

Wild Edible Fungi from the Dense Rainforests of Ivory Coast: An Update and Notes on *Agrocybe*

C.G. Yian^{1*} & M.S. Tiebre¹

Keywords: *Agrocybe*- Taxonomy- Ecology- Ethnomycology- Edible mushroom- Ivory Coast

Summary

Based on the literature and an ethnomycological survey in the dense rainforests of Ivory Coast, the number of edible fungi of Ivory Coast now counts sixty-seven species. All species are listed and local names are given in Abidji, Bété and Gban languages. Two edible species from the genus *Agrocybe* are reported: *Agrocybe broadwayi* (Murrill) Dennis and *A. elegantior* Watling. Full morphological descriptions and illustrations are given for both taxa, as well as an identification key including most related taxa in *Agrocybe*. Ethnomycological data present basic use of these taxa and suggest that local people recently started using this species for food, particularly *A. elegantior*.

Résumé

Champignons sauvages comestibles des forêts denses humides de Côte d'Ivoire: une mise à jour et notes sur les *Agrocybes*

Sur la base d'une revue de littérature et d'un relevé ethnomycologique dans les forêts tropicales denses de Côte d'Ivoire, le nombre de champignons comestibles de Côte d'Ivoire est estimé à soixante sept espèces. Toutes les espèces sont répertoriées et les noms locaux sont donnés en Abidji, Bété et Gban. Deux espèces comestibles du genre *Agrocybe* sont rapportées: *Agrocybe broadwayi* (Murrill) Dennis et *A. elegantior* Watling. Des descriptions morphologiques complètes et des illustrations sont fournies pour ces deux taxons, ainsi qu'une clé d'identification incluant la plupart des taxons apparentés au genre *Agrocybes*. Les données ethnomycologiques présentent une utilisation de base de ces taxons et suggèrent que les populations locales ont récemment commencé à utiliser cette espèce pour l'alimentation, particulièrement *A. elegantior*.

¹University Félix Houphouët-Boigny, UFR Biosciences, Laboratory of Botany, Abidjan, Ivory Coast.

*Corresponding author: Email: yangooov1@gmail.com

Introduction

Wild edible mushrooms intervene in the nutrition of populations since the antiquity (22). For a multitude of African populations from rural areas, they constitute a significant supply of nutritional elements especially during starvation periods (3, 6, 26). Since several decades the use of mushrooms for food by African populations has received a growing interest from the scientific community. Among a multitude of smaller contributions, we mention here the most important ones as they deliver information of entire countries or even regions (1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 26, 29, 31, 33, 34).

In Ivory Coast, the local knowledge concerning edible fungi is understudied, with only 4 species being listed by Boa (2), i.e. *Hygrophoropsis aurantiaca* (Wulfen) Maire, *Hygrophoropsis mangelotii* Locq., *Russula* sp. and *Termitomyces striatus* (Beeli) R. Heim (21). An ethnomycological study was executed by Tiébré (30) of the Sikensi locality. Her work lists twenty-eight vernacular names and identifies fourteen species eaten by this community. Also, Kouassi (19) and Locquin (20) have conducted a study in three classified forests in the forest area. This study identified thirty one edible species with *Chlorophyllum molydites* described for the first time (19). The knowledge of local populations in Guinea savannah areas on the genus *Termitomyces* has been studied by Kouassi *et al.* (18). This study permitted to identify seven species. Despite these works, the data on edible mushrooms of Ivory Coast remain fragmentary. The role that the mushrooms play on the alimentary and social aspect of the local population is not enough documented. A study realized in the locality of Sikensi, in the Abidjan District and in Bobia (Goh Region), in forest areas of Ivory Coast has updated two new species of mushrooms of recent consumption: *Agrocybe elegantior* Watling and *Agrocybe broadwayi* (Murrill) Dennis.

Material and methods

The collecting for this study has been realized in the locality of Sikensi in rainy season from 1 may to 31 October 2014, focusing on the edible mushrooms consumed by local population. Specimens have been photographed *in-situ*.

Ecological and ethnomycological information of this species was recorded on Excel datasheet. Once transported to the laboratory, the specimens have been macroscopically described according to the protocol proposed by De Román *et al.* (5). Then, some technical photographs have been taken. After drying, the specimens have been placed in plastics bags with "mini-grip" closure and deposited provisionally in the herbarium of the national center of floristic of the University of Felix Houphouët-Boigny of Abidjan and deposited definitely in the herbarium of the National Botanic Garden of Belgium.

Microscopical analysis has been accomplished with an Olympus BX51 microscope equipped with a drawing tube. Tissues were observed in ammonia or ammoniacal Congo red. Spore measurements are based on 30 spores and are given as (MINa) (Equation I).

$$[AVa-2*SD] - AVa - AVb - [AVb + 2*SD] (MAXb) \quad (I)$$

in which AVa= lowest mean value for the measured collections, AVb= greatest mean value and SD= standard deviation calculated for the measurements of one collection.

Q stands for "quotient length/width" and is given by equation II.

$$(MINQa) Qa - Qb (MAXQb) \quad (II)$$

in which Qa, resp. Qb, stand for the lowest, respectively the highest, mean quotient for the measured specimens (15, 16, 17, 27).

