Morphological characterization of edible wild mushrooms of the genus *Psathyrella* (Fr.) Quél. discovered in the region of Daloa (Centre-West, Côte d'Ivoire)

ABSTRACT

The aim of this work is to contribute to the study of wild edible Psathyrelles in Côte d'Ivoire. It was conducted in the region of Daloa, a forest area with a tropical climate favorable to the development of fungal species. Data collection took place during the rainy season (April-July). The carpophores were photographed before harvesting in order to observe the macroscopic characters on the different samples. The microscopic study was conducted in the laboratory to observe the reproductive organs. The different specimens were dried afterwards for further observations. The results indicate that five (5) fungal species were collected, they are : *Psathyrella caput-medusae* (Fr.) K.&M. *Psathyrella candolleana* (Fr.) Mre, *Psathyrella tuberculata, Psathyrella atroumbonata* and *Psathyrella piluliformis* (Bull: Fr.). *Psathyrella tuberculata, P. atroumbonata* and *P. piluliformis* have already been cited in Côte d'Ivoire. *P. candolleana and P. caput-medusae* were described in this work for the first time.

Keywords: Psathyrella, Basidiomycetes, Mushrooms, Edible, Daloa

1. INTRODUCTION

In recent years, the interest of Africans in the study of fungi has continued to grow. Indeed, the importance of fungi is crucial in the functioning of ecosystems, but the primary interest of African populations for fungi is the knowledge of edible species (Eyi Ndong *et al*., 2011). Despite the work done on edible mushrooms and the important role they play food-wise and socially in the daily lives of rural populations, data on edible mushrooms are lacking in Côte d'Ivoire (Yian & Tiébé, 2018).

Knowledge of African macromycetes is still very fragmentary. It is not at all exceptional that species consumed by local populations since ancient times are not yet scientifically described (Eyi Ndong *et al*., 2011). The species of the genus Psathyrella are in general thin and not very fleshy. The cap is often hygrophane and more or less campanulate. The margin is sometimes striated but never wrinkled. The blades are more or less adnate and not deliquescent. The spores are brown-black to black sometimes with purple reflections. The cap and the foot are difficult to separate (El-Assfouri *et al*., 2009). Species of this fungal genus are saprotrophic in

their habitat and most grow on soil, wood, and on the feces of various animals (coprophilous species) (Amandeep *et al*., 2013).

Numerous studies have been carried out on fungal biodiversity, but data on the diversity of edible Psathyrelle in Côte d'Ivoire are missing. This lack of survey on Psathyrelle in the consideration of sustainable management programs of fungal resources is a mistake considering the importance and interest of edible species that this genus of macromycetes abounds. The general objective of this article is to contribute to the knowledge of wild edible Psathyrelle and their ecology in the Daloa region.

2. MATERIAL AND METHODS

2.1 MATERIALS

2.1.1 Study Area

The study area is located in Daloa, in the Haut-Sassandra region of west-central Côte d'Ivoire. This city is located between 6°53'58'' north latitude and 6°26'32''W west longitude has an area of 15205 km² (RGPH, 2014). This area is covered by four seasons: a large rainy season (April to July), a small dry season (July to September), a small rainy season (September to November) and the large dry season (December to March). This is a humid tropical zone with dense forest vegetation that is regressively evolving 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 type. The region is experiencing a decrease in rainfall of about 40% (Ligban *et al.*, 2009). The average annual rainfall is between 1100 and 1230 mm, with an average annual temperature 26.7°C (Kouassi *et al.*, 2019). 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). Three experimental sites were chosen: Gonaté, Balouzon and Tazibouo University.

2.1.2 Biological materials

The biological material consists of various varieties of wild mushrooms harvested on the collection sites.

2.1.3 Essentiall equipment

The essential equipment is composed of a knife to detach the mushrooms from their supports. A basket was used to collect the mushrooms. A camera (SAMSUNG STC150F/16,2 MP) was used to take pictures of the mushrooms. The dried mushrooms were stored in plastic bags. A light microscope was used to observe the spores and reproductive organs.

2.2 METHODS

2.2.1 Mushroom collection

Fungal forage were carried out in the forests surrounding the city of Daloa during the rainy season during which fresh carpophores of Psathyrella were collected. The collection took place generally in the morning. The fungal species were photographed prior to their harvest taking care to note their natural habitats. This is particularly important because it is the only time, often ephemeral, during which the specimen is observed in a fresh state.

Harvesting was done with a knife carefully placed under the base of the mushroom stem to avoid damaging it. The different samples collected were cleared of soil and plant debris. Then they were placed in a rigid basket without being compressed or mistreated. The macroscopic characters were taken in the field. They are the aspect in the young state and in the adult state of the cap, the foot, the blades, the flesh and other remarkable features which disappear quickly. The data, concerning the substrate and the mode of development of each sample, were taken before the collection of the carpophores. Fresh samples brought back to the laboratory were described, dried and preserved for later microscopic observations.

