Cryptogamie, Mycologie, 2014, 35 (1): 23-40

Exploring the diversity of "smooth chanterelles" (*Cantharellus*, Cantharellales)

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Abstract – This paper explores the interesting diversity within the group of "smooth chanterelles" and introduces several new taxa from the tropics: *C. sublaevis* Buyck & Eyssart. and *C. cibarioides* (Heinem.) Buyck comb. nov. from Africa, *C. eccentricus* Buyck & V. Hofstetter and *C. neocaledonicus* Buyck, V. Hofstetter, Eyssart. & Ducousso from New Caledonia and *C. incrassatus* Buyck & V. Hofstetter from Malaysia.

Africa / *C. lateritius* / *C. solidus* / *Goossensia* / Malaysia / New Caledonia / United States

INTRODUCTION

In a recent paper on the phylogeny of the genus *Cantharellus*, Buyck *et al.* (2014a) demonstrated a northern hemisphere origin for the majority of species that compose subgenus *Cantharellus*, but pointed out that two species groups in this subgenus, the group of the amethyst chanterelles (*C. amethysteus* and allies) and particularly the species-complex that includes the smooth chanterelle (*C. lateritius*) have also several tropical representatives as evident from still undescribed taxa collected in tropical areas on several continents. This paper presents several new smooth chanterelles from Africa, Malaysia and New Caledonia.

Smooth chanterelles got their name because of the poor differentiation of their hymenophore which is, however, rarely completely smooth. In most cases, the hymenophore development is reduced to some very shallow ridges or veins that remain lower than "normal" (as compared to *C. cibarius* Fr. for example). Other smooth chanterelles, including some of the species discussed in this paper, have a hymenophore development that is very variable and their hymenophore differentiation can range from completely "normal" to perfectly smooth between different specimens produced by a single fruiting.

As "the Smooth chanterelle" specifically refers to the American *C. lateritius*, the more general term "smooth chanterelles" is here restricted to species that are very similar to *C. lateritius* in general habit, i.e. to other medium-sized, yellow to yellowish orange species. Poor hymenophore differentiation has also been reported for some very small, bright red, tropical chanterelles for example (Buyck *et al.,* 2014b), but these are here not considered.

doi/10.7872/crym.v35.iss1.2014.23

MATERIAL AND METHODS

Unless indicated otherwise, all cited specimens are deposited at the mycological herbarium of the Paris' Natural History Museum (PC). The color notations indicated in the descriptions follow Kornerup and Wanscher (1978). Microscopic features were examined and sketched by B. Buyck using a camera lucida setup. Original drawings for all elements of the hymenium or pellis were made at × 2400. All microscopic observations and measurements were made in ammoniacal Congo red, after a short aqueous KOH pretreatment to improve tissue dissociation and matrix dissolution. Measurements of basidiospores cite length, width and length/width ratio (Q) in the following format: (minimum measured) mean minus stand.dev. – *mean value* – mean plus stand.dev. (maximum measured); the spore measurements are based on at least twenty spores from the holotype. References to infrageneric placements follow the latest classification of the genus by Buyck *et al.* (2014a).

TAXONOMY

AFRICA :

Cantharellus cibarioides (Heinem.) Buyck comb. nov. **Figs 1-3**

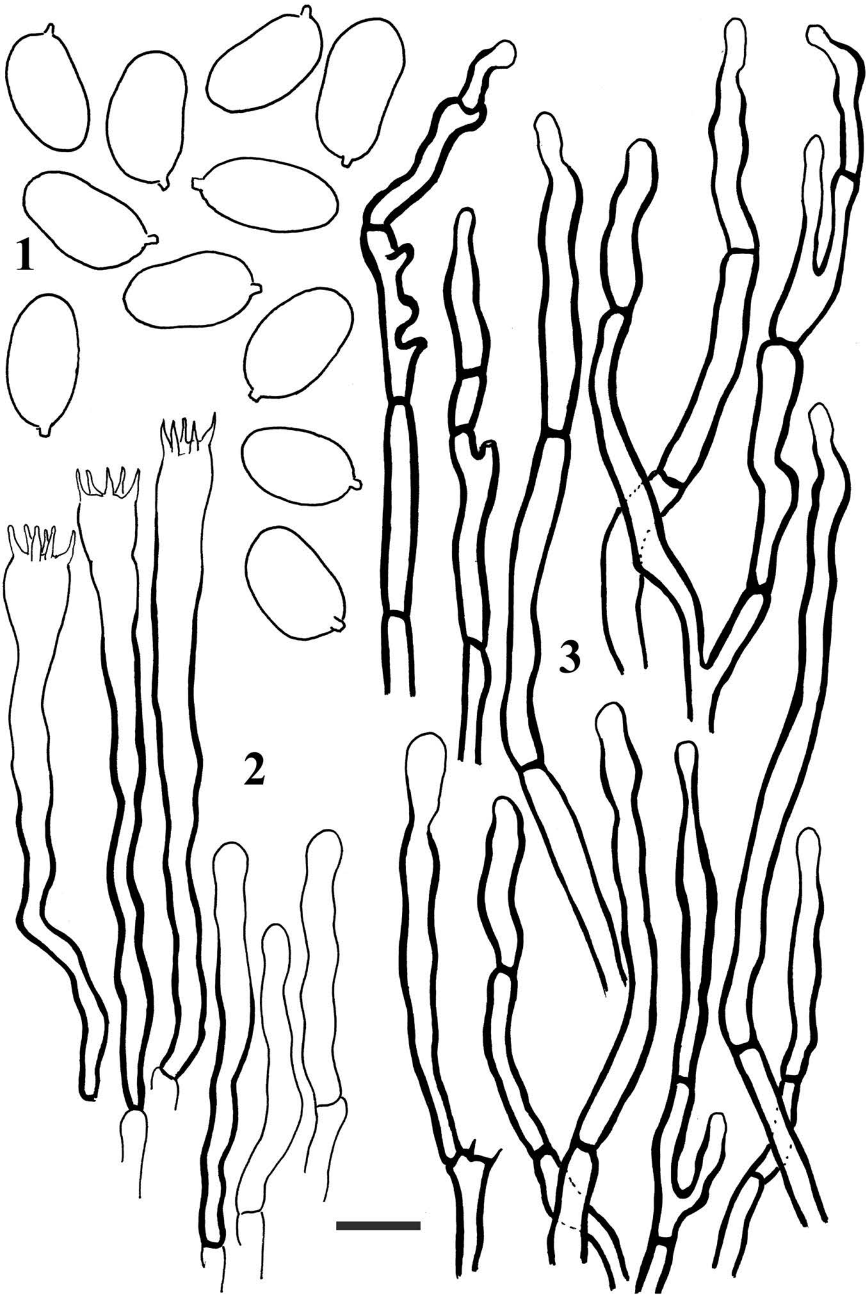
Mycobank: MB 808098

Basionym: *Goossensia cibarioides* Heinem. Bull. Jard. Bot. Etat Brux. 58:425. 1958

