & Yuan (2005). On the other hand, Martínez (2006) described sclerified hyphae in some specimens that were similar to those found in the granular core of other *Inocutis* taxa. These structures were not found in the Brazilian specimen. The species is similar to *Inocutis ludovicianus* (Pat.) T. Wagner & M. Fisch. and *I. porrecta*, which also lack a granular core. The three species differ in shape of basidiomata, and *I. jamaicensis* has a blackish thin crust in the pileus that is lacking in the other species. *Inocutis porrecta* is characterized by erect, contorted hyphae on the pileus surface and smaller basidiospores [(4.5) 5.0–6.0 × 4.0–5.5 (6.0) µm in this species; 5–7 × 4–5 µm in *I. jamaicensis*].

Inocutis porrecta (Murrill) Baltazar, **comb. nov.**

Basionym. – *Inonotus porrectus* Murrill, Tropical Polypores: 68. 1915.

Mycobank no.: MB 514141

Basidiomata annual, pileate, effuse-reflexed when young, later becoming substipitate, solitary. – Pileus semicircular to applanate

with an umbo when young, becoming dimidiate and applanate to flabelliform, 3.0–4.5 cm × 2.9–3.5 cm and up to 1.7 cm thick; upper surface tomentose to glabrous, slightly zonate, yellow (7/6 10YR), brownish yellow (6/8 10YR), yellowish brown (5/8 10YR) to dark yellowish brown (4/6 10YR). – Margin rounded, scaly to glabrous, dark yellowish brown (4/4 10YR) to yellow (7/8 10YR). – Pore surface yellow (7/8 2.5Y), olive yellow (6/8 2.5Y), dark greyish brown (4/2 2.5Y) to olive brown (4/4 2.5Y); pores circular to angular, 4–6 per mm; tubes single-layered, pale olive brown (5/6 2.5Y), up to 0.2 cm deep; dissepiments entire and thick. – Context homogenous, fibrous, lustrous, concentrically zonate, olive yellow (6/8 2.5Y), up to 1.5 cm thick.

Hyphal system monomitic; generative hyphae simple-septate, of two types: (1) thin to slightly thick-walled, hyaline to pale yellowish, 2–3.5 µm diam.; (2) thick-walled to almost solid, yellowish to pale brown, 5.0–6.5 µm diam. on trama and up to 8.0 µm diam. in the context, on pileus surface variously contorted. – Setal hyphae and hymenial setae absent. – Basidia not seen; basidioles broadly clavate, hyaline, thin-walled. – Basidiospores broadly ellipsoid to subglobose, yellow to pale golden brown, slightly thick-walled, smooth, (4.5) 5.0–6.0 × 4.0–5.5 (6.0) µm, IKI–.

Distribution. – Bahamas, Cuba and USA (Ryvarden 2005); Puerto Rico (Baltazar *et al.* 2009); Brazil.

Material examined. – BRAZIL, Santa Catarina, Florianópolis, Manguezal de Ratoles, on living *Avicennia schaueriana* Stapf & Leechm. ex Moldenke, 20 Feb 2006, leg. J.M. Baltazar & L. Trierweiler-Pereira 137 (FLOR 32139); Manguezal do Saco Grande, on living *A. schaueriana*, 27 Apr 2006, leg. J. M. Baltazar & A. Regolin 198 (FLOR 32140).

The lack of setae and the negative reaction to Melzer's reagent by the ellipsoid, colored and slightly thick-walled basidiospores supports the inclusion of this taxon in *Inocutis*. Wagner & Fischer (2002) found that *I. porrecta* is phylogenetically closely related to *Aurificaria luteo-umbrina* (Romell) D.A. Reid. Although these fungi are similar at a macromorphological level, *Aurificaria* representatives have thin-walled and hyaline to dull brown basidiospores that are different of those of *I. porrecta*.

Inocutis porrecta is characterized by flabelliform to substipitate basidiomes, lustrous and concentrically zonate context, lack of a granular core, and the presence of contorted hyphae on the pileus surface. *Inocutis porrecta* resembles *I. ludovicianus* and *I. jamaicensis* but they can be separated by macro- and microscopic features (see discussion above).

Previously known from North and Central America, this is the first report of *I. porrecta* from South America.

Inonotus patouillardii (Rick) Imazeki, Bull. Tokyo Sci. Mus., 6: 105. 1943.

Basionym. – *Polystictus patouillardii* Rick, Brotéria, sér. bot., 6: 89. 1907.

Description. – Pegler (1964) and Ryvarden (2005).

Distribution. – Tropical to subtropical and widely distributed in these zones (Ryvarden 2005).

Material examined. – BRAZIL, Paraná, Capanema, on wood, 27 Dec 1996, leg. J. Basso 1001 (FLOR 11499); Santa Catarina, Florianópolis, Rio Tavares, on wood, 18 Set 1985, leg. M. A. Da Ré & P. Ivo (FLOR 10192); Pernambuco, Moreno, leg. da Silva (SP 107250); Rio Grande do Sul, Guaíba, Fazenda da Faculdade de Agronomia e Veterinária, 29 Mar 1963, leg. Costa-Neto (SP 62209); Rio Grande do Sul, Pelotas, Horto Botânico do Instituto Agronômico do Sul, leg. Santos 146 (SP 49994); Santa Catarina, Porto Novo, 1918, leg. Rick (SP 91178).