2.2.2 Mushroom collection

Microscopic observations in the laboratory concerned the spores, basidia, cystids of the weft and cuticle of the cap. A fragment of mushroom tissue was mounted between slide and coverslip for microscopic observation. Microscopic observations were made on 20 spores for each harvest sample. The mounting fluid was water and the organs were observed at x 400 magnification. Determination and identification were carried out through the books and keys proposed by De Kesel et al. (2002), Malençon & Berthault (1970), Courtecuisse & Duhem (2000), Roux (2006) and Turkoglu et al. (2007).

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 *Psathyrella caput-medusae* (Fr.) K.&M.

The cap has a diameter between 4 to 8 cm. The shape is globular then convex plane. It presents an obtuse nipple, warm brown in the center, paler towards the margin, fibrillomechular, with more or less appressed and labile strands, concolorous to the nipple. The blades are grey-brown then chocolate-brown (**Figure 1**). They are adnate, belly and tight. The brown flesh with aromatic smell is rather strong. The length of the stipe is between 8-10 x 1-1,5cm. It is of cylindrical form a little thickened at the base. The color of the stipe is whitish and covered with scales concolorous to the cap. It presents a white ring colored above in brown, by the spores of size 10-12 x 4,-5,5 µm. It was collected in Gonate in a banana plantation on the ground and is an edible species.

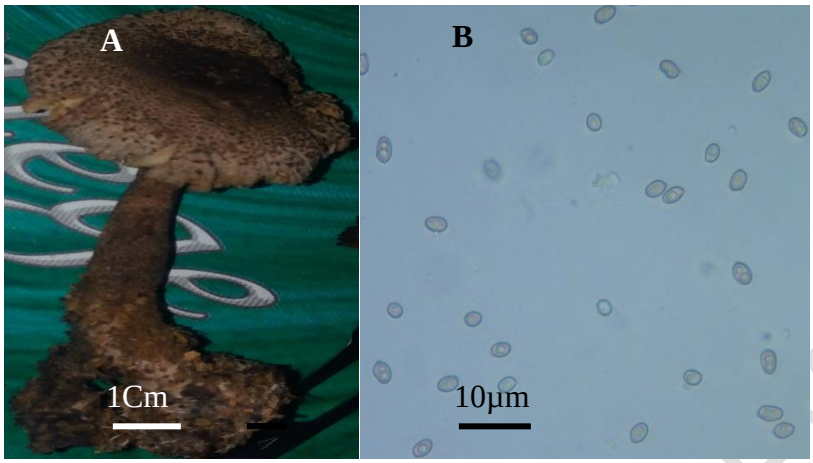

Fig. 1. A: Carpophore of *Psathyrella caput-medusae* and B: Spores (x400)

3.1.3 *Psathyrella tuberculata (Pat) S.H. Sm*

The diameter of mushroom cap was 4 cm. It is brown, dark brown to reddish purple. Its surface is smooth, loaded with squamules in fore of small tubercles. The shape is rounded then campanulate and spreads later, whole and right margin, striolated, white and fine flesh. The blades are white, tight, reaching the top of the foot, white then becoming purple to blackish brown. The foot (7.4 cm) is whitish, cylindrical, arched, hollow, rough, marked with faint squamules, arched (**Figure 2**). It has a spreading, thin, membranous, fringed at the edges, white, persistent ring inserted towards the middle or upper third of the foot. Spores (6-8 x 3 µm) are purple, ovoid, smooth, with a germinative pore. Basidia are hyaline, telespores. Cheilocystids (33.3-36.63 x 10-11.65 µm) hyaline, clavate to fusoid, slight odor, colonizes dead wood.

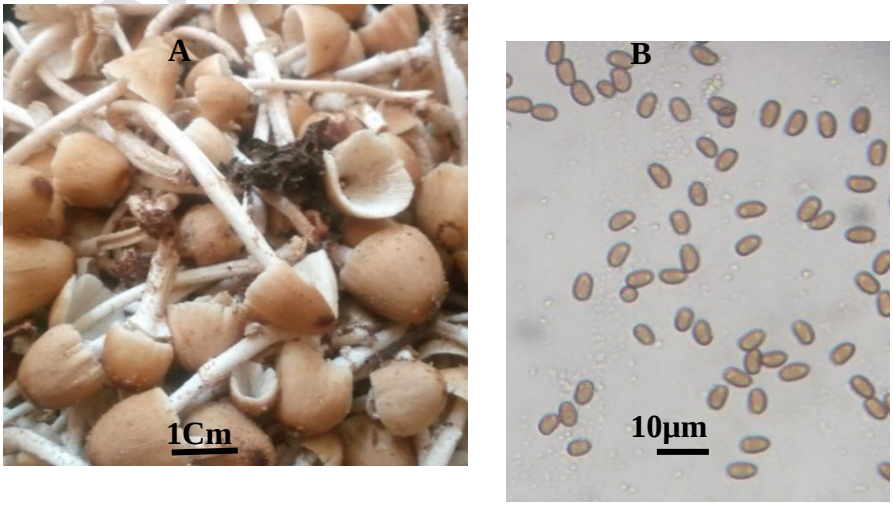

Fig. 2. *Psathyrella tuberculata* (Pat.) A. H. Smith; A: Carpophore; B: Spores (x 400)