Pileus 40-100 mm diam., fleshy, at first convex with inrolled margin, then quickly depressed in the center and finally funnel-shaped with straight to uplifted margin, bright yellow-orange, rugose-verrucose in the center, smooth toward the margin. **Stipe** stout, 40-70 × 10-20 mm, sometimes forked, pale orange-yellow, compact, or tardily somewhat hollowing, with an orange mycelium agglomerating the soil at the base. **Hymenophore** decurrent, smooth, then faintly veined or even with distinct ridges near the margin, off-white with an ochraceous tinge, then violaceous pink. **Flesh** water-soaked, firm, white, then yellowish. **Odor** of apricots. **Taste** most likely mild and agreeable. **Spore print** white.

Spores narrowly ellipsoid to nearly oblong, 7.5-*8.14*-9 (9.25) × 4.5-*4.69*-5 µm, Q = 1.5-*1.71*-1.9, sometimes slightly constricted in the middle, smooth, hyaline. **Basidia** very slender and narrow, mostly 70-90 × 6-7(-9) µm, clavulate, 5-6-spored, mostly with distinctly thickened wall in their lower part. **Cystidia** absent. **Subhymenium** filamentose. **Pileipellis** composed of thick-walled, slender hyphae, mostly 4-5(-7) µm diam., with terminal cells variable in length, often undulate or irregularly inflated-diverticulate and often subapically somewhat constricted to subcapitate. **Clamp connections** absent.

Examined material: CENTRAL AFRICA. Democratic Republic of Congo. Guineocongolian rain forest district. Binga, on the ground under *Gilbertiodendron dewevrei*, August 1942, Miss Goossens-Fontana 2097 (BR, holotype); ibidem, on soil, April 1928, Goossens-Fontana 672; on rotten trunk, Oct. 1934, Goossens-Fontana 995 (BR).



Figs 1-3. *Cantharellus cibarioides*. **1.** Spores. **2.** Basidia and basidiola. **3.** Hyphal extremities of the pileipellis. Drawings B. Buyck. Scale bar = 10 µm, but 5 µm for spores. All from holotype.

Commentary: The macroscopic description is a free English translation of the original description (Heinemann, 1958) which placed this species in the monotypic genus "*Goossensia*" solely because of the very tough, water-soaked context, a rather weak argument as Heinemann himself admitted. Nearly all chanterelles get easily water-soaked and "washing" (i.e. soaking) chanterelles is a common practice among vendors to get a higher price by selling the heavier, water-soaked fruit bodies. All morphological features as well as the typical apricot-smell, however, clearly indicate that this species belongs in *Cantharellus*. As we are not aware that this species has been recollected since its original description, its distribution remains restricted to the type locality.

Cantharellus cibarioides is an interesting species because of two features that were not clearly mentioned in the original description. Heinemann (l.c.) notes that the hymenial elements possess "zebroid incrustations from a yellowish pigment". Indeed, the lower part of the hymenium elements have an often distinctly thickened wall that is yellowish just like the hyphal extremities of the pileipellis. The second important feature for this species is the complete absence of clamp connections, not mentioned in the original description, but merely suggested by the illustration (Heinemann l.c., fig. 52A). Within *Cantharellus*, the former character is only shared so far with the here newly described *C. incrassatus* from Malaysia, a species that possesses clamp connections just like *C. lateritius* and all other species in subgenus *Cantharellus*. The absence of clamp connections would exclude a placement in the same subgenus for *C. cibarioides* as Buyck *et al.* (2014a) have shown that absence or presence of clamp connections is highly correlated with the systematic position of chanterelles, their absence being indicative of a placement in either subgenus *Rubrinus* or subgenus *Afrocantharellus*. The morphology of *C. cibarioides* would clearly suggest the former in this case although the regularly thick-walled hyphal extremities in the pileipellis of *C. cibarioides* are clearly setting it apart from the two other African smooth chanterelles that lack clamp connections: the new *C. sublaevis* described below and the Malagasy *C. sebosus* Buyck & Hofstetter (Buyck *et al.*, 2014b).

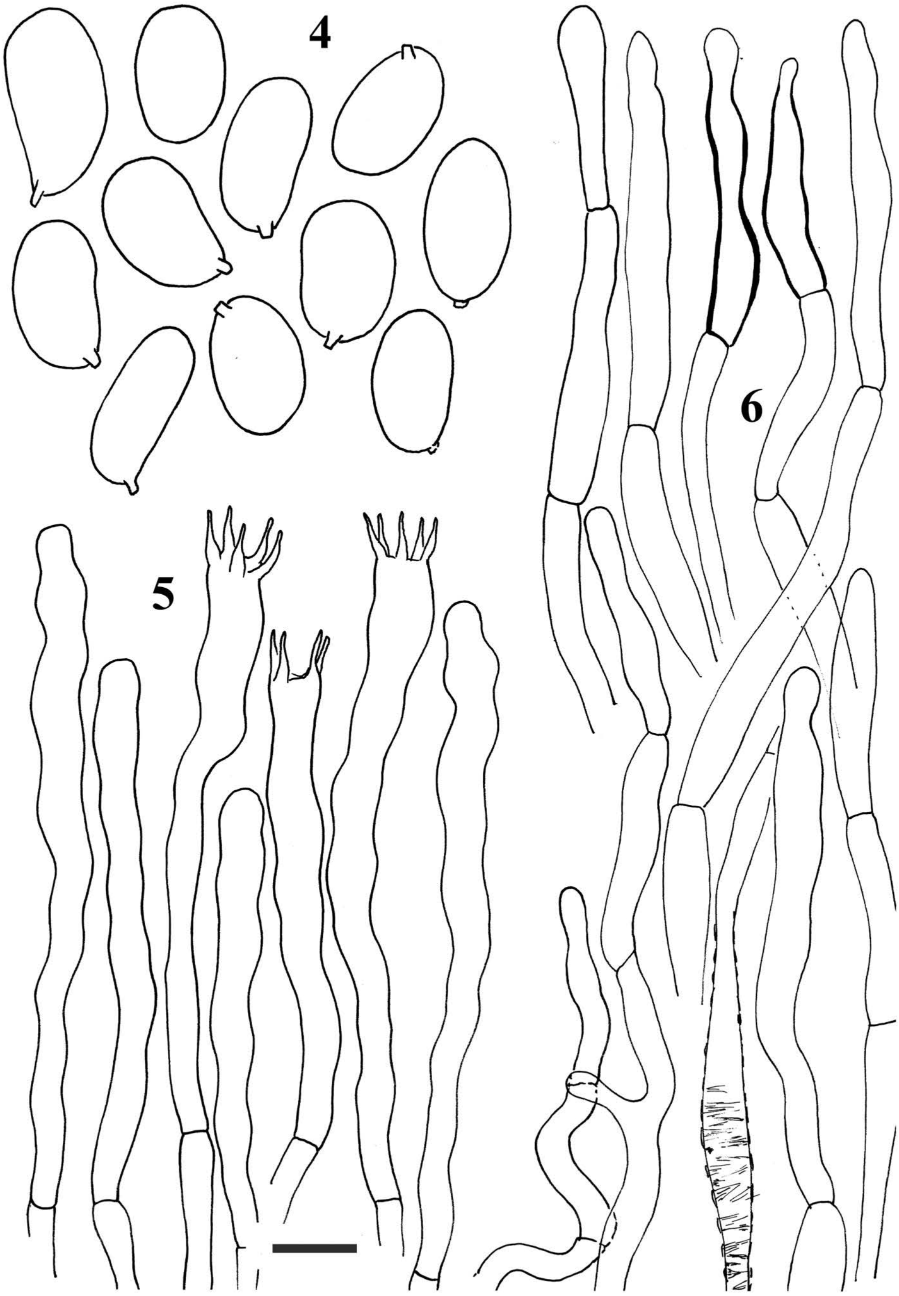
Cantharellus sublaevis Buyck & Eyssart. sp. nov. **Figs 4-6, 19**

