cryptogamie

mycologie

volume 35 n°4 2014

contents

Cryptogamie, Mycologie, 2014, 35 (4): 369-375

Cantharellus rubescens, a new chanterelle from the Brazilian semi-arid

Cristiano C. NASCIMENTO[a], *Felipe G.B. PINHEIRO*[b], *Felipe WARTCHOW*[b] & *Maria Helena ALVES*[c]

[a]*Instituto Federal de Educação, Ciência e Tecnologia do Piauí, Campus Paulistana. Rodovia BR-407, s/n. CEP: 64750-000. Paulistana, PI, BRAZIL. e-mail: encristiano.nascimento@ifpi.edu.br*

[b]*Universidade Federal da Paraíba, Departamento de Sistemática e Ecologia/CCEN, CEP: 58051-970. João Pessoa, PB, BRAZIL. e-mail: fwartchow@yahoo.com.br*

[c]*Universidade Federal do Piauí, Campus Universitário Ministro Reis Velloso. Avenida São Sebastião, 2819. CEP: 64202-020. Parnaíba, PI, BRAZIL. e-mail: malves@ufpi.edu.br*

Abstract – *Cantharellus rubescens* is described and illustrated as new species from the semi-arid of Northeastern Brazil. It is recognized by orange-yellow basidiomes, hymenophore and contex with a strong reddening-orange reaction, scaly stipe, basidiospores measuring 6-7.5(-9) × 4-5(-5.5) µm and having thick-walled (1-1.5 µm), terminal elements in the pileipellis. Morphological differences with other, orange-yellow Brazilian *Cantharellus* species are discussed, such as *C. aurantioconspicuus*, *C. guyanensis* and *C. protectus*.

Agaricomycetes / Cantharellales / neotropics / taxonomy

INTRODUCTION

Cantharellus Adans.: Fr is the type genus of the Cantharellales or "cantharelloid clade", which comprises ectomycorrhizal species of great ecological, economic and nutritional interest (Moncalvo *et al.*, 2007). It comprises six recognized subgenera (*Cantharellus*, *Rubrinus*, *Cinnabarinus*, *Parvocantharellus*, *Pseudocantharellus* and *Afrocantharellus*) according recent molecularly-based infrageneric classification using a multigene phylogenetic approach (nucLSU, mitSSU, RPB2 and tef-1) (Buyck *et al.*, 2014; Shao *et al.*, 2014). Corner (1966) recognized approximately 65 species in *Cantharellus* worldwide and about 16 varieties within the type species *C. cibarius* Fr. After a revision of species names through detailed examination of available type specimens, Eyssartier (2001) retained merely 59 good and valid species in *Cantharellus* out of a total of 418 published names. Since this revision, already a total of 40 new species have been published in *Cantharellus* s.s., mainly from Mediterranean, subtropical and tropical areas (see Buyck *et al.*, 2014).

The genus *Cantharellus* received recently more attention in Brazil. After *C. guyanensis* Mont. from Amazon, Paraiba and Paraná (Singer *et al.*, 1983; de Meijer 2006, as *C.* cf. *guyanensis*; Henkel *et al.*, 2014), three species were

doi/10.7872/crym.v35.iss4.2014.369

described, *C. aurantioconspicuus* Wartchow & Buyck, *C. amazonensis* Wartchow and *C. protectus* Wartchow & F.G.B. Pinheiro (Wartchow *et al.*, 2012a, 2012b; Pinheiro & Wartchow, 2013). Here we describe a new species of *Cantharellus* collected during January 2011 in Araripe National Forest, Ceará semi-arid, Brazil.

MATERIAL AND METHODS

Cantharellus basidiomes were collected at the Araripe National Forest (07°11'42''-07°28'38'' S and 39°13'28''-39°36'33'' W), a "caatinga" protected area localized at Araripe Plateau, State of Ceará, Northeast Brazil. It comprises 38.262 ha and ranging the municipalities of Crato, Barbalha, Jardim and Santana do Cariri (Costa & Araújo, 2007; Austregésilo-Filho *et al.*, 2001). There occur 629 species of vascular plants of which the most diverse are Leguminosae (all subfamilies), Rubiaceae, Asteraceae, Bignoniaceae, Myrtaceae, Euphorbiaceae, Apocynaceae and Malpighiaceae (Ribeiro-Silva *et al.*, 2012). In terms of physiognomic attributes, the region is an area of vegetation types associated with the wet and hot tropical climate, within which the highest coverage percentage is represented by the montane humid rainforest ("brejo de altitude"), savanna ("cerrado"), savanna woodland ("cerradão") and "carrasco", comprising transition vegetation types (Austregésilo-Filho *et al.*, 2001).