3.1.2 *Psathyrella candolleana (Fr. Fr.) Mre*

This mushroom is also called *Agaricus candolleanus* Fr. *Drosophila candolleana* (Fries: Fries) Kühner & Romagnesi (nom. nud.), *Hypholoma candolleana* (Fr.: Fr.) Quél. The cap (0.5 to 2 cm) is whitish or brown, with fine black flesh, conical shape with the presence of white flake (**Figure 3**). The foot (2 to 8 cm) has a white color not voluminous, cylindrical and hollow form. The size of the spores: 0,2 - 0,3 x 3, 33µm. It is a species collected on dead wood (a dead cheese tree).

Fig. 3. ***A and B: Carpophore of Psathyrella candolleana (Fr. :Fr.) Mre***

3.1.4 *Psathyrella atroumbonata Pegler*

The cap (4 cm) is brown to ochre brown, conical to campanulate, surmounted by an obtuse umbo, margin first straight then revolute, slightly striated, coating brown, dry, silky, darker towards the center, flesh very thin, white (**Figure 4**). The blades are adnate, loose, whitish to grayish. There is the presence of numerous uneven lamellae. The edges are crenellated and concolored. The foot (6-7 cm of diameter) is white, cylindrical, hollow, arched. It presents a spread out, thin, membranous, white ring. It is persistent and inserted towards the middle or the superior third of the foot. Spore (8.32-10 x 5 µm) brown an ochre brown, elliptical, double-walled, germinative pore present (**Figure 4**). It grows on dead wood and on the edges of paths. The taste is pleasant.

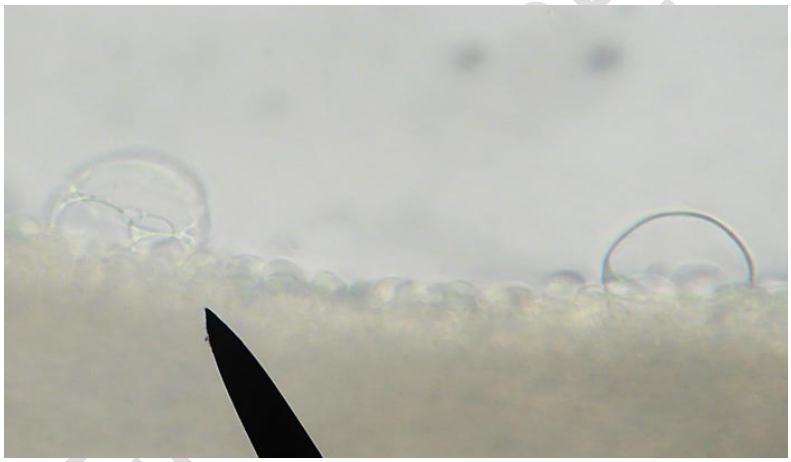

Fig. 4. ***Psathyrella atroumbonata Pegler: A: Carpophores; B: Cheilocystids (x400)***

3.1.5 *Psathyrella piluliformis (Bull. : Fr.) Orton*

The cap is 3 to 5cm in diameter. The shape is convex, campanulate to convex plane. The lining is glabrous, hygrophanous, date brown to brownish ochre and then pale ochre. The margin is often appendiculated with remains of whitish veil (**Figure 5**). The blades are tight, adnate, brown becoming chocolate at maturity. The edges are paler. The length of the stipe is between 6-10 x 0.4-0.6 cm. The stipe is fragile, white, ochraced at the base. The flesh is thin, pale with bitter taste, uncharacteristic

smell. It grows in clumps on plant debris. Spores (5,5-7 x 3-4µm) are brown to ochre, elliptic and double-walled. They present a germinative pore.

