

***Termitomyces striatus* f. *pileatus* f. nov. and f. *brunneus* f. nov. from Cameroon with a key to central African species**

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Abstract – Two new forms of *Termitomyces striatus* are described from Cameroon and a preliminary key to the central African taxa is provided for the first time. *T. striatus* f. *pileatus* is characterized by an often subinfundibuliform pileus that is usually squamulose greyish orange when young and cocoa brown or leather brown in age. This new form is additionally characterized by an obtuse to obtusely conical perforatorium, more or less conspicuously radially striate mature pileus, inconspicuous annulus present only on young basidiomes, a long filiform pseudorhiza, and polymorphic pleuro- and cheilocystidia. *T. striatus* f. *brunneus* is distinguished by a plicate- to sulcate- striate unchanging chocolate brown to dark brown pileus with a conspicuous mammiform perforatorium made of erect subcylindrical and inflated chains of cells; this form is further distinguished by polymorphic cystidia that differ from those found in *T. striatus* f. *pileatus*.

Key words – Basidiomycetes, Tricholomataceae, termite symbionts, taxonomy

Introduction

The genus *Termitomyces* R. Heim includes a group of paleotropical and good edible *Agaricales* sharing some common ecological and morphological features, of which the most conspicuous are the obligate symbiotic association with termites belonging to the subfamily *Macrotermitinae*, the presence of a more or

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less conspicuous umbo (called a 'perforatorium') that is pointed in some species and believed to help the basidiome forge its way out of the soil during growth and the presence of a pseudorhiza, a thread-like subterranean elongation of the stipe connected to combs built by termites in giant or subterranean termite nests.

Since Heim (1942) erected this genus with 10 species and 6 forms, several other taxa have been described or reported by several authors, mainly from Africa and Asia (Alasoadura 1966; Heim 1951, 1952, 1958, 1977; Mossebo et al. 2002; Natarajan 1979; Otieno 1964; Pegler 1977; Pegler & Vanhaecke 1994; Pearce 1987; Saarimäki et al. 1994; Tang et al. 2005, 2006; Turnbull & Watling 1999; Van der Westhuizen & Eicker 1999; Wei et al. 2004; Zoberi 1972). Kirk et al. (2001), who refer the genus to the *Tricholomataceae* R. Heim ex Pouzar, estimate that about 40 *Termitomyces* species have so far been described worldwide. The majority of species is restricted to tropical Africa, which together with parts of Asia are the only regions of the world where this genus grows. Aanen et al. (2002) showed that symbiosis between these fungi and termites has a single African origin, while Frøslev et al. (2003) demonstrated a phylogenetic differentiation between African and Asian samples.

No doubt, several other taxa of *Termitomyces* remain undescribed in tropical Africa, especially in still uninvestigated large areas of tropical rain forests and savannahs. In one recent contribution that expanded knowledge of African species, Mossebo et al. (2002) documented 14 records of *Termitomyces* from Cameroon that included four new species and four new forms, namely *Termitomyces griseiumbo* Mossebo, *T. subumkowaan* Mossebo, *T. mboudaeina* Mossebo, *T. subclypeatus* Mossebo, *T. subclypeatus* f. *tetrasporus* Mossebo, *T. striatus* f. *subumbonatus* Mossebo, *T. striatus* f. *bibasidiatus* Mossebo and *T. striatus* f. *griseiumboides* Mossebo. Since that time, other collections have been obtained in Cameroon and central Africa (some belonging to the *T. striatus* group) with striking morphological features not matching any previously described taxa. Therefore, here we describe *Termitomyces striatus* f. *pileatus* and f. *brunneus* as two new forms of this species. We also present a first preliminary key to the most common taxa of *Termitomyces* from the central Africa region as well as a key to the known (according to 'Index Fungorum.' www.indexfungorum.org) and two newly described forms in the *T. striatus* group.

Materials and methods

Taxon sampling

Samples of the two new forms of *T. striatus* collected and described in Cameroon were compared with herbarium material curated in the Mycology Section, Royal Botanic Gardens in Kew, where voucher specimens were

deposited and encoded in the mycological herbarium. The more than 30 specimens investigated represented most of the well-established taxa (Kirk et al. 2001) of *Termitomyces* worldwide. Voucher specimens are deposited in the herbarium of Mycological Laboratory, University of Yaoundé 1 – HUYI, and in the mycological herbarium of the Royal Botanic Gardens, Kew – K(M).

Morphology

Colours were described according to Kornerup & Wanscher (1978) and samples identified using among others the publications cited in References. For microscopic features, sections were prepared from fresh or dried materials using a razor blade and mounted in 5% KOH (for exsiccata) before staining with phloxine B or ammoniacal congo red and examined with an Olympus CH2 microscope; drawings were made from the attached camera lucida. Dimensions of basidiospores, basidia, cystidia, lamellar hyphae, pileipellis elements, and other features were measured using an ocular micrometer. Basidiospore, basidia, and cystidia morphologies were described following Berger (1980). At least 20 basidiospores were measured for each taxon collected and the following parameters calculated: $Q = L/W$, where Q is the ratio of the length (L) over the width (W) and Q_R , the arithmetic mean value of Q . Mean values of L and W are given in italics and their extreme values in brackets.