Mycobank: MB 808099

Diagnosis: Differs from *C. lateritius* in the absence of clamp connections throughout its tissues, the more elongate spores, measuring (8.7)8.9-*9.77*-10.6(11) × (4.0)4.7-*5.21*-5.7(6.0) µm, Q = 1.6-*1.90*-2.7, the predominantly thin-walled hyphal extremities in the pileipellis and its occurring in the Zambezian woodlands of tropical Africa.

Holotypus: **Zambia**. Copperbelt prov., on Chibuli hill, close to Mpongwe, in miombo woodland, Buyck & Eyssartier leg., 6 Feb. 1996, Buyck 96.321 (PC 0142175).

Pileus 35-65 mm diam., slightly convex with inrolled, strongly undulate, sometimes incised margin, subsmooth or finely fissured, without veins, but the whole cap irregularly folded, of a bright egg-yolk, yellow-orange color, dull, developing locally a whitish pruinose covering. **Hymenophore** almost perfectly smooth except for a few faint, radial ridges or folds towards the very pileus margin, milky white to pale cream, or with a very faint pinkish tinge, more yellowish near the cap margin. **Stipe** somewhat laterally compressed, 15-20 × 10-15 mm, narrowing downward, pale ochraceous orange, smooth. **Flesh** firm and compact, white or faintly tinged yellowish orange immediately beneath the pileus surface and to a lesser degree also beneath the stipe surface, yellowing



Figs 4-6. *Cantharellus sublaevis.* **4.** Spores. **5.** Basidia and basidiola. **6.** Hyphal extremities of the pileipellis. Drawings B. Buyck. Scale bar = 10 µm, but 5 µm for spores. All from holotype.

upon handling. **Smell** typical, of apricots. **Taste** mild, agreeable. **Spore print** not obtained.

Spores very irregular in size and shape, mostly ellipsoid to elongate, often more or less reniform, (8.7)8.9-*9.77*-10.6(11) × (4.0)4.7-*5.21*-5.7(6.0) µm, Q = 1.6-*1.90*-2.7, smooth, hyaline. **Basidia** long and slender, mostly (60)75-90 × 7-9 µm, (2-4)5-spored with rather long sterigmata. **Subhymenium** filamentous, composed of long and slender cells, 3-4 µm diam. **Pileipellis** a dense cutis, not gelatinous, with individual endings of hyphae not standing out very distinctly, composed of thin-walled to refringent, ramifying hyphal extremities of variable to regular diam., but quite slender, mostly 4-6 µm wide, and slightly broader below the cap surface, up to 7(-8) µm; the terminal cell subcylindrical, narrowly clavate, fusiformous, sometimes somewhat undulate, mostly 25-50(-70) µm long, mostly obtuse-rounded at the tip, thin-walled to very slightly thickened (refringent). Some hyphal fragments bearing distinct, zebroid incrustations. **Clamp connections** absent.

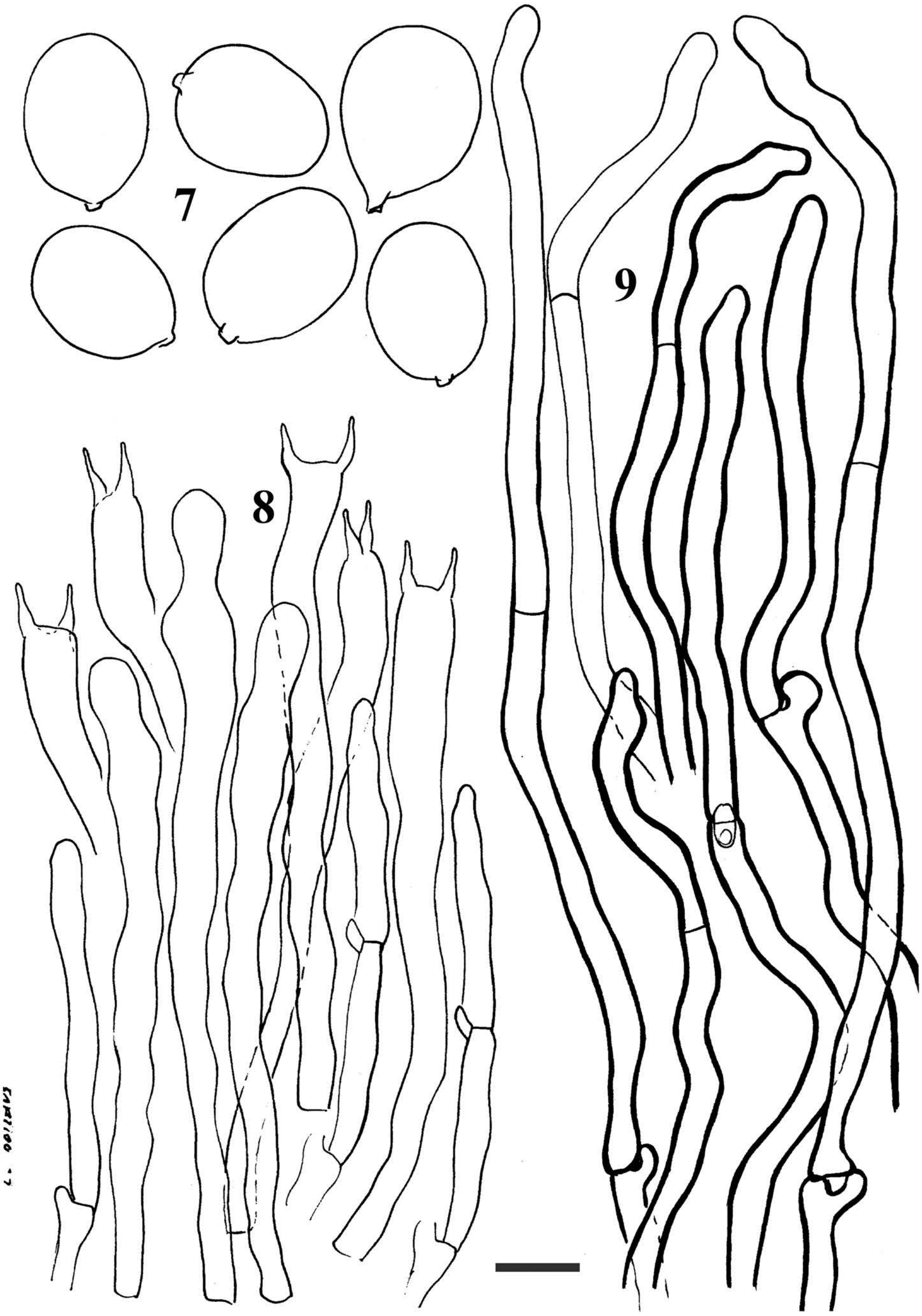
Additional examined material: **Democratic Republic of Congo**. Haut Katanga, Kanonga, National Park of Upemba, in wooded savanna, 675 m alt., 18 Feb. 1949, De Witte 5542 (BR)