Results

The list of edible mushrooms of dense rain forest of Ivory Coast has been compiled based on the existing literature (14, 20, 25, 32) and supplemented by the species harvested during the campaigns realized in the forest area. Sixty species have been recorded. Among these listed species, thirteen are mentioned for the first time as edibles for the country: *Auricularia cornea* Ehrenb., *Collybia aurea* (Beeli) Pegler, *Cookeina speciosa* (Fr.) Dennis, *Coprinus africanus* Pegler, *Gymnopilus zenkeri* (Henn.) Singer, *Hohenbuehelia aurantiocystis* Pegler, *Oudemansiella canarii* (Jungh.) Höhn, *Pleurotus flabellatus* (Berk. & Br.) Sacc., *Pleurotus fuscusquamulosus* D.A. Reid & Eicker, *Pleurotus tuber-regium* (Fr.) Fr., *Schizophyllum commune* Fr; *Agrocybe elegantior* Watling, *Agrocybe broadwayi* (Murrill) Dennis. The first species mentioned have already been described in african literature as edible. The last two species *Agrocybe elegantior* Watling and *Agrocybe broadwayi* (Murrill) Dennis are mentioned for the first time as edibles for the Africa (Table 1). In this study, we decided to describe these species and present their mode of consumption.

Agrocybe elegantior Watling

Pileus 15-37 mm diam, 1 mm thick at disc, at first globose, becoming convex, finally applanate with broad and low umbo, sometimes shallowly rivulose towards the margin; surface smooth, glabrous, subviscid when young, dry when older, pale yellowish all over, in the center more brownish; margin inflexed, becoming straighter when mature, sometimes with whitish appendiculate remains of velum.

Lamellae adnexed, crowded, sinuose, with intercalated lamellulae, at first pale, then light brown, finally dark brown; margin smooth and whitish.

Table 1
Edible mushrooms of rainy dense forests of Ivory Coast.

Species	Habitat	Ecology	References	Additional specimens	Local name
1 <i>Agaricus</i> sp. L	F	Sap	(20),		
2 <i>Agaricus subsaharianus</i> L.A. Parra, Hama & De Kesel		Sap	(33),		
3 <i>Agrocybe elegantior</i> Watling	P	Sap	present study	YIAN077	Blayéré (Bété)
4 <i>Agrocybe broadwayi</i> (Murrill) Dennis	P	Sap	present study	YIAN172	
5 <i>Auricularia cornea</i> Ehrenb.	P	Sap	present study	YIAN062	Gbagô toh (Gban); Youclitrata (Bété)
6 <i>Bulgaria</i> sp. Fr	F	Sap	(20),		
7 <i>Cantharellus addaiensis</i> Henn.		Ecto	(7),		
8 <i>Cantharellus floridulus</i> Heinem.		Ecto	(7),		
9 <i>Cantharellus pseudofriesii</i> Heinem.		Ecto	(33),		
10 <i>Cantharellus rufopunctatus</i> var <i>rufopunctatus</i> (Beeli) Heinem.		Ecto	(33),		
11 <i>Chlorophyllum carminum</i> nom. prov. Kouassi	F	Sap	(19),		
12 <i>Chlorophyllum giganteum</i> nom. prov. Kouassi	F	Sap	(19),		
13 <i>Chlorophyllum miniatense</i> nom. prov. Kouassi	Fw	Sap	(19),		
14 <i>Chlorophyllum molybdites</i> (G. Mey.) Massee	F	Sap	(19), (21)		
15 <i>Chlorophyllum rubeomarginatum</i> nom. prov. Kouassi	F	Sap	(19),		
16 <i>Collybia aurea</i> (Beeli) Pegler	F	Sap	present study	PITTA & YIAN020	
17 <i>Cookeina speciosa</i> (Fr.) Dennis	F	Sap	(29),	YIAN047	Tankoko (Gban)
18 <i>Coprinus africanus</i> Pegler	P	Sap	(19),	YIAN117	Wouinh toh (Gban); Lèglèlèlou (Bété)
19 <i>Gymnopilus zenkeri</i> (Henn.) Singer	P	Sap	(29),	YIAN104	Yéréyé (Gban); Dabadjè (Bété)
20 <i>Hohenbuehelia aurantiocystis</i> Pegler	P	Sap	present study	YIAN139	Kpèsrin (Gban); Kpatra (Bété)
21 <i>Hygrophoropsis aurantiaca</i> (Wulfen) Maire		Ecto	(2), (33)		Possibly Camarophyllus, see Heinemann (1963)
22 <i>Hygrophoropsis mangelotii</i> Locq.		Ecto	(26), (2), (33), (21)		
23 <i>Lactifluus gymnocarpus</i> (R. Heim ex Singer) Verbeken		Ecto	(33),		
24 <i>Lactifluus gymnocarpoides</i> (Verbeken) Verbeken		Ecto	(33),		
25 <i>Lactocollybia angiospermarum</i> singer		Sap	(29),		
26 <i>Lentinus</i> aff. <i>atrobrunneus</i> Pegler	F, P, J	Sap	(20), (33)		Indépendance (commonly used); Nambè-nankpian (Gban); Gômi (Bété)
27 <i>Lentinus</i> aff. <i>brunneofloccosus</i> Pegler	F, P, Fw	Sap	(20), (33)		Indépendance (commonly used); Nambè-nankpian (Gban); Gômi (Bété)
28 <i>Lentinus</i> sp. Fr	F, P, Fw	Sap	(20),		Indépendance (commonly used); Nambè-nankpian (Gban); Gômi (Bété)
29 <i>Lentinus squarrosulus</i> Mont.	F, P, Fw	Sap	(29), (20), (33)	YIAN072	Indépendance (commonly used); Nambè-nankpian (Gban); Gômi (Bété)
30 <i>Lepiota</i> sp 1 (Pers.) Gray	F	Sap	(20),		
31 <i>Lepiota</i> sp 2 (Pers.) Gray	F, P, Fw	Sap	(20),		
32 <i>Leucoagaricus</i> cf. <i>americanus</i> (Peck) Vellinga	P	Sap	(20),		

