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***Leucoagaricus cf. americanus*, an edible mushroom species poorly known of forest area of Côte d'Ivoire**

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ABSTRACT

This mycological study was realized in order to identify the edible mushrooms of the forest area of Côte d'Ivoire. The itinerant survey was used for the collection of specimens and ecological data. Ethnomycological surveys have permitted to obtain close to local populations the information on the use and sale of edible species. Macroscopic and microscopic descriptions were realized to identify the species collected. The study revealed a little known edible species. The comparison of microscopic elements such as cheilocystidia and cells of pileus coating with those of the literature made it possible to identify the species as *Leucoagaricus cf. americanus*. However, there are only a few differences that could be elucidated by molecular analyzes to better determine our species.

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Keywords: *Leucoagaricus cf. americanus*, ethnomycology, edible mushroom, Abidjan, Côte d'Ivoire.

INTRODUCTION

Tropical ecosystems have a high biodiversity. They constitute the preeminent place as well for harvesting of non-timber forest products (NTFPs). Local populations have a variety of relationships with these NTFPs including food and pharmacopeia (Codjia et al., 2009; Gbesso et al., 2013). Opportunities provided by NTFPs remain under-exploited or neglected (Eyi Ndong et al., 2011; Betti et al., 2016). The fungi, including wild edible mushrooms occupy a special place in the collection of these products. They have nutritional, therapeutic and economic values. They are involved in

eating habits, cultural and medicinal of rural populations (Tiébré, 2001; De Kesel et al., 2002; Boa, 2006). They are also used as wild food during the famine periods for local populations. Indeed, the welfare that provide natural ecosystems to local people, through the services of sampling makes the subject of renewal of interest by the scientific community for several decades. This context has led several studies on edible fungi in tropical Africa (Yorou & De Kesel, 2001; De Kesel et al., 2002; Boa, 2006; De Kesel et al., 2008; Malaisse et al., 2008; Hama et al., 2010).

In Côte d'Ivoire, some work on edible fungi has been made. Indeed Kouakou (2000) was able to demonstrate the anti-fertilizer effects of the extract of two mushrooms (*Daldinia concentrica*, Bolt. 1863 *Psathyrella efflorescens*, Berck. 1977) of the Ivorian pharmacopoeia in the rats. The work of Kouassi et al. (2007) made in the central west, helped to describe 4 new edible species for Côte d'Ivoire in the genus *Chlorophyllum* Mass. Koné et al. (2013) have meanwhile reported the existence of the 7 species of *Termitomyces* kind in the savannah and semi deciduous forests. Kpan Kpan et al. (2014) conducted a study on the contamination of basidiomycetes sold on the markets of Abidjan. Despite this work, the data on the taxonomy, ecology and ethnomycology of the edible mushroom of Côte d'Ivoire remain partial. Thus, in order to contribute to the knowledge of edible mushrooms in the forest area of Côte d'Ivoire, this article highlights *Leucoagaricus cf. americanus*, considered poorly known species.

MATERIALS AND METHODS

Data were collected during small and large rainy seasons of 2014, 2015 and 2016. During these campaigns, *Leucoagaricus cf. americanus* has been collected on the market of Adjamé in the district of Abidjan, Palmafrique in the department of Bingerville (N° 6°3'21.5", W 5°50'48.7") and Bobia in the department of Gagnoa (N° 6°3'21.5", W 5°50'48.7" 17/04/2016). The collection of this species is listed as part of a study that aimed at identifying the edible mushrooms found in the forest area of Côte d'Ivoire. In this study, information on ecology and Ethnomycology of *Leucoagaricus cf. americanus* were recorded in a field book and the collected specimens were transported to the laboratory for macroscopic descriptions from going the description sheet model used by De Kesel et al. (2002). Then, technical photographs were taken. After drying, the species was placed in plastic bags with "mini-grip" closure and stored in appropriate conditions in the

herbarium of the National Floristic Center of the University Felix Houphouët-Boigny. Microscopic analyzes were performed using a optical microscope (Olympus BX51) equipped with a drawing tube and chemical reagents (ammoniac, ammoniacal red Congo). In these analyzes, the spores were observed. The dimensions of the spores, the Q ratio, the average value (in italics) ± 1.96 x standard deviation, minimum - maximum values were observed (bracketed) and the number N of spores was also encoded in the software Excel. The value of Q is used to inform on the form of the spore. More the value of Q tends to 1, more spores are round. The more it tends to 0, they are elongated. Following analysis, the identity of the collected species was confirmed through the work of Vellinga (2000), De Kesel et al. (2002), Kouassi (2012). The species studied was deposited at the Botanical Garden Meise of Belgium.

RESULTS AND DISCUSSION

Description taxonomic

Leucoagaricus cf. americanus (Peck) Vellinga (2000) (Fungi, Basidiomycota, Agaricomycetes, Agaricales, *Leucoagaricus*) (Figures 1 and 2).