Taxonomic description

Termitomyces striatus f. *pileatus* Mossebo f. nov.

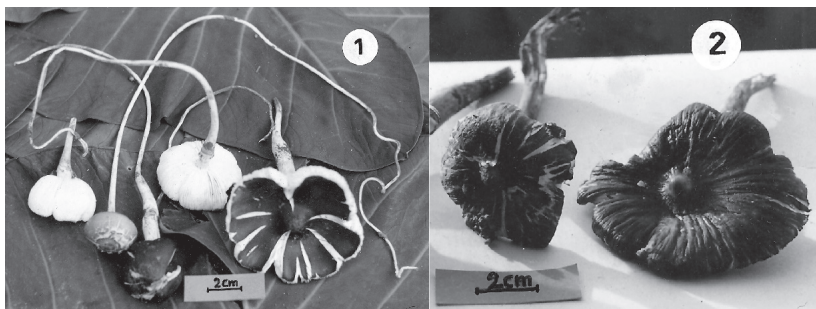
FIGS. 1 & 3

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Pileus 2–3.5 cm diametro in status juvenis, primo hemisphaericus vel convexus, aurantiacus-cinerascens atque squamulosus, dein 4–8 cm diametro ubi fungus maturus est, saepissime subinfundibuliformis, vetus cacainus vel cinereus-brunneolus atque non squamulosus. Lamellae 0.3–0.9 cm latae, liberae, ventricosae, confertae, albae. Stipes 2–6 × 0.6–1 cm, solidus, glaber, subalbidus vel cinerascens, contextus stipitis pallide subroseus et pseudorhiza filiformis longa. Annulus non conspicuus in juvenis sporocarpia vel absentia in fungus maturus. Caro alba, fere 14 mm spissa. Sporarium depositum albidum. Basidiosporae 4.5–5.7–6.0(–8.0) × 2.6–3.1–3.5 μm, ellipsoideae, subellipticae vel subcylindraceae, tenui tunica. Basidia 14–22 × 5–9 μm, clavata, 4-sporigera. Cheilocystidia 20–45 × 9–17 μm, multiformia, clavata, utriformia, lageniformia vel capitata, subcylindracea. Pleurocystidia 25–45 × 9–16 μm, multiformia, clavata, fusiformia, cylindracea vel subutriformia. Trama hymenophoralis regularis. Hyphae cuticulae pilei 2 cellula stratae, stratum superius cum hyphae 2–7 μm diametro, stratum inferius cum hyphae fere 25 μm diametro. Habitat in zonus termitariorum praesertim subterraneorum.

HOLOTYPE: AFRICA, CAMEROON, Provincia centri, vicus Toutouli, fere 20 km ab Yaoundeae, 20.XI.2002 leg. D. C. Mossebo, in Herbaria Universitatus Yaoundeae, HUYI DM 394. **ISOTYPUS** in Kew, K(M) 144 301.

MACROCHARACTERS — PILEUS 2–3.5 cm diam on young basidiomes, first hemispherical to convex, surface greyish orange [5B4] on young basidiomes



FIGS. 1–2. Two new forms of *Termitomyces striatus*. 1. *Termitomyces striatus* f. *pileatus* (K(M) 144 301, holotype). Basidiomes. 2. *Termitomyces striatus* f. *brunneus* (K(M) 144 300, holotype). Basidiomes.

usually squamulose with tiny whitish patches around the disc; 4–8 cm diam on mature subjects changing to cocoa brown or leather brown [6E6] to brownish grey [6F8], mostly subinfundibuliform with a more conspicuous and usually obtuse to obtusely conical perforatorium, sometimes radially and deeply incised at various lengths showing the contrasting white context; LAMELLAE 0.3–0.9 cm wide, free, ventricose, white, crowded with numerous lamellulae of various dimensions; STIPE 2–6 × 0.6–1 cm, solid, central, glabrous, whitish to slightly greyish with section surface becoming slightly pinkish, subcylindrical on its upper part and gradually tapering to form a long underground filiform pseudorhiza up to 60 cm long; ANNULUS born on partial veil, inconspicuous on young basidiocarps, rare or absent on mature; CONTEXT white, up to 1.4 cm thick at stipe level consisting of inflated thin-walled hyphae, 25 µm diam; ODOUR none; SPORE DEPOSIT whitish; TYPE OF GROWTH isolated or in small groups.

