STUDIES IN TROPICAL AFRICAN LACTARIUS SPECIES. 3.
Lactarius melanogalus R. Heim and related species

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The type-specimens of the African blackening Lactarius-species, L. melanogalus R. Heim, L. baliophaeus Pegler and L. griseogalus R. Heim are examined and compared to recent collections from Zaire, Cameroon, Burundi, Zambia and Tanzania. Lactarius denigricans spec. nov. and L. baliophaeus var. orientalis var. nov. are proposed.

In tropical Africa, some of the Lactarius-species in the section Plinthogali (as defined by Bon, 1983 and Hesler & Smith, 1979) are characterized by a remarkable colour-change of the latex and a strong staining of the context. The latex is first watery and transparent, then turns to grey or even black. The context is cream-coloured and becomes first greyish pink or greyish red, finally black. In dried condition, those species are easily recognized by the black color of the context.


MATERIAL AND METHODS

This study is based on herbarium material from the National Botanic Garden of Belgium (BR), the Royal Botanic Garden of Edinburgh (E), the University of Gent (GENT), the University of Helsinki (H), the Royal Botanic Gardens of Kew (K), the National Museum of Natural History of Paris (PC) and the personal herbarium of Bart Buyck (BUYCK).

Microscopic features are studied in congo-red in ammonia or L4 (Clemenc, 1972) (eventually after a short passage in KOH 10% solution). Spore ornamentation is described and illustrated as observed in Melzer's reagent. Terminology of cystidial elements is according to Buyck (1991). Line-drawings are made with the aid of a drawing tube at magnifications 6700 x for spores, 3200 x for individual elements and 1100 x for sections and surface views. Stippling indicates refractive contents in cystidia and lactifers, intracellular pigmentation in the elements of pilei- and stipitipellis. Basidia length excludes sterigmata length.

Spores are measured in side view in Melzer's reagent, excluding the ornamentation, and measurements are given as (MINa) [AVa−2*SD]−AVa−AVb−[AVb+2*SD] (MAXb) in which AVa = lowest mean value for the measured collections, AVb = greatest mean value and SD = standard deviation. Q stands for 'quotient length/width' and is given as (MINQa) Qa-Qb (MAXQb) in which Qa, resp. Qb, stand for the lowest, respectively the highest, mean quotient for the measured specimens.
Colour-codes are from Kornerup & Wanscher (1978). Colour of spore-prints is according to Romagnesi (1967). L + 1/cm means number of lamellae (L) and lamellulae (I) per cm at pileus mid-radius. Names of phytogeographical regions and vegetation types are according to White (1983).

RESULTS

In addition to the type-specimens, 40 more recent collections have been studied. Most of those collections could be identified as L. baliophaeus. Some represented L. melanogalus. When comparing all the collections of L. baliophaeus, it was striking that some of them had clearly longer spores than the type-specimen. I propose a new variety, L. baliophaeus var. orientalis.

Between the Tanzanian collections, gathered by Tiina Saarimäki et al., one blackening Lactarius that superficially resembles L. baliophaeus, was found. It shows exactly the same colour-changes, but has totally different microscopic features. The pileipellis consists of thick-walled cylindric elements on a pseudoparenchymatous layer; there are thick-walled and emergent macropleurocystidia; the ornamentation of the spores is always lower than 0.5 \( \mu \text{m} \) and is composed of warts and fine connective lines. The species is described as L. denigricans.

Lactarius melanogalus, L. griseogalus and L. baliophaeus are typical members of the section Plinthogali, because of their winged spores and hymeniderm-like pileipellis without thick-walled elements. Though superficially related with those species by the similar colour-changes, L. denigricans belongs to a different section. The closest affinities with other African Lactarii are found with Lactarius rubroviolascens R. Heim. The latex of L. rubroviolascens is water-like, almost translucid with a greyish tinge, the context becomes blackish, then reddish. Most of the microscopical features are more or less similar to those of L. denigricans: rather thick-walled elements in pilei- and stipitipellis, macropleurocystidia thick-walled and emergent; spores low ornamented.

