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# Ethnomycological notes on *Marasmiellus inoderma* from Benin and Togo (West Africa)

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**Abstract** – This paper presents a description of *Marasmiellus inoderma*, an edible species, collected in the wild and cultivated in Benin (West Africa) on waste material from *Elaeis guineensis* (oil palm). Data from specimens collected in Benin and Togo were compiled and compared with data available on a number of closely related taxa. Illustrations of macroscopy and microscopy are given, as well as information on its ecology and a low-tech method for cultivation.

**Résumé** – Cet article présente la description de *Marasmiellus inoderma*, une espèce comestible, récoltée en brousse au Bénin (Afrique de l'Ouest) et cultivée sur des déchets de *Elaeis guineensis* (palmier à huile). Les données des spécimens récoltés au Bénin et au Togo ont été étudiées et comparées à celles de quelques espèces proches. Des illustrations de la macro- et microscopie sont fournies, ainsi que quelques notes sur l'écologie et sur une méthode de culture peu sophistiquée.

**Africa / ethnomycology / taxonomy / ecology / mushroom cultivation**

## INTRODUCTION

Many populations throughout tropical Africa have a marked interest for fungi as a food resource. Collecting of wild edible mushrooms, for consumption or to sell at local markets, is still common practice in many countries South of the Sahara. The last decades, however, the amount of edible mushrooms obtained from cultivation is increasing on several local markets. This recent trend is due to the presence of a growing number of small mushroom farms in and around the bigger cities (Cotonou, Porto-Novo, Lomé, Accra). Part of these farms are run by non-governmental organisations and projects that help local people to develop income generating activities and combat poverty. In most cases local people are introduced with the cultivation of edible mushrooms by means of a practical training using low-tech and low-cost methods. Although several indigenous taxa are available for mushroom cultivation in Africa, the offered trainings almost exclusively focus on growing alien species such as *Pleurotus ostreatus* (Jacq.) P. Kumm., *P. cystidiosus* O.K. Mill. and exceptionally *Volvariella volvacea* (Bull.) Singer. Today, *Pleurotus* spp., is probably by far the most cultivated taxon in West Africa. The number of wild edible taxa known in Africa is, however, close to 400 (Rammeloo & Walleyn, 1993; Walleyn & Rammeloo, 1994; Buyck, 1994; De Kesel *et al*., 2002; Boa, 2004; Härkönen *et al*., 2003). About one third of these, i.e. 125 edible taxa, are not suitable for cultivation, because of their symbiotic (*Termitomyces*) or ectomycorrhizal nature (*Cantharellus, Lactarius, Russula, Amanita*). It is beyond doubt that several species, within the long list of edible saprotrophic mushrooms, have potential and consequently deserve to be tested for cultivation.

This paper reports on *Marasmiellus inoderma* (Berk.) Singer, one of the very few African indigenous saprotrophic fungi grown and marketed by locals.

## MATERIALS AND METHODS

Collection of specimens, field notes, photographs, ethnomycological enquiries and descriptions of the specimens was done by the first author during ethnomycological surveys organised between 1997 and 2002 in Benin, and in 2007 in Togo. Ethnomycological enquiries followed the protocol described in De Kesel *et al*. (2002). Codes (between square brackets) and names for colours correspond to the Methuen Handbook of Colour (Kornerup & Wanscher, 1983).

The microscopic structures were observed in Melzer's reagent as well as in Congo-red ammonia. Measurements were performed using an Olympus BX51 light microscope, with digital camera and AnalySIS® Five imaging software (Soft Imaging System GmbH). Mean values (in italics) $\pm$ 1.96 $\times$ standard deviations, and minimum-maximum values (between brackets) are given for all microstructures and derived parameters (length/width ratios). For the statistical data the number N of basidiospores, basidia and cystidia that were measured is given (between braces). The collections are deposited at the National Botanic Garden of Belgium's herbarium "BR" (abbreviation following Holmgren & Holmgren, 1998).