MICROCHARACTERS — BASIDIOSPORES 4.5–5.7–6.0(8.0) × 2.6–3.1–3.5 µm, Q=1.5–2.3, $Q_R=1.8 \pm 0.2$, N=20, ellipsoidal to subelliptic, sometimes subcylindrical, hyaline, granulate, thin-walled; BASIDIA 14–22 × 5–9 µm, clavate, hyaline, bearing 4 sterigmata; PLEUROCYSTIDIA 25–45 × 9–16 µm, clavate, fusiform, subcylindrical or subutriform, thin-walled; CHEILOCYSTIDIA 20–45 × 9–17 µm, polymorphic, clavate to largely clavate, utriform, subcylindrical to capitate, subcylindrical; hyaline, thin-walled; HYMENOPHORAL TRAMA regular, comprising unclamped hyphae up to 25 µm diam; SUBHYMENIAL LAYER made of pseudoparenchymatous cells up to 30 µm diam; PILEIPELLIS composed of 2 layers of cells, upper layer of repent unclamped thin-walled hyphae, 2–7 µm diam, lower layer made up of inflated hyphae up to 25 µm diam; LONGITUDINAL SECTION OF THE PERFORATORIUM shows erect chains of subcylindrical thin-walled cells measuring 5 µm diam with some scattered latticeferous hyphae.

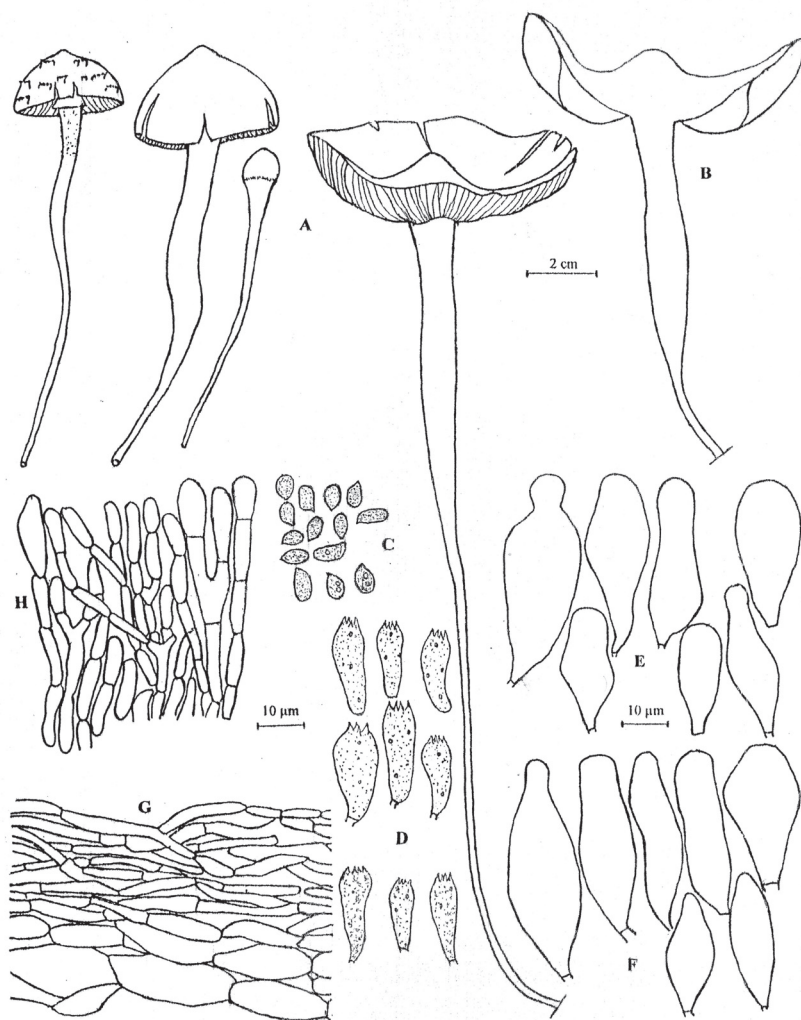


FIG. 3. *Termitomyces striatus* f. *pileatus* (K(M) 144 301, holotype).

(A) habit; (B) longitudinal section of (A); (C) basidiospores; (D) basidia; (E) cheilocystidia; (F) pleurocystidia; (G) pileipellis; (H) longitudinal section of the perforatorium.

ECOLOGY, HABITAT, DISTRIBUTION — known only from the type locality in Cameroon; growing on subterranean termitarium in forestry area.

SPECIMENS EXAMINED — CAMEROON. CENTRE PROVINCE, about 20 km from the capital Yaoundé, Toutouli village, Odza quarter, in a secondary forest, 20 Nov. 2002, leg. D.C. Mossebo; Holotype: HUWI DM 394; Isotype: K(M) 144 301.

Termitomyces striatus f. *brunneus* Mossebo f. nov.

FIGS. 2 & 4

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Pileus 4.5–8.5 cm diam, convexus vel planoconvexus cum perforatorio conspicuo mammiformi, cinereus-brunneolus vel atrobrunneus, striatus. Lamellae liberae, confertae, leviter ventricosae ad 1 cm latae, albiae vel rosaceae. Stipes 10–12.5 × 0.5–1 cm, solidus, cylindraceus, glaber, albidus, basi cum pseudorrhiza albidā; annulus nullus. Caro albidā. Basidia 15–26 × 5–7 μm, clavata vel subcylindracea, 4-sporigera. Basidiosporae 4–5.1–6.0(–8.0) × 2.4–3.1–4 μm, ellipsoideae vel subellipsoideae. Cheilocystidia 20–35 × 7–18 μm, piriformia vel clavata, subcylindracea, aliquando rostrata. Pleurocystidia 25–50 × 8–18 μm, lageniformia vel subcylindracea, subfusiformia. Trama hymenophoralis subregularis. Hyphae cuticulae pilei in 2 cellula stratae, stratum superius cum 2–5 μm diam protratus hyphae, stratum inferius cum 10–30 μm diam catenuliformis protratus hyphae. Habitat in zonus termitariorum praesertim subterraneorum.