KEY TO THE BLACKENING LACTARIUS-SPECIES IN AFRICA

1a. Terminal elements of the pileipellis thick-walled; ornamentation of the spores never exceeding 0.5 \( \mu \text{m} \) height, composed of warts and fine connective lines . L. denigricans
   b. No thick-walled elements present in the pileipellis; ornamentation of the spores exceeding 1 \( \mu \text{m} \) height, composed of ridges forming a more or less complete reticulum . . . 2
2a. Spores ellipsoid; \( Q = 1.24-1.64 \) .................................................. 3
   b. Spores globose to subglobose, rarely ellipsoid; \( Q = 1.01-1.20 \) .......................... 4
3a. Pileus and stipe greyish yellow to yellowish brown, without papilla; spores completely winged ................................................. L. baliophaeus var. orientalis
   b. Pileus and stipe dark brown, with a distinct papilla; spores partially winged, with conical warts and lower ridges present .......................... L. griseogalus
4a. Ornamentation of the spores 1–2 \( \mu \text{m} \) high; spores 6.7–7.3–7.5–8.2 \( \times 6.0-6.5-6.7-7.2 \) \( \mu \text{m} \); latex finally bluish black ............................................. L. melanogalus
   b. Ornamentation of the spores up to 1(–1.3) \( \mu \text{m} \) high; spores 7.0–7.9–8.3–9.0 \( \times 6.5-7.3-7.6-8.2 \mu \text{m} \); latex finally beige to cream-colour . L. baliophaeus var. baliophaeus
1. Lactarius melanogalus R. Heim — Figs. 1, 2


Pileus (2.5) 3–4 (5.5) cm diam., thin, planulate, then slightly depressed; margin irregular, undulate, not incurved; pellis not dehiscent, smooth, mat, dry, strongly radially wrinkled, olivaceous ochraceous brown to dark brown (5E4-6, 5F4-6, 6EF6-7) with black spots. Stipe (1.5) 2.5–4 (7) × 0.4–1.0 cm, cylindric, curved near the base, smooth, longitudinally grooved, firm, dark cream-colour and greyish brown (4EF6-8, 6CD3-4), with black spots. Lamellae adnexed to adnate with decurrent tooth, unequal with lamellulae of different lengths, rather dense, 2–3 mm broad, thick, greasy, greyish, ochraceous, cream-colour, with black spots; edge slightly crenular, sometimes darker. Context thin, first transparent to cream-colour, then greyish pink, finally blackening; taste mild to acid; smell not remarkable, sometimes sweet. Latex abundant, first watery, then cream to greyish, finally bluish black. Spore deposit not noticed.

Spores globose to subglobose, sometimes ellipsoid, 6.7–7.3–7.5–8.2 × 6.0–6.5–6.7–7.2 μm (Q = 1.04–1.11–1.13–1.20; n = 60); ornamentation amyloid, composed of high ridges (1–2 μm), forming a winged reticulum, without isolated warts, denser on adaxial side; plage not amyloid. Basidia 30–45 × 9–11 μm, cylindric to narrowly utriform, 4-spored. Macropleurocystidia sparse, not emergent, 33–43 × 6–8 μm, cylindric to fusiform, sometimes irregular, with slightly thickened wall. Pseudopleurocystidia sparse; content dark brown. Lamella-edge sterile; cheilocystidia 18–28 × 4–6 μm, cylindric to fusiform and tapering upwards, wall slightly thickened; content brown. Lamella-trama irregular, composed of hyaline thin-walled hyphae; lachertious hyphae abundant and with remarkable brown content. Pileipellis a hymeniderm; 40–70 μm thick, elements of the suprapellis 20–40 × 7–13 μm, thin-walled, subglobose to slightly clavate or clavate, with brown intracellular pigmentation; subpellis pseudoparenchymatous, thin. Stipitipellis a palissade; 40–90 μm thick; elements of the suprapellis (10) 15–30 (35) × 3–6 (10) μm, cylindric, slender, sometimes fusiform or irregular, with brown intracellular pigment; subpellis pseudoparenchymatous. Clamp-connections lacking.


