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## Cantharellus pleurotoides, a new and unusual basidiomycete from Guyana<sup>☆</sup>

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### ABSTRACT

*Cantharellus pleurotoides* sp. nov. (Cantharellaceae, Cantharellales, Basidiomycota) is described from the Pakaraima Mountains of Guyana, occurring in rainforests dominated by ectomycorrhizal *Dicymbe* spp. (Caesalpinaceae). This fungus is singular among *Cantharellus* species described worldwide in possessing a pleurotoid basidioma. Macromorphological, micro-morphological, and habitat data are provided for the new species.

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### Introduction

Species of *Cantharellus* and *Craterellus* (Cantharellaceae, Cantharellales, Basidiomycota) are conspicuous components of the macromycota associated with ectomycorrhizal (EM) canopy trees of the genus *Dicymbe* (Caesalpinaceae, tribe Amherstieae) in the primary rainforests of Guyana's Pakaraima Mountains (Henkel et al. 2002). Ectomycorrhizal fungi fruit prolifically during the tropical rainy season in *Dicymbe*-dominated forests, while remaining largely absent from the surrounding mixed forest matrix composed of arbuscular-mycorrhizal trees. Eight years of collecting in this region have uncovered approximately 150 morphospecies of putatively EM fungi, a number of

which are new species and genera (e.g. Henkel 1999; Henkel et al. 2000; Miller et al. 2001; Simmons et al. 2001; Miller et al. 2002; Matheny et al. 2003; Henkel et al. 2005), while most still await formal description. Cantharelloid taxa occurring at the site include *C. guyanensis* and *C. atratus*, as well as three undescribed species of *Craterellus*. Here we describe an additional species, *Cantharellus pleurotoides* sp. nov., which is singular macromorphologically among *Cantharellus* species worldwide in possessing a pleurotoid basidioma with a smooth hymenophore. *Cantharellus pleurotoides* also has an unusual fruiting habit, the basidiomata arising in imbricate fashion at positions elevated from the forest floor on decayed woody substrata and humic deposits on the trunks of living trees.

<sup>☆</sup> Mention of trade names or commercial products in this article is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

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## Materials and methods

### Collections

Collections were made during the May–July rainy seasons of 2000–2004 from the Upper Potaro River Basin, within a 5 km radius of a permanent base camp at 5° 18' 04.8" N; 59° 54' 40.4" W; elevation 710 m. The site was located in an undulating valley approximately 20 km east of Mt Ayanganna (2200 m), and was densely forested with a mosaic of primary *Dicymbe*-dominated and mixed forests of the *Eschweilera-Licania* association (Fanshawe 1952; Henkel 2003). All collections were made in forests dominated by *Dicymbe corymbosa*. Macroscopic features were described fresh in the field. Colors were described subjectively and coded according to Kornerup & Wanscher (1978), with color plates noted in parentheses. Macrochemical tests were performed according to the methods of Singer (1986). Fungi were field-dried with silica gel (Miller et al. 2002).

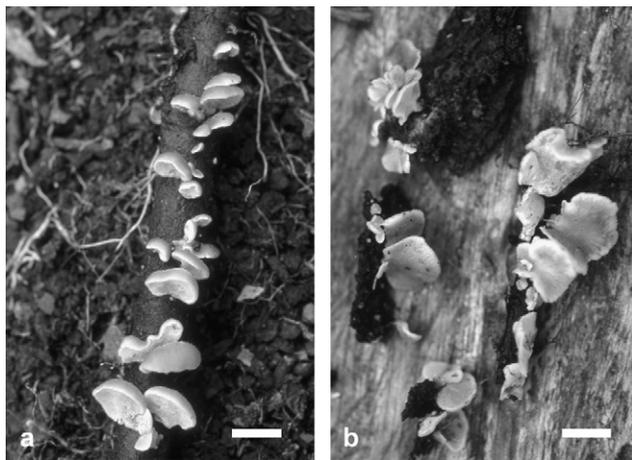
Micromorphological features of fresh specimens were examined with an EPOI field microscope with light optics; dried specimens were examined with an Olympus BX51 microscope with light and phase contrast optics. For basidiospores, basidia, and other structures at least 20 individuals were measured. Rehydrated fungal tissue was mounted in H<sub>2</sub>O, 3 % KOH, and Melzer's solution. Line drawings were made from digital photographs. Specimens were deposited in the following herbaria: BRG, University of Guyana; HSU, Humboldt State University; and BPI, US National Fungus Collections.