Macroscopic descriptions are based on the study of the fresh material as well as on analysis of the photos. Microscopic observations were made from material mounted in 3% KOH and Congo red solutions. Presentation of basidiospores data follows the methodology proposed by Tulloss *et al.* (1992), slightly modified by Wartchow (2012) and Wartchow *et al.* (2012a). Measurements and statistics are based on 30 spores. Abbreviations include **L**(**W**) = average basidiospores length (width), Q = the length : width ratio range as determined from all measured basidiospores, and **Qm** = the Q value averaged from all basidiospores measured.

Color codes are adopted from the Kornerup & Wanscher (1978).

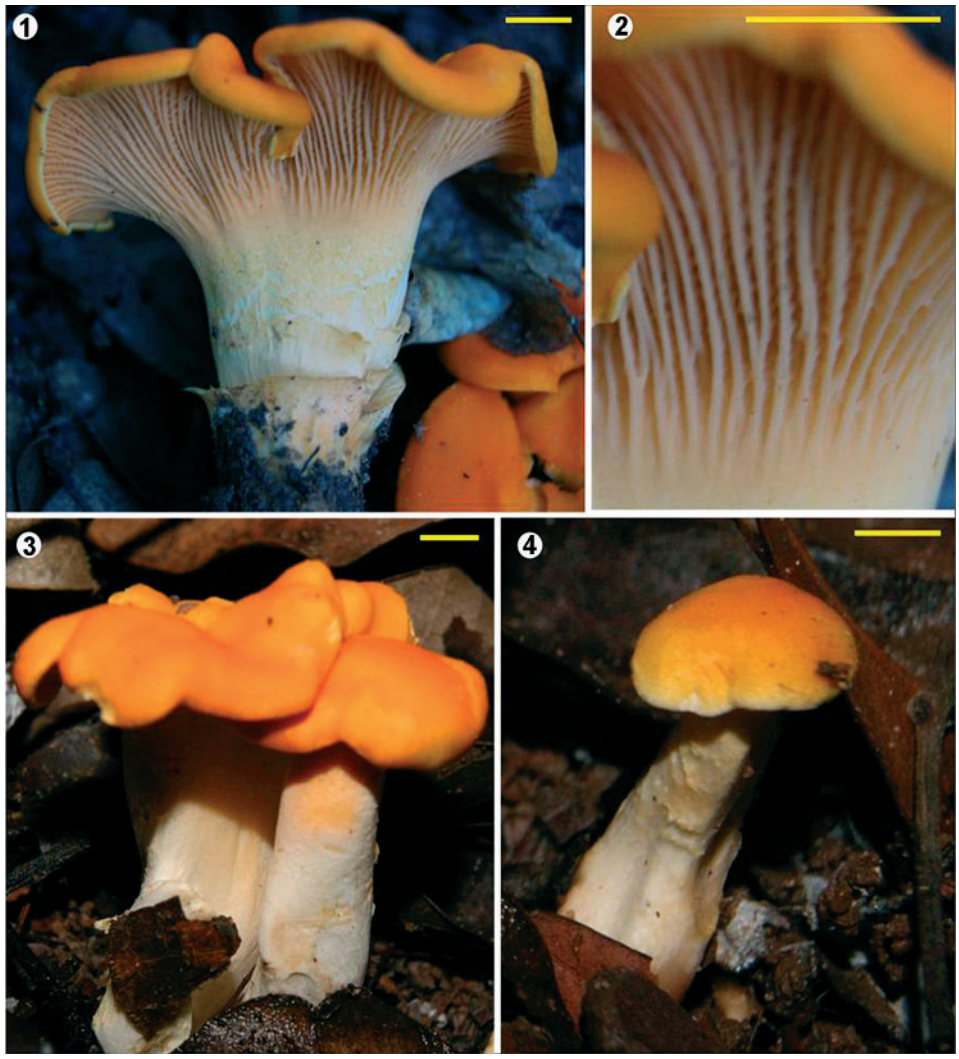
TAXONOMY

Cantharellus rubescens C.C. Nascimento, F.G.B Pinheiro, Wartchow & M.H. Alves, **sp. nov.** Figs 1-7

