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Study of Eight Species of the Genus Coprinus in the Forest Area of Daloa (Central West, Côte d'Ivoire)

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Abstract **Original Research Article**

This study on the genus coprinus was conducted in the forest area of Daloa. The objective of this work is to evaluate and list the species of the genus coprinus in the region. It will complete the knowledge acquired during previous work. The work consisted of surveys in the fallows and plantations of Daloa. After macroscopic and microscopic observation in the laboratory, eight (8) species of the genus Coprinus were cited and described. These are: *Coprinopsis lagopus var. vacillans*, *Coprinus comatus*, *Coprinellus atramentaria*, *Coprinopsis nivea*, *Coprinus africanus*, *Coprinellus domesticus*, *Coprinus plicatilis* and *Coprinus auricuma*. Among these species, *Coprinopsis nivea*, *Coprinus comatus* and *Coprinus africanus* have already been cited and described in Côte d'Ivoire. *Coprinopsis lagopus var.* vacillans, *Coprinellus atramentaria*, *Coprinellus domesticus*, *Coprinus plicatilis* and *Coprinus auricuma* are cited and described for the first time. The results obtained are part of the contribution to the determination of the Ivorian fungal diversity, which remains incomplete until now.

Keywords: Basidiomycetes, Coprinus, deliquescence, Saprophyte, Daloa.

1. INTRODUCTION

The species of the genus Coprinus have a cap often wrinkled or furrowed and with grayish or blackening blades. The spore is blackish brown or blackish. They have smooth, sometimes warty spores, with the presence of germinative pore (Gerault, 2005). Coprinus are recognized by some characters which are: the presence of pseudo paraphyses, dark basidiospores. They are saprophytic species with fragile flesh. The coprins have an ephemeral life; they absorb a lot of water and are fragile. The lamellae are parallel (Moreau, 1978). They become deliquescent at maturity forming a true ink, once used in writing wills (El Akil, 2014). The genus includes fungi growing on animal feces (coprophilous species), on lawns, pastures, composts and plant debris (Keirle *et al.*, 2004).

This genus is very easy to study; harvesting can be done all year round if the weather conditions are favorable because they are saprophytic species. This characteristic allows the study of fungi when other species are absent in the field, it is even possible to grow them on animal dung (N'Douba *et al.*, 2010). Coprins are little known because there is no data on species of the genus coprinus in Côte d'Ivoire.

Apart from this work, no mycological study has been carried out on the fungi of the genus Coprinus. The objective of this work is to evaluate and list the species of the genus Coprinus in the region.

2. MATERIALS AND METHODS

2.1. Presentation of the Study Area

This study was conducted in Daloa city, located between 6° and 7° north latitude and 7° and 8° west longitude. It has an area of 15,205 km² with an estimated population of 1,430,960 (INS, 2021). Its climate consists of four seasons: a long rainy season from April to mid-July, a short dry season from mid-July to mid-September, a short rainy season from mid-

September to November and the long dry season from December to March. This is a humid tropical zone with dense forest vegetation that is regressing due to the practice of extensive and shifting agriculture coupled with uncontrolled exploitation of forest species (Sangaré *et al.*, 2009). The edaphic heritage is of the ferralitic. Rainfall has decreased from 1868.5 mm in 1968 to an average of 1120.4 mm in 2005. The department is watered by the Sassandra River and its tributary, the Lobo, whose branches, the Dé and the Gore, flood all localities (Sangaré *et al.*, 2009).

2.2. Material

The equipment consists of a pocket magnifying glass, a knife to take the specimens. A ruler for taking measurements, a basket for collecting the samples. A camera was used to take pictures. A microscope was used for the observation of the reproductive organs and a micrometer for the microscopic measurements.

2.3. Methods

Collection of Samples

For the collection of samples, several mycological surveys were conducted in fallow lands and plantations in the city of Daloa. These surveys consisted of a systematic sampling of species of the genus Coprinus in this locality. The information collected in the field concerned the substrate and the development mode of the fungal species. Prior to the collection of the carpophores with a knife, photographs were taken from various angles. Fresh samples were brought back to the laboratory for further microscopic observations.

Observations and Identification

For microscopic observations, a thin section was made on a fresh piece of cap. Then, the tissue fragment obtained was mounted between the slide and the microscope slide, in a water solution. Microscopic observations were made on spores, cystidia and basidiospores for each fungal species collected. Determination and identification were performed through the books and keys proposed by Gerault (2005), Courtecuisse & Duheim (2000), N'Douba (2010, 2013), El-Assfouri (2009), El Akil (2014) and Cheype (2008).

