



(RESEARCH ARTICLE)



## Status of therapeutic macromycetes in traditional medicine in Daloa (Centre- West, Côte d'Ivoire)

Amako Pauline N'DOUBA <sup>1,\*</sup>, Djako Sosthène Thierry AKRE <sup>2</sup>, N'Dodo Boni Clovis KOFFI <sup>1</sup>, Kouhonon Marie-Flavie BANZA <sup>1</sup>, Allal DOUIRA <sup>3</sup> and Koutoua AYOLIE <sup>1</sup>

<sup>1</sup> *Laboratory for the Improvement of Agricultural Production, UFR Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire.*

<sup>2</sup> *Agrovalorization Laboratory, UFR Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire.*

<sup>3</sup> *Plant and Animal Production and Agro-industry Laboratory. Faculty of Sciences Kenitra, University Ibn Tofail Kenitra, BP 133 Kenitra, Morocco.*

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### Abstract

The objective of this work is to contribute to the knowledge of the superior mushrooms used in traditional medicine in Daloa. The study was carried out using ethnomycological survey forms from 100 practitioners in the city of Daloa. Among these practitioners, 70 people use macromycetes in the formulation of their remedies. The investigations concerned the sex, age of the practitioners and the pathologies treated. The results of this study identified five macromycetes. They are: *Volvariella volvacea*, *Auricularia auricula-judae*, *Psathyrella tuberculata*, *Termitomyces testui*, *Daldinia concentrica* which are commonly used in traditional medicine. These fungal species are used in the treatment of thirteen (13) pathologies. The way macromycetes are used in traditional medicine differs from one practitioner to another. The analysis of the data shows that the age of the practitioners interviewed has no influence on their knowledge of therapeutic mushrooms. Men (52) know more therapeutic species than women (24) and the difference is significant between the two groups.

**Keywords:** Mycotherapy; Traditional medicine; Macromycetes; Traditional practitioners; Pathology; Daloa

### 1. Introduction

Fungi or fungi belong to the kingdom of *fungi*. They are subdivided into two major groups: lower and higher fungi (Falandysz & Borovicka, 2013). The higher fungi contribute to the diet, and play a fundamental role in the health of all forest ecosystems (Koné *et al.*, 2013). More than 3000 mushrooms are consumed worldwide and some show promising therapeutic properties for the treatment of cancer or chronic diseases (Garibay-Orijel, 2009).

Macromycetes have been present in Chinese and Japanese pharmacopoeia for over 2000 years. They were used as food for long life, prolonged youth, sexual vigor and general tonus (Chen *et al.*, 1999). Among these medicinal mushrooms is *Ganoderma lucidum* which was tested in California on AIDS patients (Tardif, 2000). *Cordyceps sinensis*, which has stimulating virtues and anticancer properties, and *Tricholome matsutake*. These fungal species have been the subject of several research studies (Garibay-Orijel *et al.*, 2009). However, little is known about their use in Africa and particularly in Côte d'Ivoire for health care. Although some practitioners claim to use them to treat certain pathologies. To date, there is very little scientific data on the use of macromycetes in the treatment of the above-mentioned pathologies. It is

\* Corresponding author: N'Douba Amako Pauline

Laboratory for the Improvement of Agricultural Production, UFR Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire.

in this sense that this study is intended to promote knowledge of the superior mushrooms used in traditional medicine in Daloa.

## 2. Material and methods

### 2.1. Study site

The present study was conducted in the locality of Daloa. Daloa is located in west- central Côte d'Ivoire. Its climate is tropical and humid. This region is forested, characterized by two rainy seasons. The long season corresponds to the months of May, June and July and the short season to October and November. Rainfall has decreased from 1868.5 mm in 1968 to an average of 1120.4 mm in 2005 (Sangaré *et al.*, 2009). The department is watered by the tributaries of the Sassandra River: the "Lobo" and its branches, the "Dé" and the "Gore", which are present in several localities. The period of flooding corresponds to the rainy seasons, which allow for the replenishment of the soil's water reserves.

### 2.2. Methodology

A questionnaire was developed and interview guides were designed. The questionnaire is the most appropriate tool for quantifying a phenomenon and making it explicit. The questionnaire guide was used to interview 100 traditional medicine practitioners. Among these people, 70 practitioners use mushrooms in the formulation of their remedies. The essential information provided included gender, age, length of time practicing traditional medicine, secondary activity and vocation of the practitioners.