33	<i>Leucoagaricus</i> sp Locq. ex Singer		Sap	(20),		
34	<i>Leucocoprinus cretatus</i> (Bull.) Locq.	P	Sap	(20),	YIAN105, Tiétiékou (Gagnoa)	Pôpôgoua (Gban); Troglé popa (Bété)
35	<i>Leucocoprinus elaeidis</i> (Beeli) Heinem	P	Sap	(20),		
36	<i>Macrolepiota dolichaula</i> (Berk. & Broome) Pegler & R.W. Rayner	P	Sap	present study	YIAN126, bobia (Gagnoa)	
37	<i>Macrolepiota</i> sp Singer		Sap	(20),		
38	<i>Marasmiellus inoderma</i> (Berk.) Singer	P	Sap	(20),	YIAN129, Tiétiékou (Gagnoa)	Kpètrè (Gban); Gadjia (Bété)
39	<i>Marasmius gardneri</i> Singer	F	Sap	(29),		
40	<i>Marasmius haediniformis</i> Singer	P	Sap	(29),		
41	<i>Marasmius nodulocystis</i> Pegler	P	Sap	(29),		
42	<i>Mycena</i> cf. <i>alcalina</i> (Fr. ex Fr.) Kummer	F	Sap	(29),		
43	<i>Oudemansiella canarii</i> (Jungh.) Höhn.	P	Sap	present study	YIAN108, Tiétiékou (Gagnoa)	
44	<i>Phlebopus sudanicus</i> (Har. & Pat.) Heinem.	F	Sap	(20),		
45	<i>Pleurotus cystidiosus</i> O.K. Mill.	P	Sap	(20),		
46	<i>Pleurotus flabellatus</i> (Berk. & Br.) Sacc.	P	Sap	present study	YIAN109, Bobia (Gagnoa)	Kpèsrin (Gban); Kpatra (Bété)
47	<i>Pleurotus fuscusquamulosus</i> D.A. Reid & Eicker	P	Sap	present study	YIAN153, Forêt classée de la Téné	
48	<i>Pleurotus</i> sp1 (Fr.) P. Kumm.		Sap	(33),		
49	<i>Pleurotus</i> sp2 (Fr.) P. Kumm.		Sap	(33),		
50	<i>Pleurotus tuber-regium</i> (Fr.) Fr.	P	Sap	present study	YIAN107	Boutroua (Gban); Boutroua (Bété)
51	<i>Pluteus</i> cf. <i>congolensis</i> Beeli	F	Sap	(20),		
52	<i>Psathyrella atroumbonata</i> Pegler	F, P, Fw	Sap	(20),		
53	<i>Psathyrella piluliformis</i> (Bull.: Fr.)	F	Sap	(29),		
54	<i>Psathyrella tuberculata</i> (Pat.) A.H. Sm.	F, P, Fw	Sap	(20), (33)	YIAN041, Abidjan	Kpôtro (Gban); Kpatro (Bété)
55	<i>Russula</i> sp. (white species) Pers.	F	Ecto	(2), (20), (33)		
56	<i>Schizophyllum commune</i> Fr.	F, P, Fw	Sap	present study	YIAN100, Onahio (Gagnoa)	Koitèrè (godié/Bété)
57	<i>Termitomyces eurhizus</i> (Berk.) R. Heim	F	Sym	(18), (33)		
58	<i>Termitomyces fuliginosus</i> R. Heim	F	Sym	(18), (33)		
59	<i>Termitomyces le-testui</i> (Pat.) R. Heim	F, P, Fw, Sv	Sym	(26), (20), (18), (33), (13)		
60	<i>Termitomyces medius</i> R. Heim & Grassé	F, Fw, Sv	Sym	(29), (20), (18), (7)	YIAN080, Mahinadopa	Tohatoh (Gban); Dogodjèdjè, Glèglè (Bété); M'po m'po (Abidji)
61	<i>Termitomyces microcarpus</i> (Berk. & Broome) R. Heim	F	Sym	(20),		
62	<i>Termitomyces schimperi</i> (Pat.) R. Heim	P	Sym	(29), (33)	YIAN147, Gagnoa	Vié toh (Gban)
63	<i>Termitomyces striatus</i> (Beeli) R. Heim		Sym	(14), (25), (33)		
64	<i>Tubosaeta brunneosetosa</i> (Singer) E.Horak		Sym Ecto	(20),		
65	<i>Volvariella acystidiata</i> N.C. Pathak	F, P, Fw	Sap	(20),		
66	<i>Volvariella volvacea</i> (Bull.) Singer	P	Sap	(29), (20), (33)	YIAN040, Benkro	Kpôlor (Gban and Bété)
67	<i>Volvolpluteus earlei</i> (Murrill) Vizzini, Contu & Justo	P	Sap	(20), (33)	YIAN137, Benkro	Kpôlor gbé (Gban)

F: forest ; P: plantation; Fw: Fallow; Sv: savannah; Ecto: ectomycorrhizal; Sap: saprotrophic; Sym: symbiotic.