HOLOTYPE: AFRICA, CAMEROON, Provincia meridianus, Sangmelima, fere 160 km ab Yaoundeae, 3.XI.2002, leg. D. C. Mossebo, in Herbaria Universitatus Yaoundeae, HUYI DM 392. ISOTYPUS in Kew, K(M) 144 300.

MACROCHARACTERS — **PILEUS** 4.5–8.5 cm diam, convex to plano-convex with a conspicuous nipple-shaped perforatorium measuring 0.5–0.7 cm in diameter and 0.5–1 cm high, more or less concolorous to the chocolate, cocoa brown, brownish grey [6F8] to dark brown [7F8] pileus, radially plicate- to sulcate striate, sometimes marginally to radially incised; **LAMELLAE** slightly ventricose, free, up to 1 cm wide, whitish to pinkish at maturity, crowded with lamellulae of various dimensions, edge entire; **STIPE** 10–12.5 × 0.5–1 cm, solid, subcylindrical on its upper part and tapering at the base to form the pseudorrhiza; surface whitish, glabrous; **ANNULUS** absent; **CONTEXT** white, 0.5–1 cm thick at stipe junction, comprising thin-walled hyphae, 3–15 μm diam; **ODOUR** none; **TYPE OF GROWTH** isolated or in small groups.

MICROCHARACTERS — **BASIDIOSPORES** 4–5.1–6.0(–8.0) × 2.4–3.1–4 μm, Q= 1.25–2.1, Q_R=1.7 ± 0.3, N=20, ellipsoid to subelliptic, hyaline, thin-walled, granulate; **BASIDIA** 15–26 × 5–7 μm, clavate to subcylindric, hyaline, bearing 4 sterigmata; **PLEUROCYSTIDIA** 25–50 × 8–18 μm, lageniform, subcylindric, subfusiform, thin-walled; **CHEILOCYSTIDIA** 20–35 × 7–18 μm, pyriform to largely clavate, subcylindrical, sometimes rostrate, hyaline, thin-walled; **HYMENOPHORAL TRAMA** subregular, made up of hyaline hyphae, 2–15 μm diam; **SUBHYMENIAL LAYER** made up of pseudoparenchymatous cells up to 28–32 μm diam; **PILEIPELLIS** comprising 2 layers, a thin upper layer of repent hyphae measuring 2–5 μm diam and a much more thicker lower layer of equally repent hyphae in chains, 10–30 μm diam; **LONGITUDINAL SECTION OF THE PERFORATORIUM** showing a trichoderm made of erect, chains of subcylindrical and sometimes inflated cells 2–8 μm diam.

ECOLOGY, HABITAT, DISTRIBUTION – known only from the type locality in Cameroon, growing on a subterraneous termitarium in forestry area.