Pileus from 3.1 to 5.7 cm of diameter is firstly globular and hemispherical, often conical, and has a umbo; dry coating, can be scaly, flaky, light brown at the margin, dark brown in the center on white background, easily separable. The margin is straight, curved and cracked. White flesh often beige, fleshy, brittle becomes red - brown when crushed or cut. **Lamellae**, simple, are unequal, more or less spaced, white or yellowish. **Annulus**, membranous halfway up the stem, whitish blackened with age (Figure 1). **Stipe**, cylindrical curved, central is full and easily detachable of the cap, becomes red brown when cut, white over the ring and brown below, length of between 5 and 10 cm, uniform base, having dander and fibers on the surface. **Spore print**, white cream, contains smooth ellipsoid spores thick wall with the

presence of germ pore, (7-)6.7-**7.8**-8.8(-9) X (4-)4.2-**5.2**-6.2(-6) μm {N=30} ; Q = (1.33-) 1.22-**1.5**-1.78(-2). Pleurocystidia were not observed.

Appetence

This fungus is harvested in large quantities during the rainy season and then be sold on the markets of Bingerville and Abidjan district. In the Department of Gagnoa, the species has not been seen on the big market of the city, but is instead sold in the village of Bobia at 100 CFA francs the heap, with thirty carpophores. *Leucoagaricus cf. americanus* is consumed and enjoyed by unconditional of edible mushrooms in the study area.

Ecology

It is a saprotroph species that develop in clumps in plantation and forest. It grows in plantations on advanced decaying tree trunks, raids and waste *Elaeis guineensis* decaying. According to information gathered in the field, the species has been observed on waste *Elaeis guineensis* decaying in the locality of Bingerville for the great season precisely at the beginning of May to July and in small raining season from October to November. In the town of Bobia, the species was observed to the beginning of March on dead decaying wood.

Distribution

In Africa, up to now, *Leucoagaricus cf. americanus* was reported in Benin as the *Leucoagaricus braesadolae* (De Kesel et al., 2002). In Côte d'Ivoire, the species has been reported in the localities at Bayota , Bouaflé and Niégré (Kouassi, 2012). In our study area, *Leucoagaricus cf. americanus* was collected on the markets of city of Abidjan and Bingerville. In the commune of Bingerville the species is harvested in an agribusiness

plantation of oil palm and then sold on the local market.

Ethnomycology

The edibility and appreciation of *Leucoagaricus cf. americanus* were reported in Benin. It is a well known species of Beninese population. In Côte d'Ivoire, particularly in district of Abidjan, the common name that the local population attributes to this species is "false false". This name comes from the fact that the species, as *Volvariella volvacea*, grows on palm trees (*Elaeis guineensis*) and it is considered false *Volvariella volvacea*. According Kouassi (2012), *Leucoagaricus cf. americanus* is consumed by Bété, Baoulé and Gouro people in the west central region. However, only the Baoulé assign a vernacular name at this species with a meaning. Indeed, the vernacular name of the fungus provided by the Baoulé people of this region is "akouatika n'dré" which means "turtle mushroom". In the district of Abidjan only the fond of mushrooms consume this species. These last are unanimous on the fact that *Leucoagaricus cf. americanus* has a better taste than *Volvariella volvacea*. *Leucoagaricus cf. americanus* is cooked in any sauce or seasoning as a vegetable ingredient. This is among others the sauce "gombo" (*Abelmoschus esculentus* (L.) Moench, aubergine (*Solanum macrocarpum* L. and *Solanum aethiopicum* L.) seeds and palm (*Elaeis guineensis* Jacq.). Unlike in Benin where two fruit bodies of this species can cost up to 500 CFA francs, in Côte d'Ivoire heap, consisting of ten fruit bodies, varies between 100 and 200 CFA francs on markets visited. It was also reported that this species can fight against diabetes.

Taxonomy

The macroscopic and microscopic characters of the specimen studied correspond

to the characters of the species described by De Kesel et al. (2002). The size and shape of cheilocystidia that we have observed are different from those observed by Vellinga (2000). In our case, long and tapered outgrowths located at the top of cheilocystidia as mentioned by Vellinga (2000) were not observed (Figure 2). However, the size and shape of cells of the pileus covering and spores are close of our specimen. These similarities have allowed to assign the name of *Leucoagaricus* cf. *americanus* to the studied specimen. Note that De Kesel et al. (2002), based on the measurement of the spores and the ecology of his specimen met in Benin, has attributed to his specimen the name of *Leucoagaricus bresadolae*. According to the differences in our work, we may think that our case is different from European and American species. This observation was also made by De Kesel et al. (2002) who indicate that the specimen could be an intermediate species between *Leucoagaricus* and *Leucocoprinus* after noting the differences in the microscopic and macroscopic characters. Vellinga (2000) mentions that studies have highlighted the discriminatory character of *Leucoagaricus bresadolae* and *Leucoagaricus americanus*. Indeed, the study of young buds of *Lepiota americana* (synonym *Leucoagaricus americanus*) conducted by this author showed that cells *Leucoagaricus americanus* coating have a thickness of about 300-400 microns. They also mention that the hyphae of the coating is ascending, thin often intermingled at the surface. This organization sometimes forms a rudimentary trichoderma with upper cells that are not often arranged precisely. This author also mention that the surface of the coating of pileus, the pileocystidia, up to 25 µm of diameter and mixed with more narrow hyphae are not distinct. These cylindrical cells grouped into layers give an appearance of scales, they are also clavate, broadly ellipsoid or ventricular-