MycoBank MB 810094

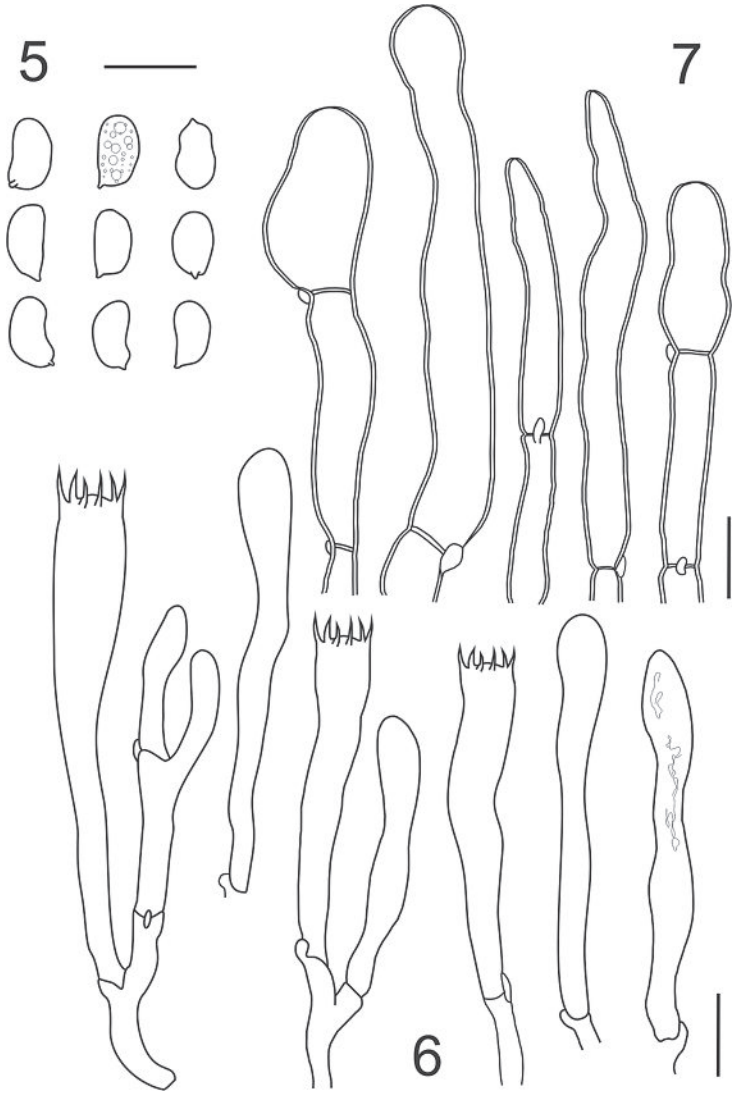
Holotypus: **BRAZIL**. Ceará, Barbalha, Floresta Nacional Araripe-Apodi, Geossítio Riacho do Meio, 9 km away from the highway CE-60, 7°21'50" **S** 39°19'45" **W**, 25 Jun 2011, *M.H. Alves & C.C. Nascimento 52/2011* (JPB 56502).

Basidiomes small to large in size, fleshy. **Pileus** up to 118 mm, at first plane-convex to convex, then becoming concave and depressed at centre to finally infundibuliform; surface smooth, waxy or dry, shiny, glabrous, deep orange at centre (7A5-8), becoming paler toward the margin, culminating in a whitish (1A1) margin; margin entire, inrolled in young basidiomes then incurved, smooth, wavy, lobed; context thick at centre, whitish to pale yellow (3A2-3), very pale orange



Figs 1-4. *Cantharellus rubescens*. Basidiomes *in situ* (M.H. Alves & C.C. Nascimento 52/2011 – holotype). Bars = 10 mm. Photos by M.H. Alves.

