



Phallus rubicundus in South Brazil

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Abstract

The widespread phalloid fungus *Phallus rubicundus* is reported for the first time in South Brazil. The collection is described and illustrated macro- and micromorphologically, and the taxonomy, distribution and ecology of the species are discussed, as well its occurrence in Brazil.

Key words – Phallales – Phallomycetidae – *Phallus* subgenus *Satyrus* – Stinkhorns

Introduction

Phalloid fungi (Phallales, Phallomycetidae) have aroused interest of researchers in the last decade in South Brazil, where several new records and rediscoveries have been reported (e.g. Meijer 2006, Trierveiler-Pereira et al. 2009, 2014a, 2014b, Cortez et al. 2011a, 2011b, Magnago et al. 2013, Sulzbacher et al. 2013, Cortez & Rossoni 2014, Alves & Cortez 2016). A summary of the current knowledge on Brazilian phalloids is given by Trierveiler-Pereira (2015). Despite the growing investigations on these peculiar mushrooms, further fieldwork has revealed more surprising findings, supporting the need for broad exploration of the Brazilian mycobiota.

In the present contribution, we report the collection of noteworthy phalloid fungi, not previously reported from South Brazil. Our aim is to improve the knowledge on the south Brazilian mycobiota, especially the phalloid species, and provide detailed a description and illustrations of this material, as well a discussion on the taxonomic limits, ecology and distribution.

Materials & Methods

Specimens were collected in the Campus of Universidade Federal do Paraná (24°17'34.14"S, 53°50'31.41"W), municipality of Palotina, Paraná State, South Brazil. The collection was gathered near a small fragment of Seasonal Semi-deciduous Forest, which is the typical vegetation of the western region of Paraná State, inserted in the Atlantic Forest Biome. Morphological analysis (both macro- and microscopical) followed standard procedures for phalloid fungi (Miller & Miller 1988). Colour names and codes adopted in the descriptions of macroscopic features are from Kernerup & Wanscher (1978). Micrographs were obtained with an Olympus CX31 light microscope, with a Toupt Cam FMA050 digital camera, and microscopic measurements were taken through the Toupt View 3.7 software. In the basidiospores description, Q is the quotient between the length and width, Q_m is the medium value of Q, and n is the number of measured basidiospores/ number of analyzed basidiomata/ number of collections. Collected specimens are preserved at the Herbarium of Campus Palotina (HCP), Universidade Federal do Paraná. In addition, material of *P. rubicundus* preserved at the Herbarium of Instituto de Botânica (SP) was loaned for comparison.

Results

Phallus rubicundus (Bosc) Fr., Syst. Mycol. 2, 284 (1823)

Fig. 1

≡ *Satyurus rubicundus* Bosc, Mag. Gesell. Naturf. Freunde, Berlin 5, 86 (1811)

= *Phallus sanguineus* Henn., Bot. Jahrb. Syst. Pflanzengesch. Pflanzengeogr. 30, 57 (1901)

= *Phallus gracilis* (E. Fisch.) Lloyd, Mycol. Writ. 7, 8 (1907)

Immature specimens ('mycoeggs') not observed. Basidiomata 133–166 × 19–21 mm, when expanded, tall, sub-cylindrical, slightly curved or erect. Pileus 25–29 × 4–5 mm, ellipsoidal to conical-campanulate, apex truncate, free (not covered by the slimy gleba), the tip 1–2 mm diameter, pastel red (7A4), surface rugulose to pored. Pseudostipe 81–99 × 6–7 mm (apex), 9–11 mm (base), cylindrical, straight to slightly curved, spongy, greyish red (7B5) to pastel red (7A4) at the apex, light orange (6A4) to pale orange (6A3) discolored at the base, pale yellow (1A3) to yellowish with (1A2) at the base, hollow. Gleba covering partially the pileus, ca. $\frac{3}{4}$ of total length, slimy mucilaginous, olive (1F4) to (1F8). Volva 18–30 × 19–21 mm, saccate, white (1A1). Rhizomorphs not numerous and short, up to 12 mm long, thin, white (1A1).

Basidiospores 3.5–4 × 1.5–2 μm, Q= 1.8–2.53, Qm= 2.14, n= 40/2/1, ellipsoid, smooth and thin-walled, greenish in KOH. Basidia not found. Pileus hyphae 1.2–4.7 μm diam., cylindrical, some branched, smooth or rarely incrustated, hyaline in KOH, without clamp-connections. Pseudostipe formed of globose, isodiametric to irregular subglobose hyphae, 26–59.2 × 19.5–52.9 μm diameter, smooth and thin-walled, hyaline in KOH. Volva composed of filamentous hyphae, 1.4–3 μm diameter, smooth, with clamp-connection, hyaline in KOH. Rhizomorph hyphae 1.5–2.8 μm diameter, smooth, with clamp-connection, hyaline in KOH. Clamp-connections present in most septa.