fusoïdes length of 77-138 µm. Contrary to *Leucoagaricus americanus*, *Leucoagaricus bresadolae* has a pileique cuticle composed of elongated pileocystides, versiformes the whole forming a clump, which the most are light brown or dark brown at the base. *Leucoagaricus americanus* and *Leucoagaricus bresadolae* has a structure of pileus covering very complex with the shape of the elements varying as well as pigmentation (Vellinga, 2000). Pigmentation of these elements is intracellular and parietal. However, the author notes the differences between these two species. These differences are in the shape the elements pileiques and the elements cystidioecious on the stipe. Although several authors have observed the specifics in the cells of pileus covering of *Leucoagaricus bresadolae* and *Leucoagaricus americanus*, the results of the analysis of molecular data of *Leucoagaricus bresadolae* and *Leucoagaricus americanus* have shown that sequences SES 1 and SES 2 are practically identical. These results have permitted to conclude that *Leucoagaricus bresadolae* and *Leucoagaricus americanus* are similar (Vellinga, 2000). Based on macroscopy, Deschuyteneer (2007), in his study indicated that *Leucoagaricus americanus* is close to *Leucoagaricus meleagris*. Indeed, this author has observed that these species become green with ammonia and that their fruit bodies turn yellow before blushing after having crumpled them. The observation of microscopic characters makes it possible to differentiate *Leucoagaricus americanus* and *Leucoagaricus meleagris*. Unlike *Leucoagaricus meleagris*, *Leucoagaricus americanus* is distinguished by these smaller spores (Deschuyteneer, 2007). Given all these already undertaken, it is important to note that the taxonomy of *Leucoagaricus* genus varies according to the authors. In this context, molecular studies should be addressed to clearly define the taxonomy of this group.



Figure 1 : *Leucoagaricus* cf. *americanus* (Peck) Vellinga (2000), (YIAN171) ; N 5°18'44.8", W3°48'3.4"

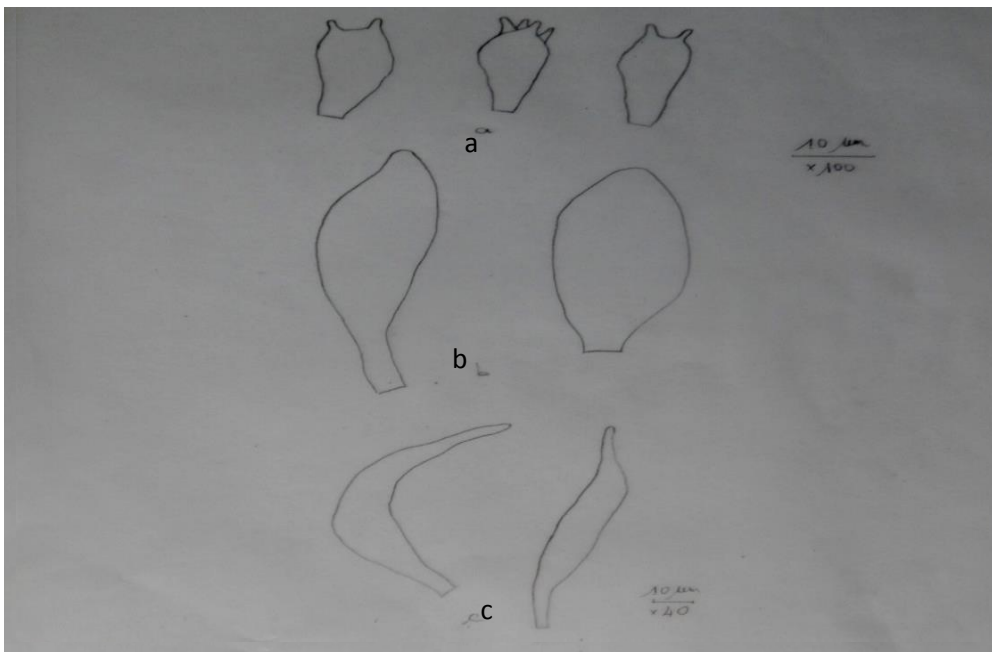


Figure 2: Drawings microscopic elements *Leucoagaricus* cf. *americanus*. a: basidia ; b : cheilocystidia ; c: cap cells coating (YIAN064).

Conclusion

The study conducted in the district of Abidjan allowed to describe a little-known species. Information on taxonomy, ecology and ethnomycology of this species were given. Taxonomically, macroscopic and microscopic descriptions were made. Microscopic elements such as cheilocystidia and cells of pileus covering were compared with those found in the literature permitted to identify the species as *Leucoagaricus* cf. *americanus*. However, some differences were observed between our species and the European and American species. A molecular study of our species could be undertaken to better define the taxonomy of this species.

COMPETING INTERESTS

The authors declare that they have no competing interests concerning this work.

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