Stipe 20-90 × 2-3 mm, cylindrical, with inflated base, fistulose; surface silky and fibrous, glabrous, white to pale yellow, non-changing when bruised; annulus membranous, fragile, white, often not persistent. Context firm, white, unchanged when cut. Odor mushroom-like. Taste more or less sweet. Spore print brown.

Spores (9.7-)9.7-10.7-11.7(-11.9) × (5.9-)6.0-6.8-7.5(-7.4) µm; Q= (1.46-)1.41-1.58-1.75(-1.76) {N=34}, ellipsoid, without suprahilar depression, smooth, brown, thick-walled, with truncate apex and well differentiated germ pore.

Basidia (16-)16.3-19.2-22(-20.7) × (7.9-)7.7-8.7-9.7(-9.6) µm, relatively short, clavate to broadly clavate, hyaline, smooth, 4-spored.

Cheilocystidia (17.9-)11-27.3-43.6(-43.4) × (8.9-)3.7-15.5-27.3(-28,1) µm {N=20}, variable, mostly ovoid, pyriform or broadly clavate with a thin base, hyaline, smooth.

Pleurocystidia absent.

Pileipellis a single-layered epithelium composed of spheropedunculate elements, in slides often mixed with variously formed inflated elements of (16.4-) 6.7-26.9-47.1(-57.8) × (10.9-)10.1-17.5-25(-25.9) µm, smooth, hyaline, sometimes with slightly thickened walls, originating from hyaline cylindrical hyphae 4–13 (–15) µm, not or slightly constricted at the septa. Clamp connections most frequent in stipe tissue, infrequent elsewhere (Figures 1, 2).

Material examined

Ivory Coast, Sikensi, N5°39'23.6"-W4°34'44.0", alt. 92.9m, 31 October 2014, Yian 077 (BR).

Ecology

Gregarious species; the fruit bodies grow on soil in plantations of *Hevea brasiliensis*. This species grow on soil rich in organic matter completely decomposed. The species appears during the rainy season, i.e. from April to July and from October to November.

Ethnomycology

In Ivory Coast, *Agrocybe elegantior* is consumed by the local community Abidji of the Sikensi and Bakanou villages. According to information provided by the local population, the species is recently entered the diet of Abidji and is sold on the local market at 50 francs CFA (0.91 USD) per unit. A unit corresponds with what a hand can grab, i.e. about 20 mature fruit bodies. The vernacular name in Abidji is "Akpôroudou". "Akpo" means road and "roudou" means mushroom. The reasons for the choice of this name are twofold. First, the name is given because the species grows abundantly on bare soil and dead wood stumps along roads. The second reason is that this species appears in large numbers and over a wide area, making reference to the extent of a highway. Women prepare the fruit bodies by washing off the sand and dirt from the base of the stipe.

Then the fruit bodies are crushed or left in full and added straight to the ingredients used for making the sauces "gombo", aubergine or palm seeds (*Elaeis guineensis* Jacq.).

Agrocybe broadwayi (Murrill) Dennis

Description

Pileus 16-38 mm diam., at first globose, becoming convex, then applanate to slightly depressed at maturity; surface smooth, glabrous, dry when young, soon entirely pitted or with small cavities on the surface, sometimes cracking, pale yellowish all over, whitish in the cracks; margin inflexed when young, becoming straighter and cracked when mature.

Lamellae first adnate, becoming slightly emarginate, leaving a rugulose zone around the stipe, more or less thick, simple, first pale brown, becoming darker brown, with deeply eroded and concolorous edge. Stipe 28-89 × 3-4 mm, cylindrical, inflated at the base, fibrous surface, white, non-changing when touched, annulus absent.

Context firm, white, unchanged when cut. Odor null.

Taste sweet.

Spore print brown.

Spores (12.1-)12.3-14.1-15.9(-15.9) × (7.1-)7.1-7.7-8.3(-8.4) µm; Q= (1.61-)1.63-1.83-2.03(-2.08) {N=30}, ellipsoid, with a feeble suprahilar depression, smooth, brown, thick-walled, with truncate apex and well differentiated germ pore.

Basidia (23.2-)22.2-27.8-33.5(-33.1) × (10-)10-11.2-12.4(-12.3) µm, clavate to broadly clavate, hyaline, smooth, with 2, 3 or 4 sterigmata.

Cheilocystidia (35.8-)33.7-44.9-56.1(-53.9) × (11.6) 10.4-20.6-30.8(-30) µm {N=15}, variable, ovoid, pyriform or broadly clavate, sometimes broadly mucronate, with a narrow base, hyaline, smooth or with debris at the apex.

Pleurocystidia absent.