## Taxonomy

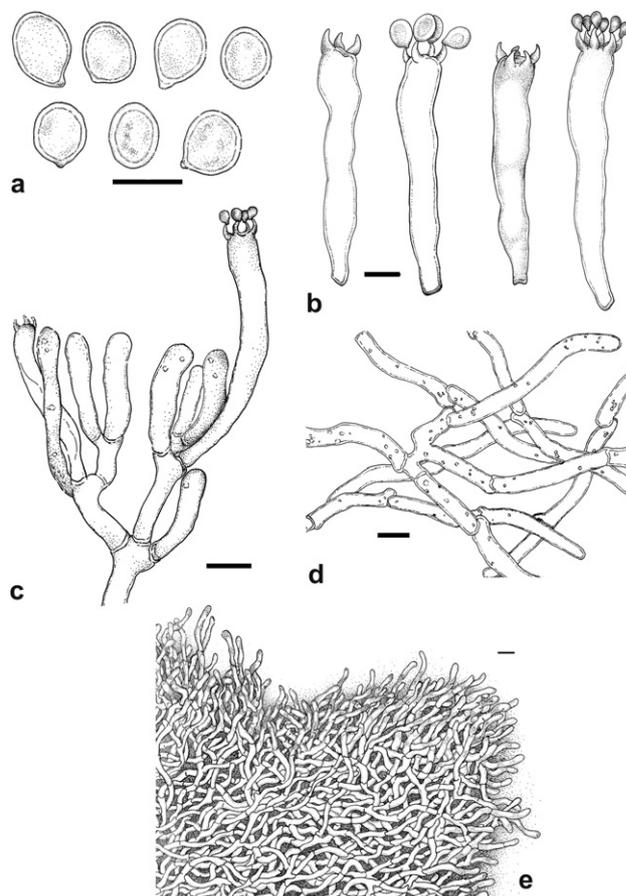
*Cantharellus pleurotoides* T.W. Henkel, Aime & S.L. Mill,  
sp. nov. Figs 1–2

Mycobank no.: MB 510239

*Etym.*: *Pleurotoides*, Latin, referring to the distinctive pleurotoid basidiomata.



**Fig 1** – Basidiomata of *Cantharellus pleurotoides* (holotype, Henkel 8528). a. Development on decaying sapling trunk. b. Mature basidiomata on well-decomposed wood from tree trunk. Bars = 10 mm.



**Fig 2** – Microscopic features of *Cantharellus pleurotoides* (holotype, Henkel 8528). a. Basidiospores. b. Basidia with immature basidiospores. c. Hymenial elements. d. Tramal hyphae. e. Pileus trama and pileipellis. Bars = 10  $\mu$ m.

Gregarius ad imbricatus in parvis gregibus in ligno carioso vel substrato humifero a solo in sylvis ectomycorrhizalis *Dicymbis corymbosae*. Basidiomata pleurotoidea, 7–23 mm lata, margine olivacea ad flava; hymenium albidum ad cineraceum, leave. Basidiosporae 8–10.5  $\times$  6.5–8.5  $\mu$ m, subglobsae, leaves, inamyloideae. Basidia (54)–60–72–(79)  $\mu$ m longa, apice 10–12  $\mu$ m lata, basi 5–7.4  $\mu$ m lata, subcylindrica; sterigmata 5–7  $\mu$ m longa, basi 1.5–2  $\mu$ m lata, cornuta, (3)–4–6 in quoque basidio. Cystidia ignota. Fibulae abundantes. *Cantharellus pleurotoides* diminutis pleurotoidibus basidiomatis et semper elevato fructificationis habitu a congeneribus diversus.

**Typus:** Guyana: Region 8, Potaro-Siparuni: Pakaraima Mts, Upper Potaro River Basin, ~ 20 km east of Mt Ayanganna, 1 km N of base-camp along river east bank, alt. 710 m, in *Dicymbe corymbosa* forest, 28 June 2003, T. W. Henkel 8741 (BRG – holotypus; HSU – isotypus).