*Observations:*

1) Heim first used the name *Lactarius melanogalus* (1943) for a specimen from Ivory Coast, without Latin diagnosis. In 1955b he redescribed the species, Latin diagnosis in-
Fig. 1. *Lactarius melanogalus*. a. Spores; b. basidia; c. cheilocystidia; d. macropleurocystidia (a–d. Goossens-Fontana 979).
Fig. 2. *Lactarius melanogalus*. a. Section through the pileipellis near the margin; b. section through the pileipellis halfway the radius; c. longitudinal section through the stipitpellis near the top (a, c. Goossens-Fontana 979; b. Buyck 3332).
cluded, and cited specimens from Ivory Coast, Cameroon and Zaire. He did not indicate a type-specimen. *Heim A87* and *Heim Q43* could not be traced at PC. Considering the water-colour of *Heim A87* and the drawings of the spores, they clearly represented the same species as *Goossens-Fontana 979*. I propose *Goossens-Fontana 979* as lectotypus. The type-specimen consists of two basidiomes in good condition.

2) The macroscopical description is based on the description of Heim (1955b) and completed with fieldnotes on *Buyck 3332* and 1356. The microscopical description is based on *Goossens-Fontana 979*, including spore-measurements of *Buyck 1356* and 3332.

3) Following the description of Heim, the colour of the pileus is ochraceous to olive-brown and the illustration of *Heim A87* shows indeed a rather pale mushroom. *Goossens-Fontana 979* is mentioned (Heim, 1955a) to be dark brown (bistre sombre), which is also the colour of the specimens of Buyck and Watling. The water-colour of *Heim A87*, which shows a very young specimen, proves that the pileus is ochraceous when young and becomes darker with age.

4) The taste of latex and context is very acrid in the specimens collected by Heim, very bitter in *Goossens-Fontana 979*, very acrid (but slow) in *Buyck 3332*, mild in *Buyck 1356*. There is a strong and sweetish smell in *Buyck 1356*, a fish-smell in *Heim Q43* and a smell of *Russula pectinata* (Foetentinae) in *Heim A87*.

5) The presence of aberrant spores is mentioned by Heim (1955b, fig. 15). Those spores can have the same size as the normal spores, but they have strongly amyloid droplet-like, globose warts, very irregular in size and number, and there is no sign of the normal reticulate ornamentation at all. I observed such spores in *Goossens-Fontana 979* and in the specimens of Cameroon, but they are certainly not characteristic for this species. Similar deviant spores were observed in collections of other African *Lactarius-* and *Russula-*species (Buyck, personal comment). An explication for their existence is unknown.


7) *Lactarius melanogalus* is cited in Nzigidahera (1993), but those specimens represent *L. baliophaeus var. baliophaeus* (Buyck 4062, 4063, 4338) and *L. baliophaeus var. orientalis* (Buyck 4375).

2. *Lactarius griseogalus* R. Heim — Fig. 3a


Because the type-specimen (1 basidiome) is in very bad condition and no other specimens of this species are known yet, no complete description can be given here. Before he gave a Latin diagnosis in 1967, Heim described the species extensively in 1966. According to Heim, this species is very closely related to *L. melanogalus*, but differs from it by the very dark brown pileus and a very pronounced papilla. The latex becomes greyish, but

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1) There exists another specimen labeled *Heim Q43*, which represents *Lactarius gymnocarpus*. As there is no confusion possible between those species and as Heim cited *Heim Q43* also under *L. gymnocarpus*, I suppose that there were two specimens with the same number. Despite a long search, this *Heim Q43* could not be traced in the National Museum of Natural History of Paris.
never black and the taste is mild and sometimes a bit astringent. He also mentions that the spores are smaller. As in the present concept of *L. melanogalus* the pileus becomes darker with age and the taste of the context and latex appears rather variable, the noted differences are of low significance. Although the type is in very poor condition, it was possible to take a careful look at the spores. They proved to be very different indeed from those of *L. melanogalus*. The spores are ellipsoid and measure 7.0–8.2–9.3 × 5.5–6.0–6.5 μm (Q = 1.24–1.36–1.55; n = 20). The winged aspect of the ornamentation of the spores is not as obvious as in *L. melanogalus*. The ornamentation is up to 1.5 μm high. Beside the normal 4-spored basidium, 2-spored basidia were frequently observed. For these reasons *L. griseogalus* is nevertheless considered as a good species.

*Examined material and distribution.* CENTRAL AFRICAN REPUBLIC: Sudanian woodland, Savanne de Bébé, close to Filifi river, associated with *Lophira alata* and *Uapaca guineensis* (the latter is likely to be the ectomycorrhizal host), Aug. 1966, *Heim LM2189* (holotypus PC).