### 2.3. Statistical analysis

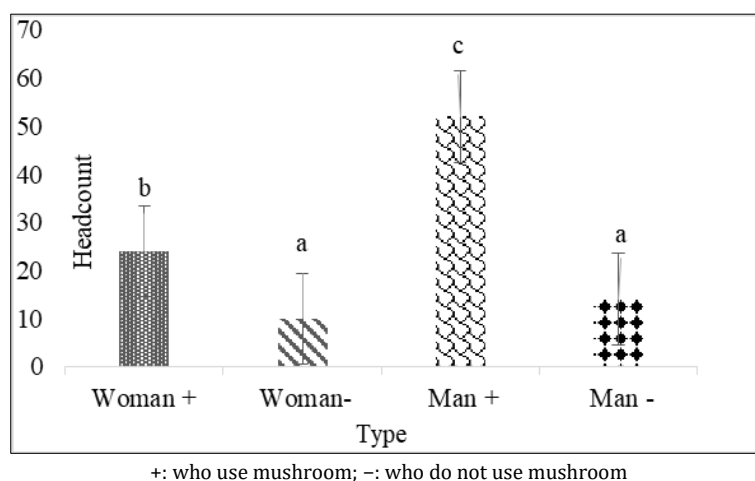
Statistical analysis of the data obtained from the different variables studied was performed with Statistica 7.1 software. A one-factor analysis of variance (ANOVA) was performed. Duncan's test was then performed at the  $\alpha = 0.05\%$  threshold.

## 3. Results

The exploitation of the data has allowed us to gather information on the knowledge and use of mushrooms in traditional medicine, mainly in the city of Daloa.

### 3.1. Level of use of therapeutic mushrooms according to age of practitioners

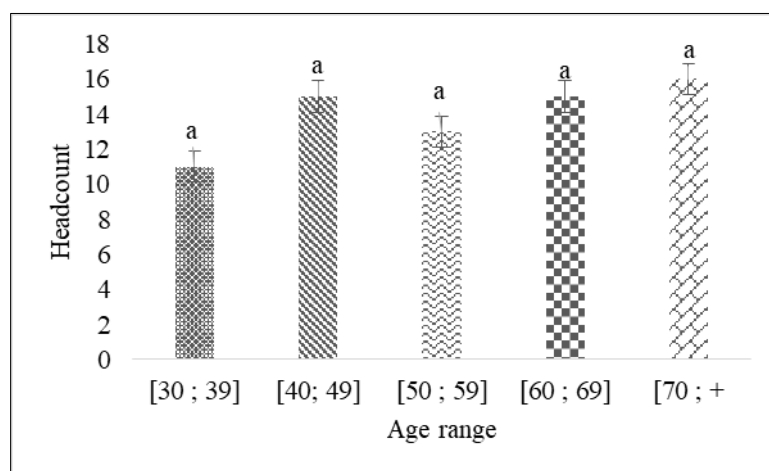
Figure 1 shows the distribution of practitioners, using top mushrooms according to gender. More than half of the respondents practice mycotherapy. According to the investigations, 42 men and 10 women use superior mushrooms in the formulation of their remedies. The survey shows that more men than women use mushrooms. Three groups can be distinguished: the first group concerns men and women who do not practice mycotherapy, they are respectively 14 and 10. The second group concerns women who use mycotherapy; there are 24 of them. The third group is made up of 52 men who use macromycetes.



**Figure 1** Top mushroom use by gender of practitioner

### 3.2. Use of mycotherapy by age of practitioner

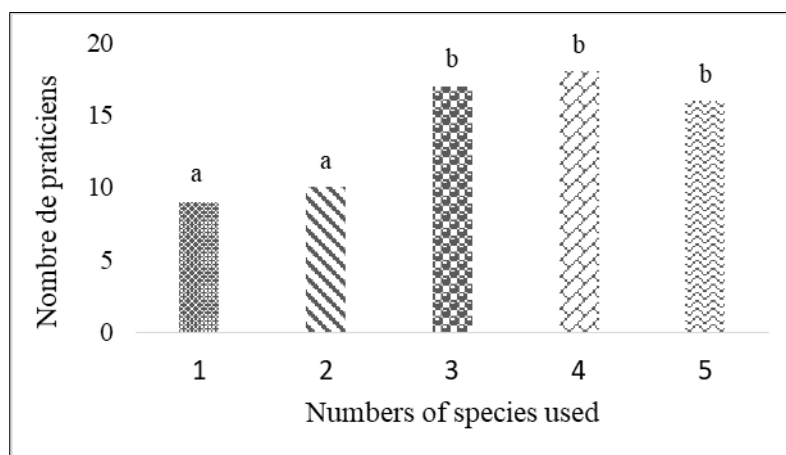
Figure 2 shows the age range of practitioners. The results show that there are 12 practitioners between the ages of 30 and 39. There were 15 practitioners between 40 and 49 years of age. Thirteen (13) practitioners are between 50 and 59 years old. Practitioners with an age between 60 and 69 years are 15. Older people over 70 years old are 16. After analysis, only one group stands out, which implies that the age of the practitioners has no influence on the knowledge of mycotherapy.