(1A3) under the pileipellis, unchanging. **Hymenophore** formed of moderately distant to distant veins in young specimens, becoming subcrowded to crowded, dichotomously forked and anastomosing (about 1-2 mm broad), decurrent, pale cream (4A2) to salmon orange (4A3), staining reddish-orange after 5-10 second after cut or bruised; edge smooth, entire and obtuse. **Stipe** 30-50 × 15-30 mm, solid, cylindrical, sometimes slightly enlarged toward the base in young specimens, then becoming tapering downward at maturity, sometimes laterally compressed; surface smooth, glabrous and subviscid, but with concentric membranous squamose projections with fibrous consistency localized downward then sometimes upward, pale yellow (3A3, 4A4) to pale cream (4A2), staining orange



Figs 5-7. *Cantharellus rubescens* (holotype). **5**. Basidiospores. **6**. Basidia, basidioles and adjacent cells of the subhymenium. **7**. Thick-walled terminal elements of the pileipellis. Bars = 10 µm.

(5A7-8, 4A8) when handled. **Context** solid and firm, concolorous in stipe and pileus, rapidly reddening after handling or when cut. Odor and taste not recorded. **Spore print** not obtained.

Basidiospores 6-7.5(-9) × 4-5(-5.5) µm, **L** = 6.8 µm; **W** = 4.6 µm; Q = (1.33-)1.38-1.87 (-1.93); **Q** = 1.61, inamyloid, hyaline in 3% KOH, ellipsoid to cylindric, reniform in side view, smooth, thin-walled, filled with small gutules; hilar appendix prominent. **Basidia** 45-60(-75) × 8-9 µm, slender-clavate, mostly (4)-6-spored. **Basidioles** abundant, subcylindric to nearly clavate. **Hymenial cystidia** absent. **Hymenophoral trama** strongly interwoven, pale yellow, similar to

context, with abundant and branched hyphae about 5.5 µm wide. **Pileus context** consisting of loosely interwoven hyphae. **Pileipellis** composed of septate hyphae, loosely organized and radially oriented 4-6(-7) µm wide, whitish-yellow to slightly orange; terminal elements 20-64 × 6-13 µm, subcylindric but sometimes fusoid-subovoid, wall up to 1-1.5 µm thick. **Clamp connections** abundant in all tissues examined, but somewhat small and inconspicuous.

Habitat: gregarious and scattered, emerging from woodland soil, among decayed woody humus deposits beneath the trunks of living Fabaceae trees.

Known distribution: known only from type locality.

Etymology: Latin, "rubescens" (= turning red, reddening, become red); propensity of the flesh to turn red on bruising or cutting.

Material examined: **Brazil**. Ceará, Barbalha, Araripe National Forest, Geossítio Riacho do Meio, 25 Jun 2011, M.H. Alves & C.C. Nascimento 52/2011 (JPB 56502 **holotype!**, HDELTA 709 **isotype!**); same place, 26 Jun 2011, M.H. Alves & C.C. Nascimento 57/2011(HDELTA 708).

Remarks: *Cantharellus rubescens* is easily recognized in the field by the robust, orange-yellow basidiomes, hymenophore composed of dichotomously forked, anastomosed folds (about 1-2 mm broad) with a strong reddening-orange reaction when bruised and a distinctly scaly stipe. Its main microscopic features can be summarized by (1) ellipsoid to cylindric, smooth, thin-walled, inamyloid basidiospores [6-7.5(-9) × 4-5(-5.5)], (2) slender-clavate, mostly 6-spored basidia, (3) thick-walled (1-1.5 µm), terminal elements in the pileipellis and (4) clamp-connections abundant in all tissues. Because of its medium size, orange-yellow basidiome, thick-walled hyphae at the pileus surface and abundant clamps in all tissues, this elegant and rare species is best included in *C.* subgen. *Cantharellus* (Eyssartier & Buyck 2001a; 2001b; Buyck *et al.*, 2014).