3. *Lactarius baliophaeus* var. *baliophaeus* Pegler — Figs. 3b, 4, 5a


Pileus 3–7 (9) cm diam., plano-concex, applanate to slightly depressed, infundibuliform when older; margin slightly incurved when young, then crenulate to undulate, striate when dry; pellis not dehiscent, smooth, dry, mat, quite thick, greyish yellow to brownish orange (4AB3–5–5C4) to dark blond and yellowish brown (5DE4–5), staining dark brown and black. Stipe central to eccentric, (1.5) 2.5–5 × 0.5–1.0 cm, cylindric, clavate towards the base, greyish yellow to brownish orange or dark blond, sometimes dark grey, staining black and dark brown, firm, smooth, dry. Lamellae broadly adnate to decurrent, very dense (4 + 12 to 3 + 6/cm), unequal with lamellulae (3–5 (7) between 2 lamellae, regular pattern), thin, paper-like, broad (3) 5–7 mm, cream, pale greyish, staining reddish then black; edge entire, sometimes black brown. Context firm, white to cream-colour, changing immediately to orange-red, greyish red and finally black; taste mild, sometimes slightly bitter (AV 94.283) or even first mild but then acrid (AV 94.438). Latex very abundant, water-like, transparent-brownish, changing to beige and cream-colour, taste mild (acrid in AV 94.438). Spore deposit cream-colour (IIa).

Spores globose to subglobose, 7.0–7.9–8.3–9.0 × 6.5–7.3–7.6–8.2 μm (Q = 1.01–1.07–1.09–1.15, n = 80); ornamentation strongly amyloid, composed of ridges, up to 1.0 (1.3) μm high, forming a complete reticulum, isolated warts very scarce; plage distal amyloid. Basidia 38–48 × 10–12 μm, clavate to utriform, tapering downwards, 4-spored; sterigmata 3–6 × 1–2 μm; content granular or guttate. Macropseudocystidia scarce to abundant, not emergent but often arising deep in the hymenium, 40–55 × 9–11, fusiform, wall slightly thickened and brown pigmented. Pseudopseudocystidia (2) 3–6 μm diam., cylindric, rarely tortuous, top rounded, tapering or muriicate; content oleiferic, yellowish brown; sometimes emergent, quite abundant. Lamella-edge sterile; chelilocystidia 21–40 × (2) 3–6 μm, tortuous to cylindric, fusiform, top rounded, muriicate or tapering, sometimes septate, sometimes slightly thick-walled, hyaline. Lamella-trama irregular, composed of thin-walled, hyaline hyphae and quite abundant lactifers with a brown content. Pileipellis a palissade; 30–80 μm thick; elements of the pileipellis 10–25 × 3–5 μm, cylindric, slender, some fusiform, thin-walled, with brown intracellular pigment; subpellis pseudo-
Fig. 3. *Lactarius griseogalus*. a. Spores (*Heim LM 2189*). – *Lactarius baliophaeus var. baliophaeus*. b. Spores; c. basidia; d. pseudopleurocystidia; e. cheilocystidia; f. macropleurocystidia (b, c. *Holden GC 66*; c–f. *Verbeken 94.153*).
parenchymatous. Stipitipellis trichoderm-like; hyphae interwoven and ascending in suprapellis, no spherical cells; terminal elements cylindric to slightly tortuous, 20–30 x 3–5 μm, thin-walled, with brown intracellular pigment; lactifers in the underlayer abundant. Clamp-connections lacking.


Fig. 4. *Lactarius baliophaeus* var. *baliophaeus*. a. Section through the pileipellis near the margin; b. part of the hymenium halfway a lamella (a. *Holden GC 66*; b. *Verbeken 94.153*).
Fig. 5. *Lactarius baliophaeus* var. *baliophaeus*. a. Section through the pileipellis halfway the radius (Verbeken 94.153). – *Lactarius baliophaeus* var. *orientalis*. b. Spores; c. basidia; d. cheilocystidia; e. section through the pileipellis halfway the radius (b–e. Verbeken 94.472).

Observations:

The macroscopical description is compiled from the description of Pegler (1969) and the fieldnotes of Verbeken. The microscopical description is based on Holden GC66, Verbeken 94.153 and Verbeken 94.283.