3. RESULTS AND DISCUSSION

3. 1. Results

Division: Basidiomycete
Class: Homobasidiomycetes.
Order: Agaricales
Family: Coprinaceae
Genus: Coprinus

***Coprinopsis lagopus* var. vacillans** (Uljé) P. Roux & Guy Garcia 2006 ; Syn. *Coprinus lagopus* var. vacillans Uljé 2000.

The cap (3-6 cm) has a conical then conical-convex or campanulate shape. The margin is striated then rolled up before deliquescence. It is long striated; the lining is formed by a fibrillated to squamulose veil. The cap is bristly in the center, labile, whitish, silvery gray, on a whitish then brownish gray cuticle (Figure 1) and finally blackish gray. The blades are tight, adnate to free, brownish gray and finally black with deliquescence. The stipe (4-10 x 0.6- 1 cm) is white, stubby (at first), clavate, pruinose to flaky especially at the base. The pulp is whitish then pale brownish grey. The spore is black; the spores (6-9 x 4.5-6 µm) are ovoid to subglobose, amygdaliform, with a central germinal pore. The cheilocystids are cylindrical, clavate, vesicular and oblong. Pleurocystids are lageniform, slightly vesiculate. This species was collected on decaying oil palm trunk.

Edibility: It is an edible species.

Coprinus comatus (Müll.: Fr.) Pers.

The cap (6-8 x 2-3cm) is cylindrical then bell-shaped. The coating is mealy, scaly, white to ochre, turning pink then black from the margin which splits, turns over while liquefying. The blades are free, thin, tight, white then purple before becoming black by liquefying from the margin. The stipe (7-15 x 1-3cm) is cylindrical, bulbous sometimes radicating, hollow, smooth, fibrous (Figure 2). It has a free, fragile and labile ring. The flesh is white. The spores (10-13 x 6-7.5µm) are light brown. It has a central germinative pore. It grows on lawns, roadsides, woods and decaying palm trees in Daloa.

Edibility: The young fruiting bodies are edible.

Coprinellus atramentaria (Bulliard); Syn.: *Coprinus atramentarius* (Bull.: Fr.) Fr.

The cap (4-8 cm) is ovoid then conical-convex and finally campanulate. The margin is lobed, irregular, striated. The coating is smooth at the margin. It presents small brownish scales, is silvery gray, brownish gray at the top and labile. The blades are tight, free. The color is whitish, then purple, grey-purple and finally black before deliquescence. The edges are whitish. The flesh is whitish at the beginning. The stipe is stubby and elongates later, it appears bulbous or volviform towards the base (Figure 3). The spores (7-11 x 5-6 µm) are dark brown, elliptical to ovoid. They have a central germinal pore. The cheilocystids (50-180 x 20- 35 µm) are oblong and more or less bulging. The pleurocystids (60-210 x 30-50 µm) are identical. This species grows in large tight clumps on more or less buried woody debris. It was collected on soil and on decomposing oil palm trunk buried in the soil.

Edibility: It is an edible species. To abstain from alcohol during 72 hours which follow its consumption.

Coprinopsis nivea (Pers.) Redhead, Vilgalys et Moncalvo ; Syn. : *Coprinus niveus* (Pers. : Fr) Fr.

The cap (1.5 to 4 cm) is ovoid to conical when young, whitish in color (Figure 7). The surface of the cap is completely covered with a white, flaky, mealy veil (Figure 4). In the adult state (1 cm), the cap may curl back and its color changes from white to gray-black. The stipe (1-12 x 0.3-0.5 cm) is hollow and white. It is fragile, flaky then glabrous with age. It carries a tuft of whitish mycelium at the base. The blades are free, white then black. Basidia are sometimes bisporate. Basidiospores (13.30 x 10 µm) are smooth, with a central germinal pore, sometimes slightly oblique. Cheilocystids (34-58 x 14-45 µm) are usually globose. Pleurocystids (65-135 x 30-40 µm) are cylindrical to fusiform. This species was collected on cow dung.

Comestibility: This species is not edible.
Coprinus africanus Pegler.

The cap (2 to 4.5 cm) is ovoid to campanulate, mamelinated, sometimes convex to concave. The color is brown to whitish (Figure 5). The surface of the cap shows flakes from the remains of the veil. The margin is straight, ridged or wrinkled, pale brown to whitish. The flesh has a thin and fragile thickness. The lamellae are free, dense and uniform. They are pale at first then become grayish and finally dark black. The foot (9-15 × 0.5 cm) is central, cylindrical, hollow, fibrous and whitish. The coating is dry, squamous. The ring is absent. This species was collected on the ground, in the Divo area.