## RESULTS AND DISCUSSION

***Marasmiellus inoderma* (Berk.) Singer, Sydowia 9: 385 (1955)** Figs 1-6
basionym: *Marasmius inoderma* Berk., Hooker's Journal of Botany 3: 15 (1851)

**Fruitbodies** (Fig. 1) subcartilaginous, mostly gregarious or in small tufts, growing on larger debris of monocotyledons. **Pileus** 10-30(350) mm across, at first convex, with or without depressed centre, later partly applanate to depressed,

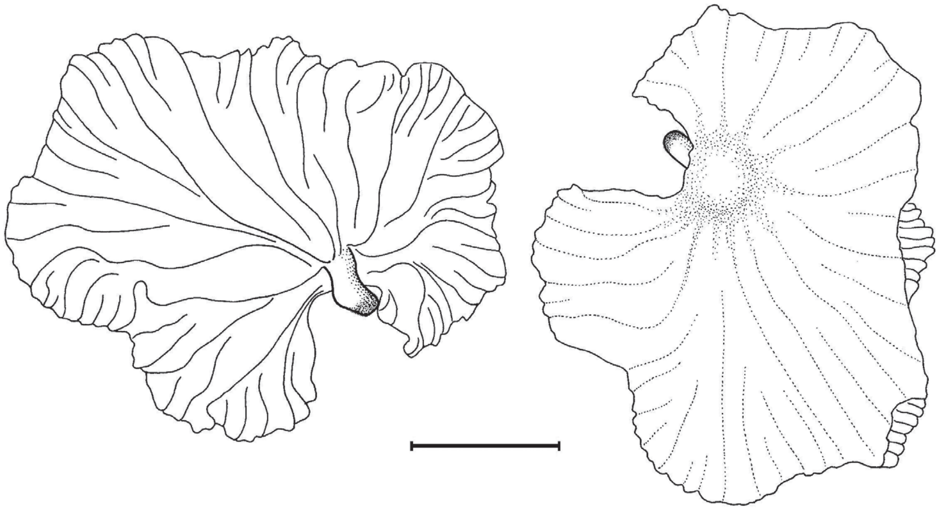


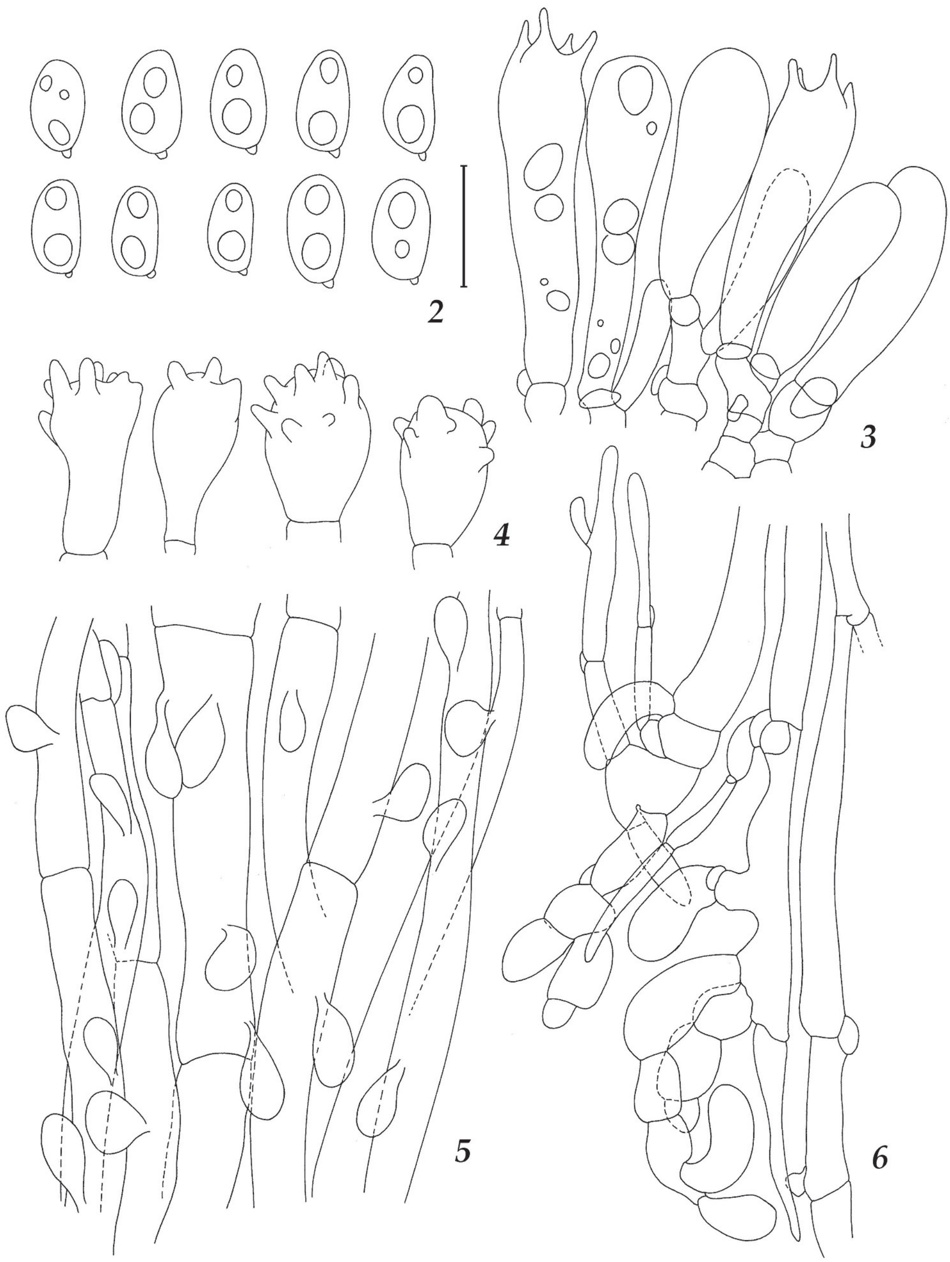
Fig. 1. *Marasmiellus inoderma*. Basidiocarps. Scale bar = 1 cm.

sometimes slightly papillate, almost entirely striate to sulcate with age; surface at first brownish orange [5B4-5C4], very soon becoming white with a faint pinkish hue, sometimes slightly translucent, subhygrophanous, subtomentose to pruinose at first, becoming partly glabrous, drying pale-yellowish all-over [4A2]; margin deflexed at first, becoming straight to reflexed, striate to sulcate, flexuose to lobed. **Lamellae** at first white, becoming yellowish when dry [4A2], 1-2(2.5) mm broad, thin, subdistant, simple, scarcely forked or intervenose, linear, adnate to subadnate (occasionally pseudocollariate), flexible; interlammelar space rugulose, with 2-3(4) lamellulae inserted per lamella; lamella edge even, concolorous or slightly paler. **Stipe** 4-15(20) × 1-2 mm, subcentral becoming excentric with age, cylindrical or slightly tapering downwards, often slightly compressed, straight or curved, solid, with a slightly swollen base; stipe surface dry, entirely powdery, partly glabrescent with age, white, drying yellow [4A2], the base always with a distinctly pinkish, orange to dull red [8C4] pubescent zone. Basal mycelium white, thin, radiating and appressed to the substrate.

**Context** white, thin, compact, subcartilaginous, fibrous in the stipe. **Taste** pronounced, mild, fungoid; **smell** strongly fungoid, pleasant.