Commentary: An extremely rare species which we only encountered once in the many years spent collecting in tropical Africa. The second collection (a single specimen consisting of several, quite small basidiomata of different age aggregated at the stipe base) was identified by Heinemann (1966) as *C. cibarius* var. *cantharellus* (Schwein.) R. Heim 1954 and has very similar spores: 8.5-9.3(10) × 4.5)5-5.7(6) µm. Although Heinemann had observed the absence of clamp connections in the African specimen, he considered the fasciculate habit to be the most significant difference with the type variety of *C. cibarius* Fr. Yet, in the same paper, Heinemann (l.c.) also reported a single collection from the same area for *C. cibarius* var. *defibulatus* Heinemann, in which case he based his new variety on the absence of clamp connections. The latter variety was recombined as *C. defibulatus* (Heinem.) Eyssartier & Buyck (2001). It looks exactly the same in the field as *C. sublaevis* except for its “normally” developed hymenophore of anastomosing ridges and veins, a feature that we observed also on the few other collections we made for *C. defibulatus*.

Although *Cantharellus sublaevis* is very similar to *C. lateritius* in the field, its very different microscopical features (no clamp connections, mainly thin-walled hyphae) place it most likely in subgenus *Rubrinus,* perhaps close to the Malagasy *C. sebosus* and perhaps also to *C. cibarioides*. *C. sublaevis* differs from both these species in its larger spores, and from the latter also by the mainly thin-walled elements of hymenium and suprapellis and perhaps also by its occurrence in the Zambezian woodland area.

Cantharellus solidus De Kesel, Yorou & Buyck, Cryptogamie, Mycologie 32: 279. 2011 **Figs 7-9**

This species was recently described in detail and we will limit ourselves here to some additional comments on this intriguing species. Not only because of the sometimes smooth hymenium, but also because of the very solid and practically rooting stipe, *C. solidus* is very similar to *C. cibarioides*, and the original description of *C. solidus* (De Kesel *et al.*, 2011) suggested a relation between this solidity and the presence of thick-walled hyphae in the stipe context. We have tried to examine this feature in more detail but were unable to confirm the presence of thick-walled hyphae in the lower stipe context. Both species were



Figs 7-9. *Cantharellus solidus.* **7.** Spores. **8.** Basidia and basidiola. **9.** Hyphal extremities of the pileipellis. Drawings B. Buyck. Scale bar = 10 µm, but 5 µm for spores. All from holotype.

also described as having ochre-yellow mycelium at the base of the stipe. If this is not simply the consequence of the yellow bruising that characterizes the entire context of both species, this would be a shared character that, in our experience, is unique in the genus as all known chanterelles so far have a white mycelium.

On the other hand, as both species are so similar in overall habit, it is surprising to observe such huge differences in their microscopic features: regular 5-6-spored versus regular two-spored basidia resulting in huge spore size differences, and absence versus presence of clamp connections. Following Buyck *et al.* (2014a), the latter difference would even exclude a close relationship between both species. However, whereas all other known chanterelles so far have either no clamps at all, or clamp connections at all septa, *C. solidus* possesses hyphal extremities in the pileipellis (less obvious elsewhere) that have frequent secondary septa without clamp connections (Fig. 9).

MALAYSIA:

Cantharellus incrassatus Buyck & V. Hofstetter sp. nov. **Figs 10-12**

Etymology: the name refers to the thickened wall of the lower basidium part.

Mycobank: MB 808100

Diagnosis: Differs from *C. lateritius* in its completely smooth hymenophore, equally thick-walled, but more inflated hyphal extremities in the pileipellis and its occurrence in dipterocarp forests of Malaysia.