4. Lactarius baliophaeus Pegler var. orientalis Verbeken, var. nov. — Fig. 5b–e

A varietate typica differt sporae forma atque sporae dimensionibus, sporis ellipsoidosis, 7.4–8.7–9.4–10.3 × 5.8–6.4–7.0–7.4 (7.7) μm (Q = 1.21–1.34–1.36–1.64; n = 60). Holotypos: Verbeken 94.472, Burundi, March 1994 (BR, isotypus GENT).

Lactarius baliophaeus var. orientalis differs from L. baliophaeus var. baliophaeus only by the spore shape and dimensions. The spores are ellipsoid, 7.4–8.7–9.4–10.3 × 5.8–6.4–7.0–7.4 (7.7) μm (Q = 1.21–1.34–1.36–1.64; n = 60).


5. Lactarius denigricans Verbeken & Karhula, spec. nov. — Figs. 6–8

Pileus 6–8 cm diam., convex ad leviter depressus; margine irregulari; pileipellis pallide ochracea, dein badio vel nigro maculata. Stipes 4.5–6 cm longus, 1.5–2 cm crassus, cylindratus, pileo concoloratus, dein badio vel nigro maculatus, in longitudine rugosus ad sulcatus. Lamellae decurrentes, modice confragae, albo-cremeae, denigricans. Latex abundans, translucido-albus, rubescens, dein niger, gutu mitis. Contextus albus, rubescens, postremo lilacinus ad niger. Sporae 6.8–7.7–8.4 (8.7) × 5.6–6.3–7.1 μm, subglobosae ad ellipsoidae, irregulariter verrucosae ad incomplete reticulatae; macula suprahilaris centrale amyloidea. Macropleurocystidia absensia. Pileipellis bistrata; elementa suprapellis 15–55 × 7–8 (10) μm, cylindrata ad clavata, pariete incrassato (0–1 μm); subpellis pseudoparenchymata.

Holotypus: Saarimäki et al. 1467, Tanzania, Jan. 1993 (H).

Pileus 6–8 cm diam., convex to slightly depressed; margin irregular; pellis mat, slightly wrinkled, pale beige, becoming brownish grey to black when bruised. Stipe 4.5–6 × 1.5–2 cm, cylindric, round to applanate on section, mat, longitudinally wrinkled to groov-
Fig. 6. *Lactarius denigricans*. a. Macropleurocystidia; b. spores; c. part of the hymenium halfway the lamella; d. basidia (a–d. Saarimäki et al. 1467).
ed, pale beige, becoming brownish grey when bruised. Lamellae decurrent, unequal with mostly short lamellulae, close, broad (8 mm), rather thick, ivory coloured, blackening when bruised; edge entire and concolorous. Context in the pileus white, becoming red, then lilac and finally black by the latex; in the stipe white, then yellow, red under the surface; taste mild, smell absent. Latex abundant, transparent-whitish, changing red on the air, finally black; taste mild. Spore deposit not noticed.

Spores subglobose to ellipsoid, 6.8–7.7–8.4 (8.7) × 5.6–6.3–7.1 μm (Q = 1.12–1.21–1.32; n = 50); ornamentation amyloid, low, up to 0.5 μm high, composed of irregular knotty warts and fine connective lines, never forming a complete reticulum; plage distinct, with a central amyloid spot. Basidia (38) 40–45 (47) × 7–9 (10) μm, cylindric to slightly clavate, 4-spored. Macropleurocystidia abundant, emergent, 60–135 × 10–11 μm, cylindric to narrowly fusiform, rounded with thickened wall (1–2 μm). Pseudopleurocystidia not abundant, cylindric, 7–8 μm diam., content brownish oleiferic. Lamella-edge fertile, macrocystidia, basidioles and basidia present. Lamella-trama composed of sphaerocytes and abundant broad lactiferous hyphae. Pileipellis a palissade; 70–100 μm thick; elements of suprapellis 15–55 × 7–8 (10) μm, cylindric, sometimes clavate, sometimes septate, thick-walled (0–1 μm); subpellis thin, pseudoparenchymatous, spherical cells 5–15 μm. Stüptipellis a trichoderm, 90–140 μm thick; terminal elements cylindric to slightly tortuous, (10) 25–60 (80) × 6–8 (10) μm, thick-walled (1–2 μm). Clamp-connections absent.

Fig. 7. Lactarius denigricans. Section through the pileipellis halfway the radius (Saarimäki et al. 1467).

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