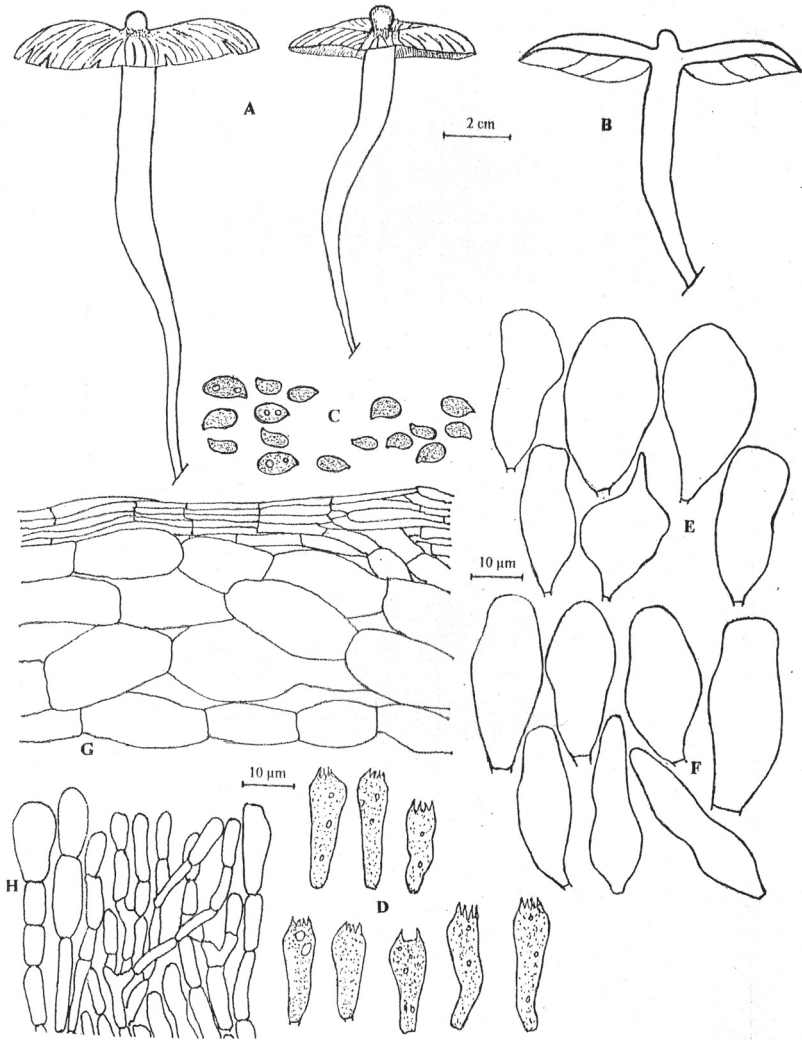


FIG. 4. *Termitomyces striatus* f. *brunneus* (K(M) 144 300, holotype).
 (A) habit; (B) longitudinal section of (A); (C) basidiospores; (D) basidia; (E) cheilocystidia;
 (F) pleurocystidia; (G) pileipellis; (H) longitudinal section of the perforatorium.

SPECIMENS EXAMINED – CAMEROON. SOUTH PROVINCE, Sangmelima, about 160 km south of the capital Yaoundé, surface ground of a subterranean termitarium, 3 Nov. 2002, leg. D.C. Mossebo; Holotype: HUYI DM 392; Isotype: K(M) 144 300.

Forms in *Termitomyces striatus*

Heim (1942) introduced forms in *Termitomyces striatus* (Beeli) R. Heim when he described *T. striatus* f. *striatus* (Beeli) R. Heim, which he also treated as a variety (*T. striatus* var. *striatus* (Beeli) R. Heim) in the *T. striatus* group (Heim 1942). Likewise, Heim later (1958) lowered his *T. striatus* var. *annulatus* R. Heim (Heim 1942) to forma as *T. striatus* f. *annulatus* (R. Heim) R. Heim. The same author (Heim 1958) also described two additional forms, *T. striatus* f. *griseus* R. Heim and *T. striatus* f. *ochraceus* R. Heim. These forms are mainly distinguished from each other by the remarkable and variable type of striation of the pileus rarely exceeding 8.5 to 12 cm diam at full maturity and usually more or less densely and radially striate, its colouration, the presence or absence of an annulus and its upwards or downwards orientation, and the morphology of the perforatorium. Other *Termitomyces* species differ from *T. striatus* mainly by the lack of this remarkable pileus striation and other features noted by various authors (Heim 1942, 1952, 1958, 1977; Pegler 1977; Pearce 1987; Van der Westhuizen & Eicker 1999). Heim (1977) later elevated *T. striatus* var. *aurantiacus* R. Heim originally characterised by a bright orange to reddish ochraceous pileus (Heim 1952) to species as *T. aurantiacus* (R. Heim) R. Heim.

The first preliminary keys within the *T. striatus* group were introduced by Heim (1977) and Pegler (1977), both of whom included three formae — f. *annulatus*, f. *griseus* and f. *ochraceus* — in their respective keys. However, Pegler (1977) retained the varieties *T. striatus* var. *aurantiacus* R. Heim and *T. striatus* var. *striatus* (Beeli) R. Heim in his key, while Heim (1977) assigned *T. aurantiacus* (R. Heim) R. Heim and *T. entomoloïdes* R. Heim to the *T. striatus* group. A key to the forms of *Termitomyces striatus* now cited on Index Fungorum (www.indexfungorum.org) with the addition of the two newly described forms and *T. striatus* f. *annulatus* (R. Heim) R. Heim described by Heim (1958) follows.

Preliminary key to the forms of *Termitomyces striatus*

(Revised and augmented from Heim (1977) and Pegler (1977))

- 1a. Mature pileus up to 12 cm diam or more, marginally or radially striate, sometimes incised, whitish, beige to ochraceous or greyish,2
- 1b. Mature pileus smaller, rarely up to 8.5 cm diam, variously striate or incised with different colourations (not orange or fox-coloured)6
- 2a (1a). Annulus absent4
- 2b. Annulus persistent and conspicuous or with membranous inconspicuous squamules on stipe3
- 3a (2b). Pileus sometimes above 12 cm diam, whitish on surface, brownish around the disc showing tiny concolorous squamules, perforatorium