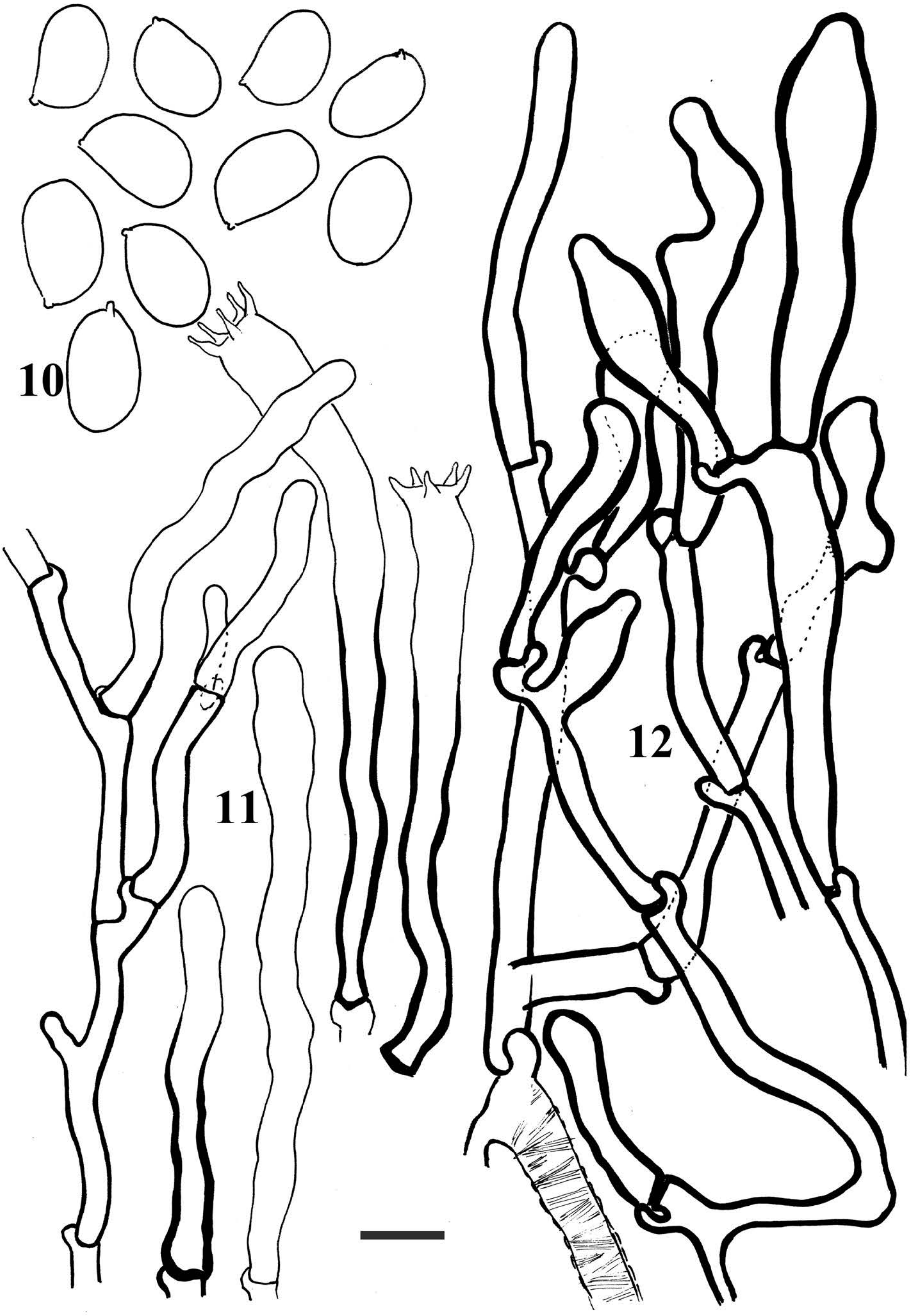
Holotypus: MALAYSIA, Negeri Sembilan, Pasoh National Forest Reserve, on the left of the beginning of "Main trail", in secondary dipterocarp lowland rain forest near *Shorea* spp., 7 September 2006, D. Stubbe 06/111 (GENT, holotypus, PC isotypus).

"**Pileus** 9-55 mm diam., often confluent between closeby individuals, plano-convex to somewhat infundibuliform, margin irregularly waving, surface dry, slightly tomentose, deep and bright golden yellow (4A8 but even more intense yellow) extreme margin paler yellow. **Hymenophore** absolutely smooth, pale yellow (4A4-6 but slightly yellower), forming a continuum with the stipe surface. **Stipe** rather plump and stout, more or less cylindrical, 15-45 × 5-17 mm, slightly tapering downwards. **Context** solid to partly hollow (but most probably because of insect damage), pale yellow (3A3). **Smell** strongly of apricots. **Taste** mild. **Spore print** not obtained (from Eyssartier *et al.*, 2009)".

Spores ellipsoid, (5.6)6.0-*6.68*-7.3(8.0) × (4.2)4.3-*4.60*-4.9(5.2) µm, Q = Q=1.3-*1.45*-1.6, smooth, very pale yellowish under the microscope. **Basidia** long, mostly 70-100 × 7-10 µm, (4-)5-6-spored, slightly clavate, in their lower part with distinctly thickened wall. **Subhymenium** filamentose. **Pileipellis** a loose layer of very irregularly inflated, thick-walled hyphae of variable diam., 5-10(15) µm width, with numerous free extremities, some fragments with slightly yellowish intracellular pigment, others distinctly zebroid encrusted. **Clamp-connections** present everywhere.

Additional material examined: MALAYSIA, Negeri Sembilan, Pasoh National Forest Reserve, on the left of the beginning of "Main trail", in secondary dipterocarp lowland rain forest near *Shorea* spp., 10 September 2006, D. Stubbe 06/163 (GENT).

Commentary: We reproduced the macroscopic description from Eyssartier *et al.* (2009, as *C. lateritius sensu lato*) for completeness. Preliminary sequence data confirm the close relationship between this species and *C. lateritius*,



Figs 10-12. *Cantharellus incrassatus*. **10.** Spores. **11.** Basidia and basidiola. **12.** Hyphal extremities of the pileipellis. Drawings B. Buyck. Scale bar = 10 µm, but 5 µm for spores. All from holotype.

from which it differs mainly in its completely smooth hymenophore, thickened basidium walls and more inflated, very irregular hyphal extremities in the pileipellis. It still is only known from the type locality.

NEW CALEDONIA:

Cantharellus neocaledoniensis Buyck, V. Hofstetter, Eyssart. & Ducousso sp. nov. **Figs 13-15, 20**