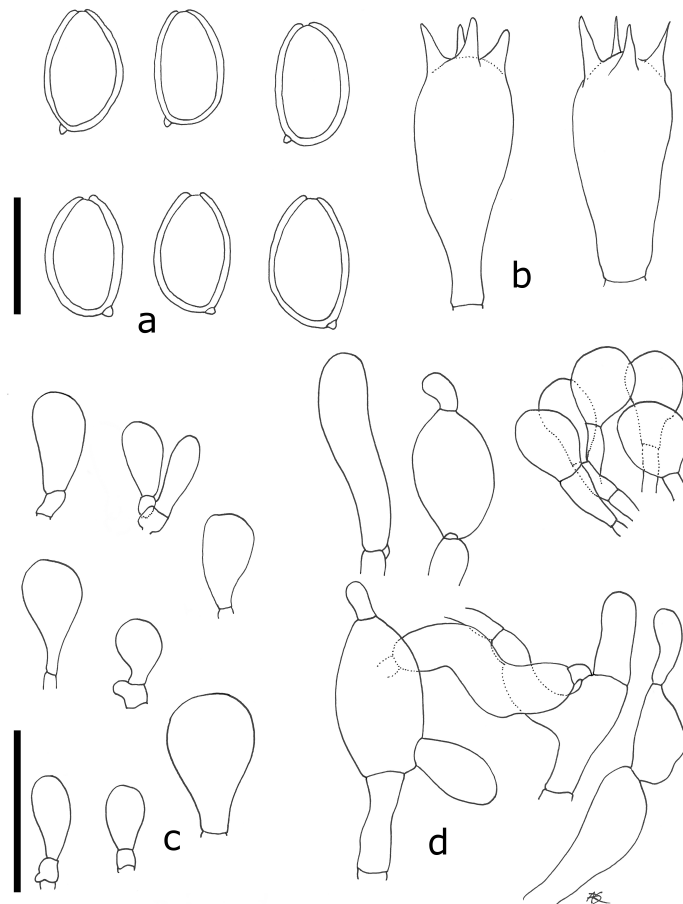
Pileipellis an epithelium composed of singular or tufted spheropedunculate elements and catenulate globose elements of (19.9-)18.2-32.7-47.2(-46.6) × (17.4-)15.4-24.4-33.3(-32.3) µm, smooth, hyaline, sometimes with slightly thickened walls, originating from hyaline cylindrical hyphae up to 10-15 µm diameter, not or slightly constricted at the septa (Figure 3, 4).

Material examined

Ivory Coast, (Bobia, 5km South-East of Tipadipa, N 6°4.291' - W 5°51.023', alt. 259.29 m, 16 April 2016 (Yian 161) (BR); Bingerville (near Eloka, Palmafrique), N 5°18.832' - W 3°47.856'W, alt. 42 m, 7 mai 2016 (YIAN 172) (BR).



Figure 1: *Agarocybe elegantior*, Sikensi; 31/10/2014 (YIAN077).

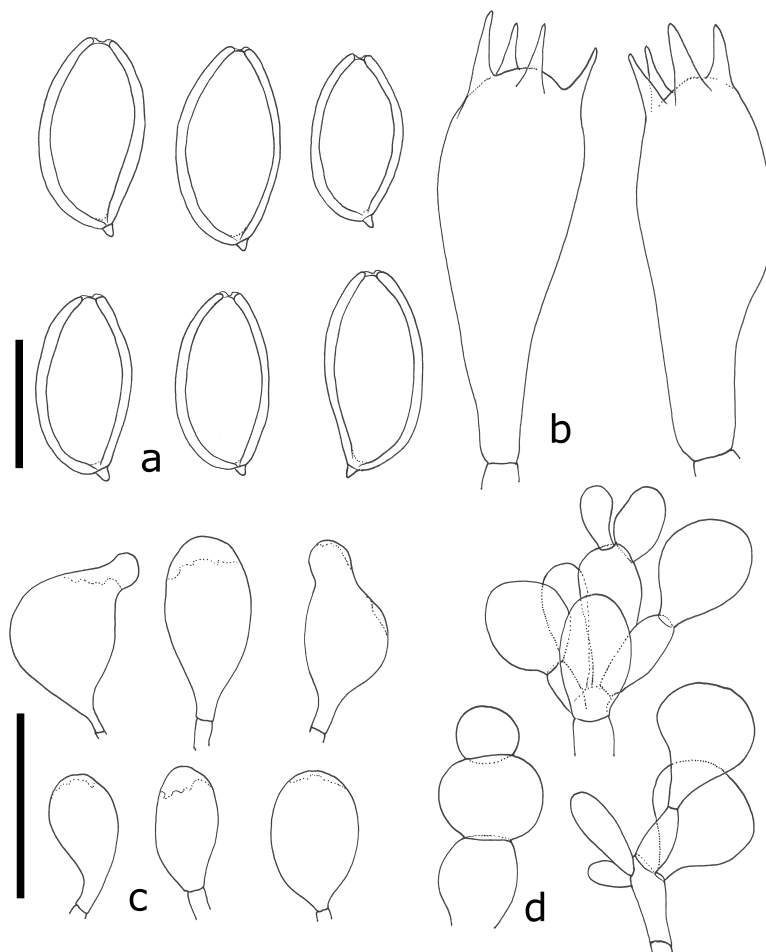


a. spores, b. basidia, c. cheilocystidia, d. elements of the pileipellis. Upper scale bar 10 μ m (a, b), lower scale bar 50 μ m (c, d). All from YIAN077.

Figure 2: *Agarocybe elegantior*.



Figure 3: *Agrocybe broadwayi*, 16/04/2016 (YIAN172).



a. spores, b. basidia, c. cheilocystidia, d. elements of the pileipellis. Upper scale bar 10µm (a, b), lower scale bar 50µm (c, d). All from YIAN172.