The overall color and size of *C. rubescens* is similar to other, orange-colored *Cantharellus* recorded from Brazil. Because of its general, robust habit this species reminds somewhat of *C. aurantioconspicuus*, another species known from Atlantic coastal forest which differs from our species by the non-reddening context, more elongate basidiospores [(6.5-) 7-9 (-9.5) × 4-5 µm, **L** = 7.8 µm, **W** = 4.6 µm, Q = (1.43-) 1.46-2.02(-2.07), **Q =** 1.67] and hyphal extremities at the pileus surface that are narrower (3.5-11 µm), and distinctly thin-walled (Wartchow *et al.*, 2012a).

Cantharellus guyanensis, a more widespread chanterelle originally described from French Guyana (Henkel *et al.*, 2014), was reported in Brazil from the states of Amazonas (Singer *et al.*, 1983), Paraíba, Pernambuco (Henkel *et al.*, 2014) and Paraná (Singer *et al.*, 1983; de Meijer, 2006 as *C.* cf. *guyanensis*; Henkel *et al.*, 2014). This species is remarkably similar to *C. rubescens* in its yellow-orange to orange pileus with downturned margin, the orange cream, well-defined, lamellar hymenophore, abundant clamp connections on hyphae of all tissues and a cuticular pileipellis with thick-walled terminal elements (Montagne, 1854; Pegler, 1983; Wartchow *et al.*, 2012a; Henkel *et al.*, 2014). However, *C. guyanensis* differs by the smaller basidiomes [10-35(-60) mm diam.], smooth stipe surface and larger basidiospores [7-9.2(-10.2) × (4-)4.5-6.2(-7.1) µm] (Henkel *et al.*, 2014) as well as by the absence of the strong and rapid reddening reaction of the pileus context upon bruising, only observed in *C. rubescens*. Purplish-orange tints in the developing pilei of *C. guyanensis* were reported in the type description by Montagne (1854) and by Eyssartier (2001) in a modern revision of the type specimen. Nevertheless it should be noted that purplish tints have never been observed in collections from Guyana nor in the recent collections from French Guiana (Henkel *et al.*, 2014). Additionally, Montagne mentioned for

C. guyanensis a quickly hollowing stipe, whereas in our new species a solid stipe can be observed in all ontogenetic stages collected. On the other hand, the hollow stipe was rarely seen in the Guyana collections of *C. guyanensis* reported by Henkel *et al.* (2014). Therefore both the purplish-orange tints and a hollow stipe might be variable characters and must be interpreted with much caution to distinguish the two aforementioned species.

Cantharellus amazonensis from central Brazilian Amazon clearly differs in the bright red pileus, non-anastomosing lamellae, larger basidiospores [8.5-10.8(-13.7) × (4.3-)4.8-6.5(-7) μm], primarily 6-sterigmate basidia and lack of thickened walls of the terminal cells in the pileipellis (Wartchow *et al.*, 2012b).

The recently described *C. protectus* from Atlantic Forest in state of Paraíba was also reported as having a general orange-yellow color and resembles our species in several morphological features (Pinheiro & Wartchow, 2013). However, it differs by the more brightly colored basidiome that fade to yellow, slightly smaller basidiospores [5.5-7.5 (-8) × (3-) 3.5-5 (-5.5)] and pileipellis terminal elements that are more slender (37-66 × 4-7 μm) and have thinner walls (0.5 μm). In our taxon the length of the stipe hardly ever exceeds the cap diameter, although young specimens are very "high upon their feet", whereas in *C. protectus* a relative longer stipe is markedly common. Additional feature to distinguish the two species is the absence of a scaly stipe and in particular the non-reddening context in *C. protectus*.

Acknowledgements. The authors whish thank CNPq (APV Proc. 558317/2009-0) for funding to collect the new species, the ICMBio (SISBIO Proc. 42891-5) for authorized collection trips and PPBio Semi-Árido (CNPq/MCT Proc. 60/2009) for financial support.

REFERENCES

AUSTREGÉSILO-FILHO P.T., SILVA J.A.C., MEUNIER I.M.J. & FERREIRA R.L.C., 2001 – Fisionomias da cobertura vegetal da Floresta Nacional do Araripe, Estado do Ceará. *Brasil Florestal* 71: 13-21.

BUYCK B., KAUFF F., EYSSARTIER G., COULOUX A. & HOFSTETTER V., 2014. — A multilocus phylogeny for worldwide *Cantharellus* (Cantharellales, Agaricomycetidae). *Fungal Diversity* 64: 101-121.