Mycobank: MB 808101

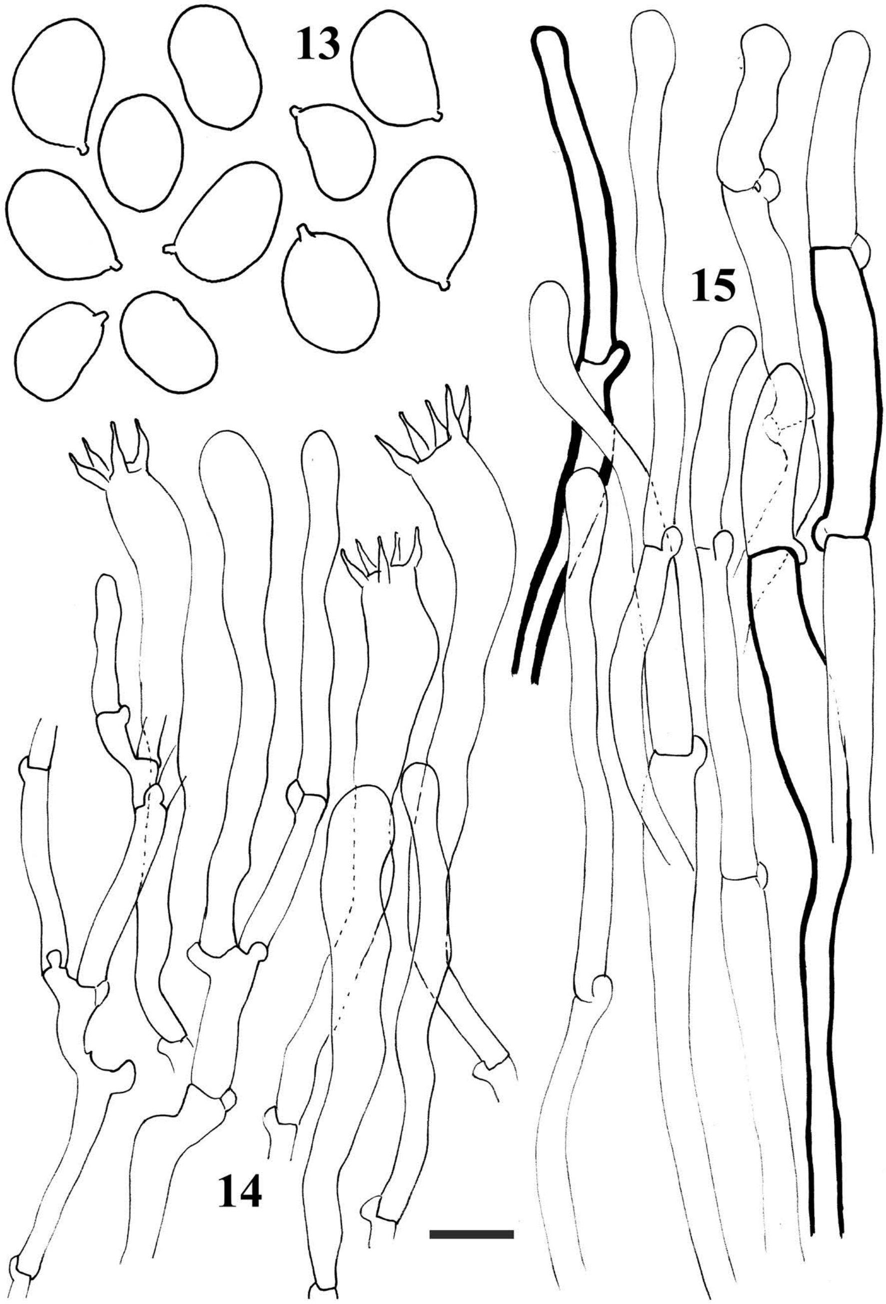
Diagnosis: differs from *C. solidus* in the 5-6-spored basidia, smaller spores measuring (6.2)6.6-*7.33*-8.0(8.5) × (4.2)4.5-*4.96*-5.4(6.0) µm, Q = 1.3-*1.48*-1.7, absence of secondary unclamped septa in the hyphal extremities of the pileipellis and its occurrence with *Melaleuca* or *Acacia* in New Caledonia.

Holotypus: New Caledonia: Poum, on silico-argilaceous soil in degraded maquis with *Melaleuca quinquenervia, Acacia spirorbis, Alphitaria neocaledonica* and other invading shrub, 16 March 2009, Buyck, Eyssartier, Hofstetter & Ducousso leg., NC09.014 (PC 0084871)

Pileus 15-40 (60) mm diam., first convex-plane or slightly depressed at the disc, rapidly more concave but rarely becoming strongly funnel-shaped, sometimes umbilicate, towards the margin becoming very thin, flexuous and nearly always strongly and irregularly lobed; surface dull, smooth to radially wrinkled, sometimes with some wooly bloom in the center, cream to pale yellowish, with rather distinct pinkish tints when fresh and young but these rapidly fading. **Hymenophore** strongly decurrent, of variable development, usually closer to the cap margin with distinct veins or low folds that fork sparsely and may be anastomosing or not in between, sometimes also with completely smooth hymenophore or with only some weak veination near the very margin, off-white and paler than the rest of the basidioma. **Stipe** 15-50 × (3) 5-10 (15) mm, narrowing downward, concolorous with cap, smooth or sometimes disrupting horizontally leaving a zebroïd pattern, compact inside, a white mycelium-like tomentum covering sometimes the very base. **Context** cream, yellowing strongly (the whole fruit body becoming chrome yellow upon handling). **Odor** agreeable, fruity. **Taste** mild. **Spore print** not obtained.

Spores broadly ellipsoid, (6.2) 6.6-*7.33*-8.0(8.5) × (4.2)4.5-*4.96*-5.4(6.0) µm, Q = 1.3-*1.48*-1.7, smooth, hyaline. **Basidia** slender, distinctly clavate, mostly 70-85 × 8-10 µm, with 4-6 robust sterigmata. **Cystidia** none. **Subhymenium** filamentose. **Pileipellis** a very loose, non-gelatinous tissue of ascending hyphal endings, with terminal parts often aggregated in pyramidal tufts, in some places nearly approaching a trichodermal structure, mostly 5-7(9) µm diam., with distinct pigment inclusions, some thin-walled, but mostly with moderately to distinctly thick-walled elements at the very surface. **Clamp connections** everywhere.

Additional examined material: **New caledonia**. Southern Prov., Mont Koghi, 9 April 2007, M. Ducousso 07.244 (PC0084875); Poum, on silico-argilaceous soil in degraded maquis with *Melaleuca quinquenervia, Acacia spirorbis, Alphitaria neocaledonica* and other invading shrub, 16 March 2009, Buyck, Eyssartier, Hofstetter & Ducousso leg., NC 09.001 (PC0084872); col d'Arama, on alterated schist soil under *Melaleuca quinquenervia* and *Acacia spirorbis*, 16 March 2009, Buyck, Eyssartier, Hofstetter & Ducousso leg., NC 09.002 (PC0084873), Poum Golone, on white sand (85% silicium rich), with *Sanantha virgata, Melaleuca quinquenervia*, 16 March 2009, Buyck, Eyssartier, Hofstetter & Ducousso leg., NC09.004 (PC0084870).



Figs 13-15. *Cantharellus neocaledoniensis*. **13.** Spores. **14.** Basidia and basidiola. **15.** Hyphal extremities of the pileipellis. Drawings B. Buyck. Scale bar = 10 µm, but 5 µm for spores. All from holotype.

C. neocaledoniensis is the most common chanterelle in New Caledonia and seems to be associated principally with *Melaleuca quinquenervia* and/or *Acacia spirorbis*. We have never found it with *Nothofagus* nor with other hosts.