**Spore print** white.

**Spores** (fig. 2) ellipsoid, (6.8-)6.9-*8.8*-10.6(-10.7) × (4.2-)4.2-*4.9*-5.7(-6) µm, l/w = (1.53-)1.52-*1.77*-2.02(-2.05) {N = 43}, smooth, hyaline, often (bi)vacuolate, thin-walled, inamyloid. **Basidia** (fig. 3) clavate, 20-30 × 7-8 µm, mostly 4-sterigmate. **Cheilocystidia** (fig. 4) abundant, making the lamella edge almost sterile, clavate to ventricose, (11.2-)10.6-*16.6*-22.7(-24.6) × (5.8-)5.8-*7.6*-9.5(-9.9) µm, l/w = (1.59-)1.46-*2.19*-2.92(-3.22) {N = 42}, with a knotty outline due to numerous (4-8) simple or forked outgrowths of 1-3 × 0.5-1 µm. **Pleurocystidia** absent. **Hymenophoral trama** subregular to regular. **Pileipellis** (fig. 5) a dry cutis, not a typical Rameales-structure, composed of interwoven filamentous hyphae (30-45 × 5-18 µm) beset with short nodulose or diverticulate elements, the latter (5.3-)4.9-*6.6*-8.4(-8.4) × (3.3-)3.4-*4.3*-5.2(-5.1) µm, l/w = (1.17-)1.06-*1.55*-2.04(-2.13) {N = 28},




Figs. 2-6. *Marasmiellus inoderma*. 2. Basidiospores. 3. Basidia. 4. Cheilocystidia with knotty outline. 5. Pileipellis with diverticulate elements. 6. Elements of the stipitipellis. Scale bar = 10 µm.

easily coming loose, creating a powdery surface. **Stipitipellis** (fig. 6) composed of simple filamentous hyphae (15-30 × 2-4 µm), bearing series of isodiametric cells, with terminal cells of 4-12 µm long. **Clamp connections** present in all tissues.

**Material examined: BENIN**. PROV. ATLANTIQUE, Abomey – Calavi, N06°28.000' E02°19.000', 05.X.1999, De Kesel 2736 (BR 116745-54); Niaouli, N06°44.415' E02°08.380', 02.VI.2002, De Kesel 3273 (BR 152084-85); Togba, N06°28.000' E02.19.000', 27.VI.2000, De Kesel 2861 (BR 1236414-23 and BRNM 710252); ibid., N06°27.739', E02°17.767', 03.VI.2002, De Kesel 3285 (BR 152079-80); Dogbo, 11.VI.1996, De Groote s.n. (BR 49546-76); PROV. BORGOU, Wari Maro, N09°10.003' E02°15.020', 08.X.2001, De Kesel 3183 (BR 149728-57). **TOGO**. PROV. PLATEAU, Akébou, Veh-N'Kougna, N07°40.025' E00°44.511', 08.VII.2007, De Kesel 4210 (BR 158497-96), 4211 (BR 158443-42), 4212 (BR 158407-06); Kpalimé, N06°57.085' E00°34.885', 05.VII.2007, De Kesel 4157 (BR 158465-64).

**Ecology:** Saprotrophic on dead wood and remains of monocotyledons, typically on remains of the oil palm (*Elaeis guineensis* Jacq.), but also on *Musa* sp. and on the grass *Andropogon gayanus* Kunth. Appearing at the onset of the rainy season and frequent as long as the rains last, i.e. from May till October. It is common in the oil palm plantations and ruderalised areas in the south of Benin and Togo, towards the drier north (Sudanian influence) it becomes rare.

**Distribution:** *Marasmiellus inoderma* was first described from the tropical and temperate regions of South America (Singer, 1973). In western Africa it is known in Ghana (Pegler, 1968; Holden, 1970) and possibly also in Nigeria (Nicholson, 1989; ut *Marasmiellus semiustus* (Berk. & M.A. Curtis) Singer, *fide* Pegler (1968)).

**Ethnomycology:** The edibility of *M. inoderma* was first reported in Dogbo (Benin, Prov. Atlantique) where the local Adja people consider it a tasty mushroom (De Kesel *et al*., 2002). The species is collected for food in the wild, but also cultivated on pasteurized waste from pressed oil palm inflorescences. The vernacular name in Adja is "huntoyi", "hunto" meaning mushroom and "yi" referring to the main substrate, i.e. the oil palm.