Edibility: The species is edible.
Coprinellus domesticus (Bolton) Vilgalys.

The cap (2-6 Cm) has a conical to convex shape. The color is pale ochre to dark brown. The margin is ridged and cracked, the lining is formed by thick flaky, whitish, creamy-white and finally ochre veil remnants breaking into flakes becoming sharp and colored at the top (Figure 6). The margin is lighter. The blades are free, tight, white then brown-gray and finally black when deliquescent. The flesh is pale, fine and fragile. The foot (3 to 10 cm) is cylindrical, clavate to subbulbous with some brownish traces of the veil, hollow, fragile and whitish. Spores (7-9 x 4-5 µm) are reniform in profile and somewhat cylindrical, light brown. The germinative pore is a bit eccentric. The cheilocystids (30- 100 x 30-60 µm) are vesicular to ovoid. The pleurocystids (50-120 x 30-50 µm) are ovoid. The species was collected on decaying dead wood.

Comestibility: Not edible.
Coprinus plicatilis (Curtis) Fr., 1838 & Hopple, 2001, Syn.: *Agaricus plicatilis* Curtis, 1787, *Parasola plicatilis* (Curtis) Redhead.

The cap (1,8-2,5 cm diameter) is ellipsoid or ovoid at the beginning, then campanulate to convex, plane at the end, sometimes depressed. It is smooth; the color varies from yellowish brown, reddish brown to pale ochre. It is darker in the center and becoming grayish towards the edge. The margin is striated to the center (Figure 7). The blades are free, forming a disk around which they radiate. They are loosely packed and not very deliquescent, grayish beige and then black. The stipe (4-7 x 0.1-0.2 cm) is thin, translucent, smooth, very fragile and weakly bulbous at the whitish base. The flesh is thin, grayish white. Spores (9.9-14 x 7-10 µm) are ovoid lentiform, broadly mitriform, convex or flattened at the base, rounded at the apex, lentiform, smooth, with rounded eccentric germinal pore. Basidia (16-34 x 9-12 µm) are tetrasporic. Cheilocystids are lageniform. The pleurocystids are to ventrous. The species is solitary and has a sweet smell. It was collected in the forest area of Divo and Daloa.

Comestibility: Not edible.
Coprinus auricuma Patouillard (1886); Syn. *Parasola auricuma* (Patouillard) Redhead, Vilgalys & Hopple (2001).

The cap (1.5-4.5 cm in diameter) is brown, creamy brown. The shape is first ovoid then campanulate and finally spread out. It is devoid of veil. The surface is dry, matt, shiny when wet and grooved. The margin is striated to the center. The blades are whitish, later beige-gray, black-brown with age, broad, tightly adnate to free and whitish whole edges. The flesh is grey- brown, thin to membranous. The stipe (5-9 x 2-4.5 mm) is cylindrical, thinned towards the top, hollow, brittle, smooth surface, white adorned with fine longitudinal fibrils, base sometimes faintly felted white (Figure 8). The odor is weak, not typical. The flavor is sweet and slightly rubbery. They are isolated to gregarious on buried wood.

Comestibility: Not edible.

Figure 1: Carpophore of *Coprinus lagopus ;* A : Young carpophore ; B : Adult species

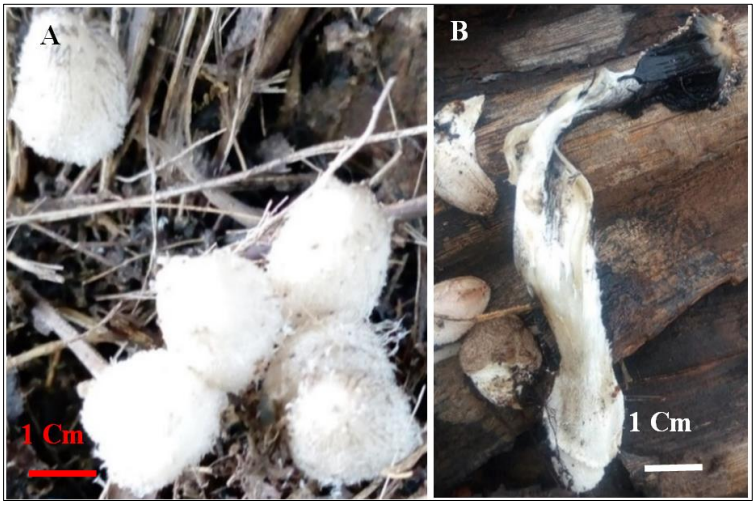

Figure 2: Carpophore of *Coprinus comatus*; A: young appearance; B: adult appearance