Commentary: This species is macroscopically very close to the West-African *C. solidus* De Kesel, Yorou & Buyck. Dried specimens of both species cannot be separated without a microscope. Both are characterized by a highly variable hymenophore development, ranging from a completely smooth surface to well-developed, strongly anastomosing and forking ridges, both have pale overall colors and some pinkish tints when young, both also possess a firm, almost radicating stipe and both are yellowing when handled. Under the microscope, however, the differences are immediately clear and both species are even not closely related as deduced from preliminary sequence data. *Cantharellus solidus* (figs. 7-9) is easily recognized by its very large spores, the largest observed so far in the genus, produced on two-spored basidia; *C. neocaledoniensis* produces ordinary spores on predominantly 5-6-spored basidia as in most *Cantharellus*.

Cantharellus eccentricus Buyck, V. Hofstetter & Eyssart. **Figs 16-18, 21-22**

Mycobank: MB 808102

Diagnosis: differs from all other *Cantharellus* in its laterally inserted stipe, the strongly wrinkled-merulioid hymenophore configuration and its occurrence under *Nothofagus* or *Aryllastrum* in New Caledonia.

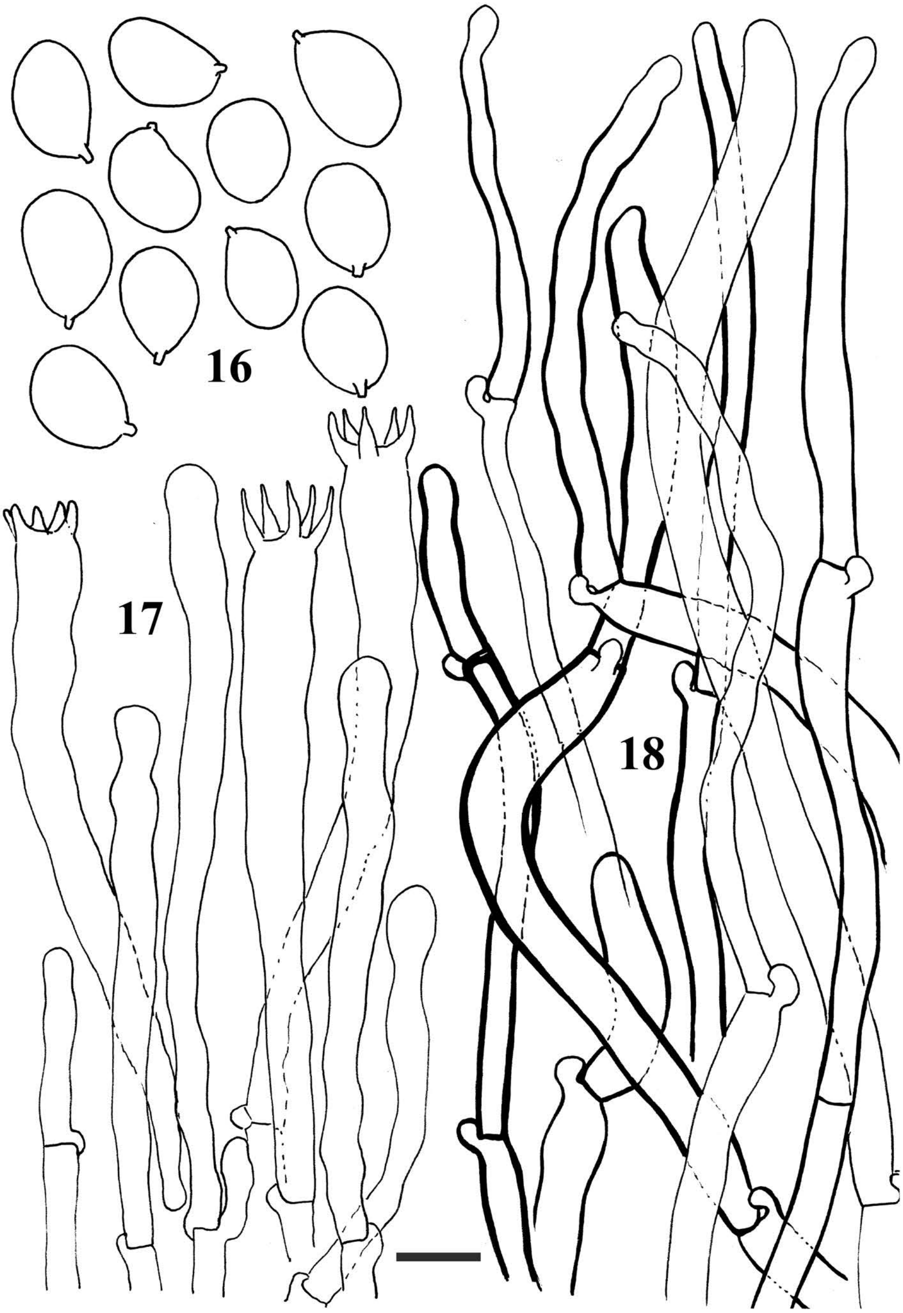
Holotypus: NEW CALEDONIA. Southern Prov., Koniambo massif, on ultramafic soil under *Nothofagus balansae*, 860 m alt., 19 March 2009, Buyck, Eyssartier, Hofstetter & Ducousso leg., NC 09.129 (PC0084864)

Pileus up to 80 mm wide, laterally inserted on the stipe, very irregular with an incurved margin locally prolonged by numerous, irregular, small lobes; surface smooth to slightly uneven or with some veins, having a pale creamish yellow with greyish isabelline 'marbled' aspect probably due to water-soaked, underlying tissues, becoming rusty- yellow with age and from handling. **Hymenophore** strongly decurrent, very irregularly veined-wrinkled (more merulioid than the regularly forked and anastomosing veins or folds of other *Cantharellus*), most of the larger veins radially oriented, a dirty isabelline color, near the margin becoming completely smooth, very pale gray and finally ending as a perfectly white borderline. **Stipe** subcylindrical or narrowing downward, 25-37 × 8-11 mm, compact. **Flesh** cream, slowly yellowing then ferrugineous. **Smell** weak, fungal, not of apricots. **Taste** mild. **Spore print** not obtained.

Spores ellipsoid, (6.2)6.7-*7.46*-8.2(8.7) × (4.8)4.9-*5.24*-5.5(6.0) µm, Q = 1.1-*1.43*-1.7, smooth. **Basidia** clavulate to subcylindrical, slender, up to 110 µm long, ca. 8-10 µm wide, thin-walled, (4-)5(-6) spored with stout sterigmata. **Subhymenium** filamentous, composed of long and slender, thin-walled elements of the same diam. as the base of basidia. **Pileipellis** a cutis of thin- to thick-walled, subcylindrical elements, often with widely spaced septa, of quite variable diam., 3-10 µm wide; the terminal cell of similar diam. and short or long (up to 100 µm), mostly subcylindrical, sometimes narrowing near the tip, sometimes more clavulate. **Clamp connections** everywhere.