Material examined – BRAZIL, Paraná State, Palotina, Universidade Federal do Paraná, Campus Palotina, 30 November 2015, collected by V.G. Cortez (HCP 1034); São Paulo State, Cananea, Parque Estadual Ilha do Cardoso, November 1982, collected and determined by V.L.R. Bononi (SP-Fungi 178206).

Habitat and distribution: in small groups, on the ground, among woodchips and fallen fruits of *Parapitadenia rigida* (Benth.) Brenan (Leguminosae, Mimosoideae). Widely distributed in tropical and subtropical zones of the world: Africa (Dring 1964), Australia (Grgurinovic 1997), Asia (Kour et al. 2016), North America (Hemmes & Desjardin 2002), and Europe (Calonge 1998). From Brazil, it was recorded only once in sandbank vegetation in Atlantic Forest biome, São Paulo State (Bononi et al. 1984). First record from South Brazil and Seasonal Semideciduous Forest.

Discussion

Phallus rubicundus is the type species of the genus *Satyurus* Bosc, which Kreisel (1996) considered as a subgenus *Satyurus* (Bosc) Kreisel, in a broader concept of the genus *Phallus*. According to Kreisel (1996), the following diagnostic features of this subgenus are: small basidiomata, with a *Mutinus*-like stature, pileus varying from campanulate, acute to obtuse or truncate, with a granulate, rugulose or merulioid surface, absence of indusium and pseudostipe with conspicuous yellow, orange, or red colors.

Calonge (2005) presented a preliminary key for the worldwide species of *Phallus sensu lato* and, although not mentioning the name *Satyurus* in the synonyms list, seems to agree with Kreisel's statement of synonymy with *Phallus*. On *P. rubicundus*, Calonge (2005) applied a broader concept of that species, including *P. rugulosus* (E. Fischer) O. Kuntze and *P. novae-hollandiae* Corda, two species that Kreisel (1996) considered distinct from *P. rubicundus*. Grgurinovic (1997) presented an extensive list of synonyms, most of them Australian names described by mycologists like E. Fischer, P. Hennings, C.G. Lloyd, F.M. Bailey, and others. The numerous synonyms obviously reflect the high variability of this phalloid, especially regarding the size and color variation of the basidiomata, which are the most used features to distinguish taxa in the group (Dring 1964).

Many authors mention the confusion of *P. rubicundus* with members of the genus *Mutinus* (e.g. Kour et al. 2016), especially by virtue of the tall basidiomata, with a not so conspicuous pileus – whose presence is the main distinguishing feature of *Phallus*, and absent in *Mutinus*

(Calonge 1998). A simple internet search for *Mutinus* spp. or *P. rubicundus* terms reveals a sort of confusion and numerous misidentifications in blogs and websites throughout the world.



Fig. 1 – *Phallus rubicundus*. A Basidiomata. B Basidiospores. C Pseudostipe hyphae. D Hyphae from rhizomorphs with clamp connection (arrow). Bars: A= 10 mm. B–E = 10 μ m. Photographs: A by V.G. Cortez, B–D by AGS Silva-Filho.

Regarding the ecological aspects, the species has been reported from several habitats, varying from lawns, gardens, farms and forest parks. Hemmes & Desjardin (2002, 2009) reported it as common on woodchips in Hawaii; our material was also growing near the base of a very rotten stump, on soil covered by numerous wood chips and fallen fruits (legumes) of *Parapitadenia rigida* (Figure 1A), in full accordance with the observations of these authors.

Our material is very similar to that illustrated by Calonge (1998, 2005), regarding the size, stature and colors of the basidiomata. Microscopically, the basidiospores exhibited a small degree of variation. Our observations are in agreement to those of Calonge (1998) and Dring (1964), who reported basidiospores $3.5\text{--}5 \times 1.5\text{--}2.5 \mu\text{m}$.

Regarding the distribution of the species, it is poorly known in South America and Brazil. The study of South Brazilian phalloid fungi started with contributions by Braun (1932) and Rick (1961), but no similar or synonymous species were reported by these authors. The only known record of this phalloid in the Brazilian territory was published by Bononi et al (1984), from the State of São Paulo. Unfortunately, the material loaned from Herbarium SP, is not in good condition and did not allow a conclusion regarding its identification.

It can be assumed that *P. rubicundus* is not a common stinkhorn in South America, and may represent to a recent introduction, considering the scattered reports from Brazil. Even in the South American countries with recognized mycological activity (especially on phalloids), as Argentina, Chile, Paraguay, Suriname and Venezuela, there are not known reports for *P. rubicundus* or some of its numerous synonyms (Spegazzini 1887, Fischer 1928, Dennis 1953, Wright 1960, Sandoval-Leiva et al. 2014). Thus, future collections are expected to expand the knowledge on the distribution of this species in Brazil and South America.

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