Figure 4: *Agrocybe broadwayi*.

Ecology

Gregarious species; the fruit bodies grow on soil, in a rice field with piled up organic matter composed of spent maize stalks and decomposing banana trees. It is also found in palm tree plantations amidst grasses. The species appears in April and May during the rainy season.

Ethnomycology

The species is consumed by *Bété* population of Bobia locality. People name it "*Blayère*", meaning "neutralised the spicy pepper". Indeed, it is so sweet it takes away or neutralises the taste of pepper. It is collected by women during or after harvesting food for family consumption, but it is not presented on local market stalls.

It is cooked in every meal made by the women, including sauce gombo, aubergine or palm seeds. It is washed with clean water and cooked with the other sauce ingredients. Although present in the south (Palmafrique village, Bingerville department), the species is not recognised as edible and not presented on market stalls.

Taxonomy

Several species of the genus *Agrocybe* have been identified in Africa, including *A. dura* (Bolt. Ex Fr.) Singer, *A. stercorearia* Pegler, sp. nov. *A. manihotis* Pegler, *A. carneobrunneus* Walting, *A. aff. howeana* (Peck) Singer, *A. ochraceobrunneus* Walting, *A. praecox* (Pers. Per Fr.), *A. aff. cyndracea* (DC: Fr.) R. Mre., *A. bokotensis* (Beeli) Walting, *A. semiorbicularis* (Fr. Per St Amans) Fayod, *A. vervactis* (Fr.). Among them, two are similar to *A. broadwayi* and *A. elegantior* in carpophore size, colour and shape pileus, habitats and microscopic elements. An identification key is presented here to avoid confusion with similar taxa.

- *species growing on completely decomposed wood stumps or on rich soil in organic debris*
-Pileus viscous or subviscous when young; surface pale yellow at margin, tinged of brown at center, pileipellis elements bulging, vesiculose, thick-wall; spores $9.7\text{--}11.9 \times 5.9\text{--}7.4 \mu\text{m}$... *Agrocybe elegantior*
- Pileus not viscous, surface ochraceous yellow pale; pileipellis elements long ellipsoid at center and ellipsoid to globose at the marge, spores $12\text{--}13 \times 6\text{--}7 \mu\text{m}$ *Agrocybe aff. howeana*
- *species growing on rich soil in organic matter or amidst grass:*
-Pileus with small cavities on the surface, sometimes cracking, pileocystidia absent, pleurocystidia absent; elements of pileipellis spheropedunculate and catenulate globose elements, spores $12.1\text{--}15.9 \times 7.1\text{--}8.4 \mu\text{m}$..3 *Agrocybe broadwayi*
-Pileus smooth at the disk, slightly striate at the margin; pleurocystidia present and abundant; elements pileipellis inflated not catenulate, suglobose to piriforme; spores $10\text{--}14.5 \times 6\text{--}9.5 \mu\text{m}$ *Agrocybe manihotis*.

Discussion

Wild edible mushrooms occupy an important place in the diet of African populations (22). However, their study is very fragmented in West Africa (2, 28). This study revealed the presence of sixty-seven species consumed by the local populations.

This information adds to that available for West Africa. The compilation of mycological data may permit to draw up a list of the edible mushrooms of this region. In addition, as far as concern, our study is the first to reveal the use of edible *Agrocybe* in Western Africa. Few *Agrocybe* have been reported as edible in Africa. Only four species have been reported as edible in South Africa (26). These are *A. cylindracea*, *A. Praecox*, *A. semiorbicularis* and *A. vervacti*.

Distribution

Agrocybe elegantior and *Agrocybe broadwayi* respectively have been collected in the Binga locality in Democratic Republic of the Congo (15) and Thika, Central Province, Nairobi in Kenya (24). It is point out for the first time in Ivory Coast particularly in Sikensi, Bobia, at 5 km of South-East of Tipadipa and at Bingerville.

Ethnomycology

To date, no study mentions the edibility of *Agrocybe elegantior* and *A. broadwayi*. In Africa, particularly in the Democratic Republic of the Congo and Kenya, the works of Hesler (15) and Pegler *et al.* (24) do not report the consumption of these two species. However, in Ivory Coast, this is the first time that they are mentioned as edible by the populations of the localities of Sikensi and Bobia.

Taxonomy

No synonym exists for *Agrocybe elegantior*. The specimen collected in this study has a pileus and a stipe measuring respectively 15-37 mm of diameter and 20-90 x 2-3 mm of height. These dimensions are lower than those of the specimen described by Hesler (15). Indeed, the specimen described by this author shows a pileus 43-112 mm of diameter with the upper stipe of 118-221 x 6-12 mm whose base is white and bulbous. For this author, the specimen presents an ochre yellow pileus, brown tinged; at the adult stage, the center of the pileus retains an ochraceous yellow color. He also denotes that in the young stage, the pileus is finely wrinkled and becomes smooth in the adult stage having a yellow ochre color. The surface of our specimen has a coloring that varies between pale yellow and yellow. The center of the pileus becomes brown in the center with whitish flakes towards the margin in the young stage. As the specimen described by Hesler (15), the annulus of our specimen, is membranous, fragile and fugacious.