Additional examined material: NEW CALEDONIA. Southern Prov., "Bois du Sud", on the ground under *Arrilastrum gummiferum*, 30 March 2009, Buyck, Eyssartier, Hofstetter & Ducousso leg. (PCsn)

Commentary: When collecting this species in New Caledonia, we were unable to place it in a particular genus because *C. eccentricus* has nothing that reminds one of a normal chanterelle. The strange aspect of the hymenophore



Figs 16-18. *Cantharellus eccentricus*. **16.** Spores. **17.** Basidia and basidiola. **18.** Hyphal extremities of the pileipellis. Drawings B. Buyck. Scale bar = 10 µm, but 5 µm for spores. All from holotype.

Fig. 19. *Cantharellus sublaevis***.** Fresh basidiomata (photo B. Buyck).

Fig. 20. *Cantharellus neocaledoniensis.* Fresh basidiomata (photo B. Buyck).

Figs 21-22. *Cantharellus eccentricus.* Fresh basidiomata (photos B. Buyck).

configuration and quasi lateral stipe are unique in the genus. The collected specimens were water-soaked and quite fragile, breaking easily when handled. The earlier described *Cantharellus pleurotoides* T.W. Henkel, Aime & S.L. Mill. was recently recombined in *Craterellus* (Wilson *et al.*, 2012) and is much smaller. Microscopic features as well as preliminary sequence data place *C. eccentricus* firmly within *Cantharellus* subgenus *Cantharellus*, close to the Malayan *C. incrassatus*, a look-a-like of *C. lateritius*. It differs microscopically from the former in the thin-walled basidia and from both in its irregularly thickened to thin-walled hyphal extremities of the pileipellis.

DISCUSSION

Smooth chanterelles are absolutely very rare species on every continent with the exception of the southeastern United States where the *C. lateritius* complex is in our experience one of the more common edible mushrooms. Never recorded from Europe, smooth chanterelles must be rare in Asia as Corner (1966), for example, apparently never collected such chanterelles notwithstanding his particular interest in the genus. There exist no published records of smooth chanterelles from Australia, but the group appears to be present there and equally rare (R. Halling pers. comm.). Also the three known smooth chanterelles from Africa are exclusively known from the type locality, and this notwithstanding a long history of fungal inventory. This equally applies to the here newly described *C. sublaevis*, found in the Democratic Republic of Congo as well as in Zambia. Both these collections, however, come from the same area (the Copperbelt) and from exactly the same kind of habitat on different sides of the border between both countries. This rarity might reflect the ancient history of these species.

Although we were not yet successful in sequencing all of the discussed taxa, preliminary LSU and mitSSU data suggest that smooth chanterelles occupy indeed a basal position within their respective clades, with species having clamp connections belonging mostly in subgenus *Cantharellus* and those without clamp connections in subgenus *Rubrinus,* close to species of section *Heinemannianus*. Both subgenera constitute a well-supported monophyletic clade (Buyck *et al.*, 2014a) and it is tempting to hypothesize that the smooth chanterelles might represent the archetype in both subgenera and most closely resemble the common ancestor of both clades. We had one surprise however: although still lacking bootstrap support, a preliminary combined analysis of mitSSU and LSU data resolves the predominantly clamped *C. solidus* as basal to the clampless subgenus *Rubrinus*. This suggests that the lack of clamps in this still exclusively African subgenus is a derived condition. This makes sense considering the fact that the clamped, African *C. subincarnatus* was resolved in an even more basal position, but puts smooth chanterelles evolutionary in between chanterelles with a ‘normal’ hymenophore, as more basal clades in the genus have not yet revealed smooth chanterelles, nor did more derived groups.

With the exception of the quasi pleurotoid, New Caledonian *C. eccentricus*, and the clampless African species with mostly elongate spores, all other smooth chanterelles possess a very similar general appearance and very similar spores. The key below tries to highlight their most important features.

1. Without clamp connections, spores elongate or ellipsoid .... (2)

1. With clamp connections, spores never elongate but ellipsoid to nearly subglobose .... (4)

2. Hymenophore completely smooth; spore length-width ratio Q=1.6-*1.90*-2.7. Central Africa, Zambezian miombo woodlands .... ***C. sublaevis***

2. Hymenophore development variable, with specimens developing sometimes normal ridges and others having a strongly reduced to smooth hymenophore ....(3)

3. Quite small species with bright yellow cap looking like a small *C. cibarius*; spore length-width ratio Q=1.2*1.4*1.6 Madagascar, Central Highlands. *Uapaca* woodland .... ***C. sebosus***

3. A medium-sized yellow-orange species; spore length-width ratio Q = 1.5-*1.71*-1.9. Central Africa, Guineo-congolian rain forest .... ***C. cibarioides***

4. Stipe lateral. Hymenophore entirely wrinkled, meruloid. Associated with *Nothofagus/Aryllastrum*. Spores length-width ratio Q = 1.1-*1.43*-1.7. New Caledonia .... ***C. eccentricus***

4. Stipe central to eccentric, never lateral; hymenophore not entirely wrinkled-meruloid .... (5)

5. Predominantly creamy isabelline colored basidiomata with a huge differences in hymenophore development between individual specimens, hymenophore showing well-developed ridges, low veins or being entirely smooth .... (6)

5. Yellow orange species with the hymenophore always at least partly smooth (7)

6. Basidia two-spored, spore length-width ratio Q = 1.1-*1.26*-1.5. West African humid gallery forest .... ***C. solidus***

6. Basidia four to six-spored, associated with *Melaleuca/Acacia*, spore length-width ratio Q = 1.3-*1.48*-1.7. New Caledonia .... ***C. neocaledoniensis***

7. Partly smooth hymenophore. America .... ***C. lateritius*** and its American satellite taxa

7. Completely smooth hymenophore. Spore length-width ratio Q = 1.3-*1.45*-1.6. Dipterocarp forest, Malaysia .... ***C. incrassatus***

Acknowledgements. The authors thank the curators of BR and GENT for loan of specimens. Funding for field work in New Caledonia was obtained through two ANR (French National Agency for Research) grants (BIONEOCAL ANR-07-BDIV-006 and ULTRABIO ANR-07-BDIV-010). Mr. Denis Poignonec of Koniambo Nickel SAS is thanked for access to the Koniambo Massif mining area. Mr. David Paulaud of the “Direction de l’Environnement” for Southern Prov. is thanked for collecting permissions in New Caledonia.

Sequencing of the collections was financed through a 2014 project submitted to the ATM « Emergences » (Dir. S. Peigné) of the National History Museum in Paris.

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