This fungus is characterized by its large and conspicuous setal hyphae and the hard and lustrous context. The hymenial setae are rare in many specimens or even absent, as described by Gilbertson (1976) in specimens from Arizona (US.), and Gottlieb *et al.* (2002) in Argentinean specimens.

In Brazil, it is known from the states of Bahia, Paraná, Rio Grande do Sul, São Paulo and Santa Catarina. This is the first report from Pernambuco.

Inonotus radiatus (Sowerby) P. Karst., Revue mycol., 3(9): 19. 1881.

Basionym. – *Boletus radiatus* Sowerby, Col. fig. Engl. Fung. Mushr., 2: 83. 1799.

Description. – Pegler (1964) and Ryvarden (2005).

Distribution. – Widespread (Pegler 1964).

Material examined. – BRAZIL, Rio Grande do Sul, Lageado, on *Baccharis* sp., 1919, leg. Rick 7211 (SP 33785); São Paulo, São Paulo, Parque das Fontes do Ipiranga, 24 Jan 1987, leg. L. Ryvarden, D.N. Pegler & K. Hjortstam 24345 (SP 213143).

Inonotus radiatus is characterized by golden brown basidiospores, and hooked to straight hymenial setae. The species usually is pileate, but may have nodulose to resupinate basidiomata. Specimen SP 33785 was resupinate and corresponds to *I. radiatus* var. *resupinatus* (Bourdot & Galzin) Donk, while specimen SP 213143, with a nodulose basidiome, was identified as *I. radiatus* var. *cephalanthi* (Overh.) Pegler. However, the two specimens have basidiospores with similar size: var. *resupinatus* presenting basidiospores $4.0\text{--}5.0$ (5.5) $\times$ $3.5\text{--}4.5$ μm , while var. *cephalanthi* presented (3.5) $4.0\text{--}4.5$ $\times$ $3.0\text{--}4.0$ μm . In the Brazilian specimens, the hymenial setae are scarce and present a straight apex.

Inonotus radiatus was previously reported from the Brazilian states of Bahia (Góes-Neto 1999) and Rio Grande do Sul (Rick 1960). This is the first report from São Paulo.

Inonotus splitgerberi (Mont.) Ryvarden, Norweg. J. Bot., 19: 232. 1972.

Basionym. – *Polyporus splitgerberi* Mont., Annals Sci. Nat., Bot., sér. 2, 15: 109. 1841.

Description. – Ryvarden (2005).

Distribution. – Neotropical (Ryvarden 2005).

Material examined. – BRAZIL, Paraná, São José dos Pinhais, 23 Feb 1987, *leg.* A.A.R. Meijer (FLOR 11189 ex BAFC 31294); Rio Grande do Sul, São Leopoldo, 1909, *leg.* Rick (SP 22833); Santa Catarina, Ipuçu, 25 Jul 2005, *leg.* E.A. Moura (FLOR 32209).

This species is characterized by its small and imbricate, often fan-shaped to spatulate basidiomata, hyaline to pale golden yellow basidiospores, and a lack of hymenial setae. The pores are dentate and the xanthochroic reaction is first deep red, soon becoming black. *Inonotus splitgerberi* is closely related to *Inonotus xanthoporus* Ryvarden, but the latter has hymenial setae.

Key to species of *Inonotus s.l.* recorded from Brazil

1. Hyphal system dimitic *I. tropicalis*
- 1*. Hyphal system monomitic 2
2. Setal hyphae present 3
- 2*. Setal hyphae absent 6
3. Chlamydospores usually present in the context *I. rickii*
- 3*. Chlamydospores absent in the context 4
4. Basidiospores globose to subglobose, 10.0–13.0 µm in the largest dimension *I. micantissimus*
- 4*. Basidiospores ovoid to ellipsoid, 5.0–8.0 µm in the largest dimension 5
5. Hymenial setae rare, 15.0–21.0 × 5.0–9.0 µm, basidiospores (5.5) 6.0–8.0 µm in the largest dimension *I. patouillardii*
- 5*. Hymenial setae frequent, 15.0–40.0 × 6.0–14.0 µm, basidiospores 5.0–6.0 (6.5) µm in the largest dimension *I. radiatus*
6. Hymenial setae present 7
- 6*. Hymenial setae absent 9
7. Hymenial setae hooked *I. fulvomelleus*
- 7*. Hymenial setae straight 8
8. Basidiomata pileate sessile, flabelliform to fan-shaped, pores 3–4 per mm *I. pseudoradiatus*
- 8*. Basidiomata effused-reflexed, pores 5–6 per mm ... *I. xanthoporus*
9. Basidiomata always resupinate *I. venezuelicus*
- 9*. Basidiomata effused-reflexed to pileate sessile 10
10. Basidiospores hyaline to pale yellow *I. splitgerberi*
- 10*. Basidiospores rusty to reddish brown 11

11. Basidiomata effused-reflexed to pileate sessile, pileus dimidiate to triquetrous, pileus surface encrusted, blackish and wrinkled *Inocutis jamaicensis*
- 11*. Basidiomata pileate sessile to substipitate, pileus flabelliform, pileus surface not encrusted, yellowish to brown and not wrinkled *Inocutis porrecta*

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