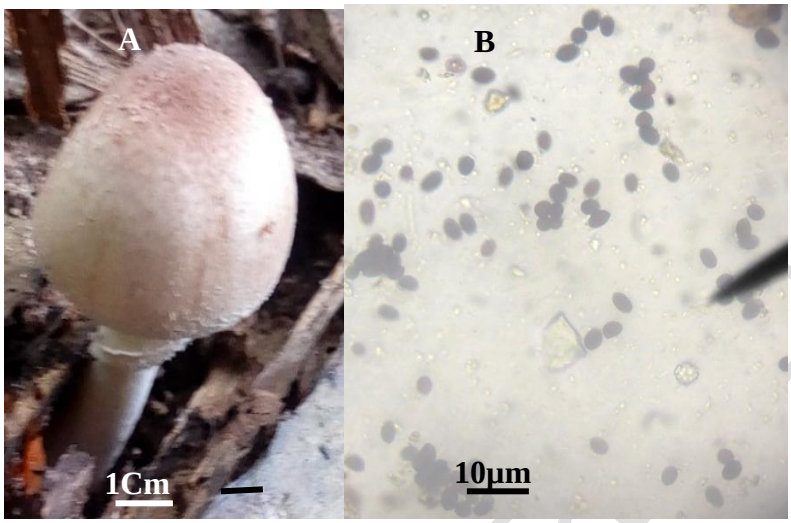

Fig. 5. ***Psathyrella piluliformis (Bull.: Fr.) Orton; A: Carpophores; B: Spores (x400)***

3.2 DISCUSSION

The Daloa region abounds with a significant diversity of wild mushrooms. This diversity is probably due to the forest vegetation and tropical climate conducive to the proliferation of different ecological groups of fungi (Kouamé *et al.*, 2018). According to Loubelo (2012), tropical ecosystems are full of enormous natural resources including non-timber forest products.

In Côte d'Ivoire many works have focused on plant and animal diversity but data on the biodiversity of edible fungi are lacking (Yian & Tiébé, 2018). Kouamé *et al*. (2018) showed that most of the work on edible fungi has generally focused on three species that are very often encountered on the Ivorian market: *Termitomyces le-testui*, *Volvariella volvacea* and *Psathyrella tuberculata.* Despite the work done on edible mushrooms and their roles in the food and social life of rural populations, data on edible mushrooms are insufficient in Côte d'Ivoire (Yian & Tiébé, 2018). According to Fadeyi *et al*. (2017), endogenous knowledge on edible mushrooms is poorly documented in West Africa.

According to Malaisse *et al.* (2008), edible mushrooms are an important part of people's diet. They are non-timber forest products (NTFPs) with a high commercial value (Boa, 2006). They are exploited by rural African populations as food resources (Eyi-Ndong *et al.,* 2011; Yorou *et al*., 2014). They are a source of income thus contributing to the substantial reduction of poverty in rural areas (Boa, 2006; Koné *et al*., 2013).

The seasonality in the appearance of carpophores is a limiting factor for their availability, which is often random and concentrated in a few weeks per year, mainly during the rainy season. In Côte d'Ivoire, as in other regions of Africa, the harvesting period for certain edible mushrooms corresponds to the beginning of the rainy season. This period coincides with periods of famine (N'Douba *et al.*, 2021). Wild edible mushrooms have a great contribution in the life of African populations that in rural West Africa (Yorou *et al*., 2014).

In this study, 5 (five) edible fungi of the genus *Psathyrella* were described in the region of Daloa: *Psathyrella caput-medusae (*Fr.) K.&M., *Psathyrella candolleana* (Fr. Fr.) Mre, *Psathyrella tuberculata* (Pat) S.H. Sm*, Psathyrella atroumbonata* Pegler and *Psathyrella puliformis* (Bull : Fr.). Kane *et al* (2020) in their work on the description of macromycetes of the Niokolo-Koba National Park in Senegal, cited two species of Psathyrella: *Psathyrella atroumbonata, Psathyrella tuberculata.* Also, in their studies on the edible mushrooms of the dense forest of Côte d'Ivoire, Yian and Tiebré (2018) recorded three (03) edible Psathyrella encountered in the Abidjan region. These are: *Psathyrella atroumbonata, Psathyrella tuberculata, Psathyrella puliformis*. El Assfouri *et al* (2009) in their work on the species of the genus Psathyrella cited five (5) species including three (03) new to Morocco: *Psathyrella leucotephra*, *Psathyrella atrolaminata* and *Psathyrella populina*.

4. CONCLUSION

This work is a contribution to the knowledge of wild edible Psathyrelles of Côte d'Ivoire. It allowed to discover the diversity of edible Psathyrelles of the region of Daloa. In total five (5) edible species were identified: *Psathyrella caput-medusae* (Fr.) K.&M., *Psathyrella candolleana* (Fr. Fr.) Mre, *Psathyrella tuberculata, Psathyrella atroumbonata* and *Psathyrella piluliformis* (Bull: Fr.). Among these species are three (03) species already cited in previous studies in Côte d'Ivoire: *Psathyrella tuberculata, Psathyrella piluliformis* and *Psathyrella atroumbonata.* Two (02) new species are cited and described in the present study, they are: *Psathyrella caput-medusae* and *Psathyrella candolleana*.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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