Outside these morphological differences, the spore measurement of our specimen ((9.7-) 9.7-10.7-11.7 (-11.9) × (5.9-) 6.0-6.8-7.5 (-7.4) µm) is similar to the Democratic Republic of the Congo specimen (10-11 (-12) × 6-7 µm). The similarity is also observable on the 4-spored basidia, with a clamp connection. The size and shape of the cheilocystidia we observed are also similar to those observed by Heinemann (14) and for both specimens, the pleurocystidia are not observed. All these microscopic data allow us to conclude that our specimen can be considered as *Agrocybe elegantior*.

Analysis of the identification key established by Hesler (15) shows that *Agrocybe elegantior* and *Agrocybe carmineobrunnea* seem closer when considering spores measurement. However, if we consider the form of cystidia then we notice a significant difference.

Agrocybe elegantior has variable cheilocystidia forms (ellipsoids, globuloses or widely claviform globuloses) whereas *Agrocybe carmineobrunnea* presents two types of cheilocystidia (thin-wall vesiculoses and thick-wall lageniform). According to Thiombiano and Kampmann (27), *Agrocybe carmineobrunnea* correspond to South America species called *Agrocybe platensis* (Speg.) Sing. The surface of the pileus of these two species is either rough or present of cavities. They belong to the same range of spore measurement.

Like the specimen described by Rammeloo and Walley (24), our specimen presents a pileus, subviscid, sometimes cracked on the surface on a white ground. the lamellae are adnate. the size of the spores is large ((12.1-)12.3-14.1-15.9(-15.9) × (7.1-)7.1-7.7-8.3(-8.4)). These spores are ellipsoid, smooth, thick-walled, with truncate apex and well differentiated germ pore. The basidia are clavate and the pleurocystidia are absents. According to the key proposed by Thiombiano and Kampmann (27), the *Agrocybe broadwayi* specimen from tropical America present large spores (13-15.3 X 7-8.5 µm). The pileus is subviscid measuring 3 to 5 cm in diameter. This specimen is macroscopically and microscopically similar to our specimens collected on the African continent. However, our specimen has a more or less sweet taste unlike that of America which is rather farinaceous.

The study of Thiombiano and Kampmann (27) shows that *Agrocybe broadwayi* native to America correspond to *Agrocybe manihotis* which is an African species. These two species are similar in shape, coating of the pileus and spore size. The taxonomic studies of the *Agrocybes* based on the macroscopic and microscopic characteristics seem limited to establish a true identification of this taxon. It is therefore important to carry out molecular studies which take into account all the species of the *Agrocybe* genus in order to better classify them.

Conclusion

This study has enabled to list the mushrooms consumed in the dense rainforests of Ivory Coast. A total of sixty-seven edible species have been identified. *Agrocybe broadwayi* and *A. elegantior*, some edibles species have been described for the first time in Ivory Coast. Of these two species, *A. elegantior* is sold on the local market. This shows that the species is appreciated and constitute an important economic asset for the local population. This species has been identified and described in taxonomical and ecological plan for the first time in Ivory Coast. Conscious that the forest area of Ivory Coast abounds an important diversity of edible mushrooms, more studies need to be undertaken to establish an exhaustive list of these fungi and to know the various uses by the local people. Some test of growing could also be considered to fight durably against poverty in rural communities.

Acknowledgments

The authors thank to the technical and financial support of the Global Taxonomy Initiative, the Royal Institute of Natural Sciences of Belgium and the Botanic Garden Meise of Belgium for the taxonomic training. The authors are grateful to Drs. J. Degreef, Head of Mycology and A. De Kesel to their real contribution to the identification of species. Our thanks also go to Prof. E.K. N'Guessan for initiated this research project in Ivory Coast. We also express our gratitude to Drs. Y.C.Y. Adou and B.T. Vroh for their judicious advices during this work.