*Basidiomata* pleurotoid, generally dimidate to occasionally sublabelliform, 7–23 mm broad, astipitate or occasionally with a minute eccentric to lateral pseudostipe (Fig 1a,b); pileipellis olivaceous-yellow (3B8–3C8, 4C6–8), lightening to yellow (3A8) at extreme margin, moist, with short, erect strigose elements forming a whitish bloom throughout and a short projecting fringe at the margin; margin strongly incurved when young, becoming more upturned to irregularly and broadly

wavy with age; hymenium covering entire lower surface, off-white to light greyish (3B2-4B2), drying orangish-yellow (4A4-4A6), smooth, minutely hispid under lens, thickening slightly with age; context concolorous, soft, watery, unchanging. Taste and odour none. Macrochemical reactions: KOH and NH<sub>4</sub>OH nil on pileipellis and hymenium. Spore deposit not obtained.

**Basidiospores** 8–10.5 × 6.5–8.5 μm (mean  $Q = 1.3$ ,  $n = 20$ ), subglobose, smooth, inamyloid, wall hyaline, contents a single large guttule, minutely and evenly granulate, pale yellow in KOH; hilar appendix 0.75–1 μm long (Fig. 2a). **Basidia** (54)–60–72–(79) μm long, width at apex 10–12 μm, at base 5–7.4 μm, subcylindric, tapering evenly toward base, older basidia devoid of contents and hyaline, developing basidia with opaque, minutely granulate, light yellow contents, basal clamp connections occasionally observed; **sterigmata** 5–7 μm long, 1.5–2 μm wide at base, cornute, (3)–4–6 per basidium (Fig. 2b). **Basidioles** numerous, with opaque light yellow contents in KOH (Fig. 2c). **Cystidia** not observed. **Tramal hyphae** tightly interwoven, branching frequently, hyaline to faint yellowish in KOH, moderately inflated, 6–13 μm wide, constricted slightly at septa, with minute granulate contents, wall 0.75–1 μm wide; **clamp connections** abundant (Fig. 2d). **Pileipellis** consisting of a subpellis arising anticlinally from tramal hyphae, with light yellow, opaque contents in KOH, these terminating in a suprapellis of ±anticlinal elements arranged in loose, irregular fascicles; terminal cells undifferentiated (Fig. 2e).

**Habit, habitat, and distribution.** Gregarious to imbricate in small troops at positions elevated from the forest floor, on decayed woody substrata and humic deposits on the trunks of living trees. Infrequently encountered during the May–July rainy season in forests dominated by the ectomycorrhizal canopy tree *Dicymbe corymbosa*. Known only from the type locality in the Upper Potaro River Basin, Guyana.

**Additional specimens examined.** **Guyana:** Region 8, Potaro-Siparuni: Pakaraima Mountains. Upper Potaro River Basin, ~20 km east of Mt. Ayanganna, environs of base camp located on Potaro River one km upstream from confluence with Whitewater Creek: near Ayanganna Airstrip, on sticks in *D. corymbosa* forest, 20 May 2000, Aime 986 (BRG, BPI); Black Water Creek, gregarious on sticks, mosses, decaying wood, and living roots, in *D. corymbosa* forest, 9 June 2000, Aime 1171 (BRG, BPI); vicinity of Potaro base camp, 720 m elevation, in *D. corymbosa* forest, scattered on twigs, sticks, and sides of decomposed logs, 7 June 2002, Aime 1908 (BRG, BPI); vicinity of Potaro base camp, 720 m elevation, in *D. corymbosa* forest, 26 June 2001, Henkel 8382 (BRG, HSU), vicinity of Potaro base camp, 720 m elevation, in *D. corymbosa* forest, 13 June 2002, Henkel 8462 (BRG, HSU).

**Commentary.** *Cantharellus pleurotoides* is recognized in the field by the small, olive-yellow pleurotoid basidiomata in small troops, sometimes nearly imbricate, on rotting sticks, logs, and elevated humus in *Dicymbe corymbosa* forests. The fungus could initially be mistaken for a discomycete, due to the cupulate appearance when young, but the downward-facing hymenium is telling. Currently, *C. pleurotoides* has been collected only in stands dominated by EM *Dicymbe* spp., suggesting an ectotrophic nutritional mode for the fungus, corroborated by the presumed EM status of other *Cantharellus* species.