- conical to subcylindric-mammiform, concolorous with pileus surface;
annulus conspicuous, persistent and downwards oriented
..... *T. striatus* f. *annulatus*
- 3b. Pileus not exceeding 12 cm diam, surface greyish brown, ochraceous brown
to ochraceous orange, darkish at the centre, perforatorium ± conspicuous,
annulus inconspicuous or as membranous squamules on stipe
..... *T. striatus* f. *striatus*
- 4a (2a). Pileus beige to greyish or dark to greyish-dark5
- 4b. Pileus cream to ochraceous brown *T. striatus* f. *ochraceus*
- 5a (4a). Hymenium showing 2 types of basidia: thin-walled (18–19 × 6.5–8 μm),
rare, 4-sterigmate basidia; thick-walled (19–22 × 6–7 μm), abundant, with
1–4-sterigmate basidia; cheilo- and pleurocystidia similar, sometimes with
median constrictions *T. striatus* f. *bibasidiatus*
- 5b. Hymenium with only one type of basidia: thin-walled (22–25 × 7–8 μm),
clavate, with 4 sterigmata *T. striatus* f. *griseus*
- 6a (1b). Stipe with a swelling at the base before tapering to form pseudorhiza,
pileus 2.5–5 cm at maturity, beige-greyish to greyish-dark with a
contrasting grey-blackish perforatorium *T. striatus* f. *griseumboides*
- 6b. Stipe showing no swelling at the base, rather ± subcylindrical above the
pseudorhiza7
- 7a (6b). Perforatorium conspicuous, obtuse to subcylindrical or mammiform
(nipple-shaped).....8
- 7b. Perforatorium inconspicuous, subumbonate with a greyish brown to violaceous
brown umbo showing tiny squamules, pileus whitish to pale greyish,
pileipellis made of erect septate and gelified hyphae 5–8 μm diam
..... *T. striatus* f. *subumbonatus*
- 8a (7a). Perforatorium nipple-shaped (mammiform), pileus uniformly and
constantly chocolate brown to dark brown from origin, plicate to sulcate
striate *T. striatus* f. *brunneus*
- 8b. Perforatorium obtuse to obtusely conical, pileus changing from greyish orange
with squamules when young, to cocoa brown or leather brown when mature,
glabrous and usually subinfundibuliform at maturity *T. striatus* f. *pileatus*

The above-mentioned forms of *T. striatus* (Beeli) R. Heim are variously distributed in whole Africa south of Sahara. They are found in most central African countries including Cameroon, Central African Republic, Gabon, Congo Brazzaville, Congo DRC, Burundi, and Rwanda. *Termitomyces striatus* (Beeli) R. Heim, and particularly its form *striatus*, is also reported in several Asian countries including China, India, Thailand, Pakistan, and Malaysia.

ADDITIONAL SPECIMENS EXAMINED – CAMEROON: 1) *T. striatus* f. *subumbonatus*: Yaoundé, Centre Province, university of Yaoundé 1 campus, Oct. 1998, D.C. Mossebo DM 208 (K(M) 144294); 2) *T. striatus* f. *annulatus*: Yaoundé, Nov. 2002, D.C. Mossebo DM 213 (K(M) 144286); 3) *T. striatus* f. *bibasidiatus*: near Yaoundé, purchased in Mokolo

mushroom market, Oct. 2000, D.C. Mossebo DM 280 (K(M) 144292); 4) *T. striatus* f. *griseumboides*: near Yaoundé, May 2001, D.C. Mossebo DM 372 (K(M) 144288); 5) *T. griseumbo*: Yaoundé, Mokolo mushroom market, May 1999, D.C. Mossebo DM 224 (K(M) 143970). **CENTRAL AFRICAN REPUBLIC**: 6) *T. medius* R. Heim & Grassé: Bangui mushroom market, 29 August 2008, M. Djamndo Djasbé DSB 036 (DM 687); 7) *T. striatus* f. *annulatus*: Bangui mushroom market, 29 August 2008, M. Djamndo Djasbé DSB 037 (DM 688); **CONGO**: 8) *T. striatus* f. *striatus*: mushroom market about 4 km in the outskirts of Brazzaville, Sept. 2008, N. Nkouka, NNK 01 (DM 689). **GABUN**: 9) *T. striatus* f. *annulatus*: in a banana plantation about 10 km in the outskirts of Libreville, Oct. 2008, Obam Moundoundou OMD 01 (DM 690). **NIGERIA**: 10) *T. striatus*: Cross River State, Uyo, Anua, St Luke's Hospital, May 1990, R.A. Nicholson 431 (K(M) 16687); 11) *T. clypeatus*: Zaria, Ahmadu Bello University, July 1994, P. Mwarze (K(M) 117359). **GHANA**: 12) *Termitomyces* sp.: Cape Coast, University College, May 1971, A.C. Rose, CC7109 (K(M) 109563). **UGANDA**: 13) *T. robustus*: Kampala, purchased in the market, March 1957, A. French 7 (K(M) 109570). **KENYA**: 14) *Termitomyces* sp.: Malindi, Robertson Plot, Coast Province, April 1997, S.A. Robertson 7241 (KM 77539); 15) *T. striatus*: Nairobi, City Park, April 1968, D.N. Pegler K375 (K(M) 109535). **MALAWI**: 16) *T. robustus*: Blantyre, Limke, Nov. 1972, C. Anthony 2 (K(M) 109569); 17) *T. striatus*: Lilongwe, Bunda College, Dec 1973, D.J. Allen 1 (K(M) 142436). **ZAMBIA**: 18) *T. reticulatus* Van der West. & Eicker: North Luangwa National Park, Dec. 1994, D. Shah-Smith 57 (K(M) 29129); 19) *T. titanicus* Pegler & Pearce: Kitwe and Ndola (between), Copperbelt Province, purchased by road side, Dec. 1978, G.D. Pearce FP536 (K(M) 142416). **SOUTH AFRICA**: 20) *T. reticulatus*: Pretoria, Brummeria, National Botanic Gardens, Nov. 1986, G.C.A. v.d. Westhuizen 226 (K(M) 109564); 21) *T. cartilagineus* (Berk.) R. Heim: Pretoria, Arcadia Park, (K(M) 109565). **TANZANIA**: 22) *T. mammiformis* f. *albus* R. Heim: Kisimbani, July 1962, H. Faulkner 3076 (K(M) 109542); 23) *T. eurhizus* (Berk.) R. Heim: Isanga District, Lugoda Tea Estate, May 1968, D.N. Pegler T835 (K(M) 142418).