**Taxonomic notes:** Our first specimens were provisionally identified as a *Gerronema* (De Kesel *et al*., 2002). This was supported by the fact that the pileipellis does not show a typical Rameales-structure and that cheilocystidia are, although numerous, inconspicuous. Following Singers' system, it clearly belongs in *Marasmiellus* sect. *Marasmiellus* subsect. *Inodermini* (Singer, 1973; Singer, 1986).

In the field *Marasmiellus inoderma* is characterized by its gregarious, white hygrophanous basidiocarps with sulcate-striate pileus, relatively distant lamellae and a very typical pinkish, subtomentose base of the stipe. It can eventually be confused with young specimens of *Nothopanus hygrophanus* (Mont.) Singer. The latter is very common throughout tropical Africa, but tends to stain purplish black while maturing. Moreover, it has a more pleurotoid habit, with decurrent lamellae, a strongly hygrophanous pileus and a very bitter taste.

Pegler (1968) places *Marasmiellus semiustus* (Berk. & M.A. Curtis) Singer in synonymy with *M. inoderma*. According to Singer's (1973) description, *Marasmiellus semiustus* var. *semiustus*, has much smaller carpophores (4-15 mm broad), with relatively longer stipe and cheilocystidia with larger, erect to diverging setulae (2-5 × 1-2 µm).

*Marasmiellus cocophilus* Pegler and *Marasmius palmivorus* Sharples are relatively close relatives that can grow on the same substrates as *Marasmiellus inoderma*, i.e. *Elaeis guineensis* and *Cocos nucifera*. *Marasmiellus cocophilus* is however a minute species (pileus 4-7 mm) from East Africa (Kenya & Tanzania) with lacrimoid and much larger spores (14.5 × 3.8 µm) (Pegler, 1977). *Marasmius* *palmivorus* is widely spread throughout Malesia where it causes oil palm bunch rot. Though growing on the same host under a tropical climate, it is a much bigger species (up to 6 cm) with a wholly pinkish orange or apricot pileus (Corner, 1996).

## Cultivation on pasteurized substrates

Thanks to the collaboration with a local NGO (CECODI, Benin), specialised in the valorisation of non-timber forest products and the low-tech culture of *Pleurotus* spp., a protocol was developed to grow *Marasmiellus inoderma* on waste material from *Elaeis guineensis*. The method described here is very similar to the one used for growing *Pleurotus* spp. on pasteurized substrates (Oei, 2003).

It enables one to grow *Marasmiellus inoderma* all the year round. It was successfully started in 1999 and today people are still using this technique in the area of Togba (Prov. Atlantique, Benin).

Axenic tissue cultures are made using small pieces of young fruitbodies placed in sterile test tubes with malt agar and gypsum. The pure tissue culture is introduced in a previously autoclaved polyethylene bag filled with preboiled grains of sorghum. Good quality grain spawn is obtained in less than three weeks. It is used to inoculate large thin plastic bags (allow some breathing) filled with pasteurized pressed inflorescences of *Elaeis guineensis* (3-6 kg). This substrate is a common and free waste obtained from the local palm oil factories. Pasteurization is obtained by immersion of the pressed inflorescences in hot (70-80°C) water for 30 min. This procedure has to be repeated once to better evacuate the remaining oil from the substrate. Too oily substrates tend to be inadequate for mycelial growth. The inoculum/substrate ratio is kept between 1/20 and 1/10. After three weeks at ambient temperatures (25-30°C), high air humidity and protected from the sun, the mycelium will colonize the entire substrate. After removal or opening of the bags, air humidity should be kept high (85 %) in the growery. *Marasmiellus inoderma* forms pinheads within days and fruitbodies can be harvested in less than a week. Fruitbodies are sold fresh or dried. Transformation for long term conservation (3-6 months) is done by sun-drying (2-4 days) on a mesh wire frame. The dried mushrooms are packed in air-tight recipients (plastic bags or jars).

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