Literature

1. Alasoadura S.O., 1967, Studies in the Higher Fungi of Nigeria III. Fruiting in *Pleurotus squarrosulus* (Mont.) Sing. *Nova Hedwigia*, **14**, 327-337.
2. Boa E.R., 2006, *Champignons comestibles sauvages: vue d'ensemble sur leur utilisation et leur importance pour les populations*. Produits forestiers non ligneux 17. Rome, FAO, 157 p.
3. Buyck B., 1994, Ubobwa: les champignons comestibles de l'Ouest du Burundi, Administration Gén. Coop. Dév., Bruxelles, *Publ. Agricole*, **34**, 124 p.
4. Dennis, R.W.G. 1953. Les Agaricales de l'Île de la Trinité: Rhodosporae-Ochrosporae, *Bull. Soc. Mycol. France*, **69**, 2, 145-198.
5. De Kesel A., Codjia J.C. & Yorou S.N., 2002, *Guide des champignons comestibles du Bénin*. Cotonou, Jardin Botanique National de Belgique et CECODI, 275 p.
6. De Román M., Boa E. & Woodward S., 2006, Wild-gathered fungi for health and rural livelihoods, *Proc. Nutr. Soc.*, **65**, 190-197.
7. Ducouso M., Bâ A.M. & Thoen D., 2003, Les champignons ectomycorhiziens des forêts naturelles et des plantations d'Afrique de l'Ouest: une source de champignons comestibles, *Bois For. Trop.*, **275**, 1, 51-63.
8. Eyî Ndong H.E., Degreef J. & De Kesel A., 2011, *Champignons comestibles des forêts denses d'Afrique Centrale*, Taxonomie et identification, ABC Taxa 10, 253 p.
9. Guissou K.M.L. Sanon E., Sankara Ph. & Guinko S., 2014, La mycothérapie au Burkina Faso: État des lieux et perspectives, *J. Appl. Biosci.*, **79**, 6896-6908.
10. Härkönen M., Saarimäki T. & Mwasumbi L., 1995, Edible mushrooms of Tanzania, *Karstenia*, **35**, 1-91.
11. Härkönen M., Niemelä T. & Mwasumbi L., 2003, Edible Mushrooms of Tanzania: edible, harmful and other fungi, *Norrinia*, **10**, 1-200.
12. Härkönen M., Niemelä T., Mbindo K., Kotiranta H. & Pearce G., 2015, Zambian mushrooms and mycology, *Norrinia*, **29**, 1-208.
13. Heim R., 1936, *Aperçu sur les champignons toxiques et comestibles des colonies françaises*, In: CURASSON G., *Pathol. Exot. Vétérin. Comp.*, **3**, 1-31.
14. Heim R., 1977, Termites et champignons. *Les champignons termitophiles d'Afrique noire et d'Asie méridionale*, Paris, Boubée, 190 p.
15. Heinemann P., 1974, Bolbitiaceae. *Flore illustrée des Champignons d'Afrique Centrale*, **3**, 71.
16. Hesler L.R., 2013, *Agrocybe Notebook 1Trace*: Tennessee Research and Creative Exchange, 250 p.
17. Kauffman C.H., 1918, *The Agaricaceae of Michigan: Pholiota and Flammula*, pp 289-314 and pp 483-492.
18. Koné N.Y.A., Konate S. & Linsenmair K.E., 2013, Socio-economical aspects of the exploitation of Termitomyces fruit bodies in central and southern Côte d'Ivoire: Raising awareness for their sustainable use, *J. Appl. Biosci.*, **70**, 5580-5590.
19. Kouassi K.C., N'Takpé K.M.B., Da K.P. & Traoré D., 2007, Le genre *Chlorophyllum* Mass.: Nouvelles espèces de Côte d'Ivoire, *Sci. Techn. Appl.*, **1**, 103-114.
20. Kouassi K.C., 2012, *Taxinomie, Ecologie et Ethnomycologie des Champignons de Côte: cas des Macromycètes des forêts classées de Bouaflé, Bayota et Niégré*. Thèse de Doctorat, Université Félix Houphouët-Boigny, UFR Biosciences, Abidjan, Côte d'Ivoire, 216 p.
21. Locquin M., 1954, Une chanterelle comestible de la Ivory Coast: *Hygrophoropsis mangelotii* sp., *J. Agric. Bot. Trop. Appl.*, **1**, 359-361.
22. Malaisse F., De Kesel A., N'gasse G. & Lognay G., 2008, Diversité des champignons consommés par les pygmées Bofi de la Lobaye (République centrafricaine). *Geo-Eco-Trop*, **32**, 1-8.
23. Murrill W.A., 1912, The Agaricaceae of tropical North America, *Mycologia*, **4**, 2, 72-83.
24. Pegler D.N., 1977, A preliminary agaric flora of East Africa, *Kew Bull. Add. Ser.*, **6**, 615 p.
25. Pegler, D. N. & Vanhaecke M., 1994, Termitomyces of Southeast Asia, *Kew Bull.*, **49**, 4, 717-736.
26. Rammeloo J. & Walley R., 1993, The edible fungi of Africa south of the Sahara: a literature survey, *Scripta Bot. Belg.*, **5**, 1-62.
27. Singer R., 1977, Keys for the identification of the species of Agaricales. *Sydowia*, **30**, 192-279.
28. Smith A.H. & Hesler L.R., 1968, *North American Species of Pholiota*. Hafner publishing company, New York and London 349. p.
29. Thiombiano A. & Kampmann D., 2010, *Atlas de la Biodiversité de l'Afrique de l'Ouest*. Tome II: Burkina Faso, Ouagadougou & Frankfurt/Main, Biota, 336-343.
30. Tiébré M.S., 2001, *Ethnomycologie dans la région de Sikensi en Ivory Coast*. Mémoire de DEA, Faculté Universitaire des Sciences Agronomiques de Gembloux, Belgique, 108 p.
31. Walley R. & Rammeloo J., 1994, The poisonous and useful fungi of Africa South of the Sahara, *Scripta Bot. Belg.*, **10**, 1-56.
32. Watling R. 1973. New species of Bolbitiaceae (Agaricales) from Zaire, *Bull. Jardin Bot. National Belg.*, **43**, 1-2, 187-192.
33. Yorou N.S. & De Kesel A., 2001, Indigenous ethnomycological knowledge of the Nagot people from the centre of Benin (West Africa), *Syst. Geogr. Plant.*, **71**, 627-637.
34. Yorou N.S., N'Golo A.K., Guissou M.L., Guelly A.K., Ekué Marius R.M. & De Kesel A., 2014, *Biodiversity and sustainable use of wild edible fungi in the Sudanian centre of endemism: a plea for valorization*. pp 241-271. In: *Ectomycorrhizal symbiosis in tropical and Neotropical forests* (Eds). Bâ A.M., McGuire K.L. & Diédhiou A.