COMMENTS — Considering the taxa of *Termitomyces* so far described, the closest species to *T. striatus* f. *brunneus* and f. *pileatus* are *T. robustus* (Beeli) R. Heim and *T. fuliginosus* R. Heim as far as the pileus features in particular are concerned. However, the essentially similar dark brown to cocoa brown pileus in these four taxa can be differentiated by various tints and ornamentations and size, the major difference being one of size, where the pileus diameter of the two newly described *T. striatus* forms rarely exceeds 8.5 cm at full maturity, whereas that of *T. robustus* and *T. fuliginosus* can each measure up to 16.5 or 20 cm diam or more (Heim 1977, Pegler 1977).

Similarly, whereas mature representatives of both *T. striatus* f. *brunneus* and *T. striatus* f. *pileatus* show an almost uniformly coloured pileus, *T. robustus* is remarkably darker or blackish at the disc and perforatorium. The perforatorium in *T. robustus* and *T. striatus* f. *brunneus* is similarly mammiform to obtusely mammiform, contrasting with the obtuse to obtusely conical perforatorium found in *T. striatus* f. *pileatus* and *T. fuliginosus*.

Termitomyces robustus also differs by its dark umber venate and scrobiculate pileus revealed by concentric irregular and radial ridges and finely tuberculate

patches on the surface. This species is also singularly distinguished by the presence of interwoven white rhizomorphic threads between the pseudorhiza and termitarium comb. Heim (1977) reports that this rhizomorphic type is found only in *T. robustus*. *T. fuliginosus* is characterized by a remarkable pileus surface ornamentation consisting of dense whitish radial striations of various lengths overlying a brownish to chocolate background. Contrary to the rhizomorphs found in *T. robustus*, *T. fuliginosus* is diagnosed by a sclerotized basal disc at the pseudorhizal base.

Termitomyces striatus f. *pileatus* is distinguished from the other forms and varieties of the *T. striatus* group by some remarkable features, including the subinfundibuliform and eventually more or less deeply radially striate pileus that is squamulose greyish orange when young and cocoa brown or leather brown in age, an inconspicuous and evanescent annulus that is present only on young basidiomes, the late appearing obtuse perforatorium, and long filiform pseudorhiza. Microscopically, the polymorphic nature of pleuro- and cheilocystidia are equally noteworthy.

Termitomyces striatus f. *brunneus* differs from other taxa by its unchanging plicate- to sulcate-striate chocolate brown to dark brown pileus with a conspicuous mammiform perforatorium made of erect chains of subcylindrical and inflated cells. The polymorphic pleuro- and cheilocystidia also differ slightly from those of *T. striatus* f. *pileatus*.

An on-going phylogenetic study of central African taxa of *Termitomyces* is still preliminary and additional representatives of some taxa still require sequencing. However, preliminary analyses of the very similar ITS, mtSSU- and nLSU-rDNA sequences for the two newly described forms support their placement in the same species, despite their morphological differences from the previously recognized forms.

Heim (1958) was the first to propose a key to African species based on the 13 taxa described in tropical Africa at that time. The addition of new species in different regions led to the development of national, regional or subregional keys for Asia as well as for tropical Africa. These include keys by Pegler (1994) for 14 taxa from Southeast Asia, by Pearce (1987) for 11 species from Zambia, by Van der Westhuizen and Eicker (1990) for 7 species from South Africa, by Otieno (1964; later amended by Pegler 1977) for 12 taxa from East Africa, and by Buyck (1994) for 5 species from the western part of Burundi. Given that no key for central Africa existed so far, the first preliminary key to *Termitomyces* from this region of Africa south of Sahara is proposed below with 17 taxa described by Heim (1951, 1952, 1958, 1977), Pegler (1977), Buyck (1994), Mossebo (2000, 2002), and Mossebo et al. (2002, 2006).