Figure 3: Carpophore of *Coprinellus atramentaria*

Figure 4: Carpophore of *Coprinopsis nivea*; A: Young carpophore development on cow dung; B: Young carpophore detached from its support

Figure 5: Carpophore of *Coprinus africanus*

Figure 6: Carpophore of *Coprinellus domesticus*

Figure 7: Carpophore of *Coprinellus plicatilis*

Figure 8: Carpophore of *Coprinus auricuma*

DISCUSSION

This study on the species of the genus Coprinus in the fallow lands and plantations of Daloa allowed the inventory of eight (8) species. These are : *Coprinopsis lagopus* var. vacillans, *Coprinus comatus*, *Coprinellus atramentaria*, *Coprinopsis nivea*, *Coprinus africanus*, *Coprinellus domesticus*, *Coprinus plicatilis* and *Coprinus auricuma.* No studies have been conducted on species of the genus Coprinus in Côte d'Ivoire. In the Daloa forest area, N'Douba *et al.,* (2021) recorded two species of coprinus: *Coprinus nivea* and *Coprinus comatus*. El Akil *et al.,* (2014) in their work on coprinoid fungi of the state forest of the Jerada mining site (North-East Morocco), cited six species. These are *Coprinellus bipellis, C. xanthotrix, C. radians, Parasola plicatilis, Coprinopsis strossmayeri* and *C. comatus*. This variation in the number of species is due to the difference in climate, temperature and plant species. It is also due to the time of year the survey was conducted (De Kesel *et al.*, 2017).

Among the species cited: *Coprinus africanus, C. domesticus and C. auricuma* have been collected in the area (southwestern Côte d'Ivoire). Yian *et al.,* (2020), in their work on the mushrooms of the forest zone of Côte d'Ivoire, cited only one species of coprin: *Coprinus africanus.* Also Pitta *et al.,* (2021), in "Wild Edible Mushrooms and Traditional Knowledge of Southwestern Côte d'Ivoire" cited and described *Coprinus africanus*. This study was conducted specifically in the forest area of Soubré. Soro *et al.,* (2022) in their work in Central-Western Côte d'Ivoire, with the theme "Sale of useful wild mushrooms in Côte d'Ivoire: diversity, availability and socio-economic importance" cited *Coprinus africanus*.

Based on these results, it is noted that *Coprinus africanus* is a typical species of the southwestern and central- western region of Côte d'Ivoire. In the Daloa forest area, N'Douba *et al.,* (2021) recorded two species of coprins: *Coprinus nivea* and *Coprinus comatus*. Of the eight species of the genus Coprinus recorded, four species are edible: *Coprinopsis lagopus* var. vacillans, *Coprinus comatus, Coprinellus atramentaria,* and *Coprinus africanus*. In the case of *Coprinus africanus,* it is sold in the markets and villages of west-central Côte d'Ivoire and its consumption is incompatible with wine drinking (Soro *et al.*, 2022). In Quebec, *Coprinus comatus* is edible when young (Noordeloos *et al.*, 2005). This very good edible (Luo *et al.*, 1991) has been designated as a natural and healthy nutrient by two organizations: Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO) (Liu & Zhang, 2003).

Species of the genus coprinus produce ink at the deliquescence stage. This ink production is due to the abundant production of spore. *Coprin atramentarius* provides the best and largest amount of ink. Other Coprins could do the same but most are too small. *C. comatus* is a species that has a larger size but gives a less black colored ink. This less black coloration is due to a very small amount of suspended spores (Boudier, 2014).

Coprinopsis lagopus var. vacillans, *Coprinus comatus* and *Coprinellus atramentaria were* collected from dead decaying palm trees buried in the ground. Also, *Coprinus africanus* and *Coprinellus domesticus*, *Coprinus plicatilis* and *Coprinus auricuma* were collected from the ground and from plant debris buried in the soil. *Coprinopsis nivea* was collected on cow dung. In Spain, García Blanco (2012) found *Coprinus comatus*, on sunny sand. In Europe (England, Scotland, Northern Ireland), *C. comatus* occurs on soil disturbed especially by humans, or mixed with woody debris, often among grass on roadsides, lawns, and garbage dumps. In Morocco N'Douba *et al.,* (2010) collected *Coprinopsis nivea* on cow dung. Thus *Copronopsis nivea* is the only coprophilous species identified in this paper.

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