CORNER E.J.H., 1966 — *A monograph of Cantharelloid Fungi.* Annals of Botany Memoir 2. Oxford University Press, Oxford.

COSTA I.R & ARAÚJO F.S., 2007 — Organização comunitária de um encrave de cerrado *sensu stricto* no bioma Caatinga, chapada do Araripe, Barbalha, Ceará. *Acta Botanica Brasilica* 21: 281-291.

EYSSARTIER G., 2001 — Vers une monographie du genre *Cantharellus* Adans.:Fr. Dissertation, National History Museum Paris. 259 p.

HENKEL T. W., WILSON A. W., AIME M. C., DIERKS J., UEHLING J. K., ROY M., SCHIMANN H., WARTCHOW F. & MUELLER G. M., 2014 — Cantharellaceae of Guyana II: New species of *Craterellus*, new South American distribution records of *Cantharellus guyanensis* and *Craterellus excelsus*, and a Key to the Neotropical taxa. *Mycologia* 106: 307-322.

KORNERUP A. & WANSCHER J.H., 1978 — *Methuen Handbook of Colour*. 3rd ed., London, Eyre Methuen. 252 p.

de MEIJER A.A.R., 2006 — Preliminary list of the macromycetes from the Brazilian state of Paraná. *Boletim do Museu Botânico Municipal (Curitiba)* 68: 1-55.

MONCALVO J.M., NILSSON R.H., KOSTER B., DUNHAM S.M., BERNARUER T., MATHENY P.B., MCLENON T., MARGARITESCU S., WEIß M., GARNICA S., DANELL E., LANGER G., LANGER E., LARSSON E., LARSSON K-H. & VILGALYS R., 2007 (for 2006) — The cantharelloid clade: dealing with incongruent gene trees and phylogenetic reconstruction methods. *Mycologia* 98(6): 937-948.

MONTAGNE J.P.F.C., 1854 — Cryptogamia Guyanensis. *Annales des Sciences Naturelles Botanique Serie IV* 1: 91-144.
PEGLER, D.N., 1983 — The Agaric flora of Lesser Antilles. *Kew Bulletin Additional Series* 9: 1-668.
PINHEIRO F.G.B. & WARTCHOW F., 2013 — *Cantharellus protectus*, a new species from Paraíba, Brazil. *Sydowia* 65: 27-31.
RIBEIRO-SILVA S., MEDEIROS M.B., GOMES B.M., SEIXAS E.N.C & SILVA M.A.P., 2012 — Angiosperms from the Araripe National Forest, Ceará, Brazil. *Check List* 8: 744-751.
SHAO S.C., BUYCK B., HOFSTETTER V., TIAN X.-F., GUENG Y.-H., YU F.-Q. & LIU P.-G., 2014 — *Cantharellus hygrophorus*, a new species in the subgenus *Afrocantharellus* from tropical southwestern China. *Cryptogamie, Mycologie* 35: 283-291.
SINGER R., ARAUJO I. & IVORY M.H., 1983 — The ectotrophically mycorrhizal fungi of the Neotropical lowlands, especially central Amazonia. *Beihefte zur Nova Hedwigia* 77: 1-352.
THIERS B., 2014 [continuously updated] — *Index Herbariorum: A global directory of public herbaria and associated staff.* New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/ih/
TULLOSS R.E., OVREBO C.L. & HALLING R.E., 1992 — Studies on *Amanita* (Amanitaceae) from Andean Colombia. *Memoirs of the New York Botanical Garden* 66: 1-46.
WARTCHOW F., 2012 — *Clavulina incrustata*, a new species from Pernambuco, Brazil. *Cryptogamie, Mycologie* 33: 105-113.
WARTCHOW F., BUYCK B. & MAIA L. C., 2012a — *Cantharellus aurantioconspicuus* (Cantharellales), a new species from Pernambuco, Brazil. *Nova Hedwigia* 94: 129-137.
WARTCHOW F., SANTOS J.C. & FONSECA M.D.P., 2012b — *Cantharellus amazonensis*, a new species from Amazon. *Mycosphere* 3: 414-418.