The small pleurotoid basidioma with smooth hymenophore of *C. pleurotoides* constitutes a singular macromorphology among *Cantharellus* species described worldwide (Heinemann

1959; Corner 1966, 1969), although the incurved margin of the young pilei is consistent with that of other *Cantharellus* species (Corner 1966). Micromorphologically, the long, narrow basidia bearing 4–6 curved sterigmata, white, smooth, thin-walled, inamyloid basidiospores, and monomitic, inflated, regularly-clamped tramal hyphae are consistent with the placement of *C. pleurotoides* in *Cantharellus*. While clamp connections are known to occur in some species of the closely related genus *Craterellus* (e.g. *C. tubaeformis*), *C. pleurotoides* cannot be referred to *Craterellus* due to its lack of both a straight pileal margin when young and a membranous texture, the presence of which are diagnostic features for *Craterellus* in the traditional and modern senses (Corner 1966; Feibelman et al. 1997; Dahlman et al. 2000). Additionally, *C. pleurotoides* cannot be referred on morphological grounds to any resupinate taxa now known to occur in the cantharelloid clade as defined by molecular data (e.g. *Botryobasidium*, *Sistotrema*; Binder et al. 2005). *Cantharellus pleurotoides* is inconsistent morphologically with *Botryobasidium*, species of which have short (<20 μm), cylindrical to subuniform basidia, hyphae branching at right-angles, and resupinate basidiomata, and with *Sistotrema*, species of which have uniform or utriform basidia and are typically ampullate near the septa. The unusual pleurotoid basidioma notwithstanding, we see no morphological reason not to ally *C. pleurotoides* with the *Cantharellus/Craterellus/Hydnum* clade, within which the taxon is best disposed in *Cantharellus* due to its fleshy, imperforate basidioma. Infragenerically, *C. pleurotoides* most closely fits in subgen. *Cantharellus*, sect. *Cantharellus* due to the brightly coloured basidiomata, regularly clamped hyphae, and lack of a regularly palisadic pileipellis (Corner 1966).

Diminutive basidiomata characterize some species of *Cantharellus*, but in most cases the basidiomata differ from those of *C. pleurotoides* in being more or less centrally stipitate with the hymenium underlying an apical pileate portion, having well-developed hymenophoral folds, and a terrestrial fruiting habit. Stipitate *Cantharellus* species described with pilei <20 mm diam. appear to be entirely tropical and include the Congolian *C. tenuis*, *C. alboroseus*, and *C. addaiensis* (Heinemann 1959; Corner 1966), the Congolian/Tanzanian *C. microcibarius*. (Buyck et al. 2000), the Madagascarian *C. decolorans* (Eyssartier & Buyck 1999), the Malaysian *C. diminutivus* and *C. ianthinus* (Corner 1966, 1969), and *C. garnierii* (Ducousso et al. 2004) from New Caledonia. Corner (1966) records two species from Brazil, *C. fuscipes* and *C. reniformis* with very narrow (<10 mm), reniform, yellowish pilei with short lateral stipes, but both of these species differ from *C. pleurotoides* in having distinct intervenose hymenophoral folds and short (<30 μm), 4-sterigmate basidia. Additionally, the Asian species *C. furfuraceous*, *C. pusio*, and *C. merrillii* approach the small, pleurotoid form but have distinct hymenophoral folds and short basidia (Corner 1966).

As in *C. pleurotoides*, an extreme reduction in basidioma size combined with fruiting from elevated positions on humic substrata occurs in other ectotrophic basidiomycetes found in Guyanese *Dicymbe* forests, including the centrally stipitate *Inocybe pulchella* and *I. epidendron* (Matheny et al. 2003), *Tylopilus exiguus* (Henkel 1999), and *Coltricia verrucata* (Aime et al. 2002), and the pleurotoid *Lactarius panuoides*, *L. brunellus*, *L. multiceps*, and *Russula campinensis* (Henkel et al. 2002; Miller

et al. 2002). Given the high precipitation occurring during the May–July rainy season (Henkel et al. 2002) and the great propensity for *Dicymbe* roots to explore and form ectomycorrhizas in suspended humus (Woolley & Henkel 2005), perhaps there were selection pressures for fruiting above the sodden conditions of the forest floor, for more effective aerial spore dispersal (Ingold 1965). Basidiomata in this case would no longer require the mycelial resources necessary to reach a size sufficient to rise above the litter layer; smaller basidiomata, with a higher hymenium area to mass ratio, would therefore be selected for.

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