Preliminary key to *Termitomyces* taxa from central Africa

- 1a. Mature pileus generally smaller than 2.5 cm diam, pseudorhiza absent
 *Termitomyces microcarpus*
- 1b. Mature pileus generally greater than 2.5 cm diam; pseudorhiza present2
- 2a (1b). Annulus present3
- 2b. Annulus absent9
- 3a (2a). Mature pileus 2.5–10 cm diam, basidia bearing 4 to 2 (or 1) sterigmata4
- 3b. Mature pileus generally larger than 10 cm diam, basidia bearing 4 sterigmata7
- 4a (3a). Perforatorium generally conspicuous, more or less prominent5
- 4b. Perforatorium absent or inconspicuous, resembling an umbo8
- 5a (4a). Pileus beige to greyish beige or greyish orange and hemispherical to convex when young, when mature cacao brown, leather brown to brownish grey and subinfundibuliform with an obtuse perforatorium; annulus not persistent *T. striatus* f. *pileatus*
- 5b. Pileus generally unchanging or barely changing colour and not becoming (sub-) infundibuliform till full maturity; annulus conspicuous.....6
- 6a (5b). Pileus beige to beige ochraceous with greyish to dark grey disc; annulus more or less persistent; perforatorium originally mammiform, more or less conspicuous; cystidia with a remarkable appendix of various lengths at the base, pleurocystidia larger than cheilocystidia. *T. mammiformis*
- 6b. Pileus whitish ochraceous with an area of tiny brownish squamulae at the disc (perforatorium) and around; persistent downwards oriented annulus; perforatorium conical to subcylindric-mammiform, rarely less differentiated; cystidia barely appendiculate, pleurocystidia smaller than cheilocystidia
 *T. striatus* f. *annulatus*
- 7a (3b). Pileus beige to light brown or dark ochraceous, sometimes showing a darker central area around the disc on mature specimens; perforatorium subcylindrical (to mammiform), measuring up to 2 cm diam at maturity
 *T. letestui*
- 7b. Pileus whitish with brownish to greyish squamulae, turning dark to blackish and showing concentric areas on the pileus with a 2 to 5 cm diam, central, thick and blackish plaque in place of a nonexistent real perforatorium
 *T. schimperi*
- 8a (4b). Pileus with a barely apparent perforatorium (rarely absent) forming an inconspicuous umbo; usually striate or split at the margins; convex to plano-convex, whitish-greyish with an area of tiny brown greyish to brown violaceous squamulae in the middle of the pileus; annulus more or less persistent; cystidia thin-walled non-septate..... *T. striatus* f. *subumbonatus*
- 8b. Pileus without perforatorium besides the other characteristics described above (7b), cystidia thick-walled and most often septate *T. schimperi*

- 9a (2b). Mature pileus 2.5–5 cm diam *T. striatus* f. *griseumboides*
- 9b. Mature pileus usually broader than 5 cm diam 10
- 10a (9b). Perforatorium darkish or blackish, generally long and acutely spiniform
..... *T. clypeatus*
- 10b. Perforatorium not long, not spiniform, but differently shaped and more or
less conspicuous 11
- 11a (10b). Stipe of more or less regular diameter, generally without thickening at
the base of the epigeous part 12
- 11b. Stipe most often with a thickening at the base of the epigeous part
before tapering gradually to form a pseudorhiza 16
- 12a (11a). Perforatorium conical, most often obtuse to obtusely conical at maturity,
sometimes pointed on young specimens, more or less conspicuous and
concolorous to the pileus 13
- 12b. Perforatorium mammiform to cylindraceous or rather less apparent at the disc 14
- 13a (12a). Pileus most often dark beige to brown greyish and radially split;
spores thin-walled; basidia predominantly with 2 sterigmata, (rarely with
4 sterigmata); pleurocystidia absent, perforatorium more or less concolorous
with the pileus *T. subclypeatus*
- 13b. Pileus most often light beige (to whitish) and split at the margins; spores thick-
walled; basidia bearing 4 sterigmata; pleurocystidia absent, perforatorium
concolorous to the pileus *T. subclypeatus* f. *tetrasporus*
- 14a (12b). Perforatorium mammiform to subcylindrical, generally concolorous
with the pileus; basidia either thin- , or thin- and thick-walled 15
- 14b. Pileus most often rugose and more or less conspicuously radially wrinkled;
perforatorium 1–2.5 cm diameter, flattened at the disc (or obtusely conical),
brown greyish to dark grey in strong contrast with the whitish pileus
..... *T. griseumbo*
- 15a (14a). Pileus chocolate to cocoa brown, brownish grey to dark brown, radially
striate to sulcate striate; basidia thin-walled, clavate to subcylindric, bearing
4 sterigmata *T. striatus* f. *brunneus*
- 15b. Pileus beige to beige ochraceous, most often splitting at the margins at
maturity, basidia both thin-walled with 4 sterigmata and thick-walled with
1 to 4 sterigmata *T. striatus* f. *bibasidiatus*
- 16a (11b). Stipe bulb beige to whitish, always concolorous to the rest of the stipe . . . 17
- 16b. Stipe bulb blackish to black from its lower half to the pseudorhiza
..... *T. subumkowaan*
- 17a (16a). Pileus dark grey to grey blackish around a generally short, concolorous
and more or less pointed perforatorium; spores thin-walled *T. mboudaeina*
- 17b. Pileus uniformly fox-coloured to orange brown (rarely ochraceous to brownish);
perforatorium concolorous, sometimes less conspicuous in some specimens;
spores more or less thick-walled *T. aurantiacus*

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