**Figure 2** Age range of practitioners

### 3.3. Number of species used in traditional medicine

Figure 3 shows the proportion of species used by practitioners. Two groups can be distinguished : The first group, concerns practitioners who use one or two species of macromycetes to treat patients. They are respectively 8 and 10 in number. The second group concerns practitioners using three or more species in the formulation of their remedies. Those using three species number 17, those using 4 species number 18 and those using 5 species number 16. In total, 51 practitioners use a number of macromycetes greater than or equal to three.



**Figure 3** Proportion of practitioners using macromycetes for the treatment of their patients

### 3.4. Description of fungal species

#### 3.4.1. *Auricularia auricula-judae* (Bull.) Quél.

This species is present in most wetlands. The cap (5 - 7 cm) is gelatinous, smooth of light brown color, fleshy mine. The foot is absent or very short. It is collected on dead wood (Figure 4).

3.4.2. *Termitomyces le-testui* (Pat.) R. Heim

The cap (16 cm) is convex then flattens out at adulthood. It is smooth, brittle with a whitish-brown color in the center. The whitish ring is attached to the foot. Whitish blade is free and tight. The foot (115 cm) is white to creamy white, cylindrical (Figure 5). The smell is strong and pleasant. This species grows on termite mounds.

3.4.3. *Volvariella volvacea* (Bull. Ex. Fr.) Sing S.I.

The cap (3.8-6.2 cm) is conical then campanulate, slightly striated at the margin. It is smooth in the center, brittle, with the shape of a parasol when it is not well opened. The flesh is white, fine and very firm. The blades are free, fine, tight, with intercalated lamellae and lamellae. They are whitish becoming pinkish to salmon when mature (Figure 6). The foot (5.5-6.5 x 0.5-0.7 cm) is white to grey-white, solid and enclosed in a sheathing volva. The foot is thick, cylindrical, smooth and hollow.

3.4.4. *Daldinia concentrica*

The shape is more or less compressed (Figure 7). It is bulbous with a diameter of 2 to 5 cm. The color is dark brown with a russet tinge rapidly becoming black. It has a slightly rough to satiny surface texture, then shiny. It does not have a very significant odor. The dark flesh has concentric areas. It is saprophytic and has black spores.

3.4.5. *Psathyrella tuberculata* (Pat.) A. H. Smith

The cap (4 cm) is brown, dark brown to reddish purple. The surface is smooth, loaded with squamules in the shape of small tubercles. It has a rounded form then campanulate and spreads out thereafter. The margin is whole, right and striated, white and fine flesh. The blades are white, tight, reaching the top of the foot. They are white then becoming purple to blackish brown. The foot (7,4 cm) is whitish, cylindrical, arched, hollow, rough. It is marked by squamules not very prominent and arched. It presents a spread out, thin and membranous ring. It is white, persistent, inserted towards the middle or the upper third of the foot (Figure 8).



**Figure 4** Carpophore of *Auricularia auricula-judae* (Bull.) Quél



**Figure 5** Carpophore of *Termitomyces le-testui* (Pat.) R. Heim



**Figure 6** Carpophore of *Volvariella volvacea* (Bull. Ex. Fr.) Sing S.I.



**Figure 7** Carpophore of *Daldinia concentrica*



**Figure 8** Carpophore of *Psathyrella tuberculata*

### 3.5. Therapeutic mushrooms, diseases treated and how to use them

Table 1 presents the different species used by practitioners and the mode of use according to the pathology. The five mushrooms presented intervene in the following cases: Burili ulcer, asthma, dry cough, pulmonary infections, prostate, renal insufficiency, hemorrhoids; sexual insufficiency, umbilical hernia, fibroma, nerve problem, arterial hypertension and navel ache of babies. The mode of use of these species varies according to the pathology.

**Table 1** Diseases treated and the way macromycetes are used

Species of macromycetes	Vernacular name (Baoulé)	Diseases treated	How to use
<i>Volvariella volvacea</i>	Boyo fêh	Burili's Ulcer	Reduce the dry mushroom to ash, mix it with kaolin or plants. The resulting mixture is applied to the wound of the patient.
<i>Psathyrella tuberculata</i>	N'dré blé	Asthma, dry cough, lung infections	It is added to kaolin and a plant and applied to the diaphragm of the patient. The lightly salted broth is given as a drink to the patient.
<i>Daldinia concentrica</i>	N'zrêlè	Prostate, stomach ulcers, sexual insufficiency, fibroids, umbilical hernia, navel pain in newborns.	Mix with herbs and purge (gastric enemas) once a day.
<i>Termitomyces le-testui</i>	N'glo	Nerve problems, high blood pressure	Boil and drink the decoction
<i>Auricularia auricula-judae</i>	Ahoulouwa soukpô	Advise the elderly, nerve problems and hemorrhoids.	Drink the decoction and eat it cooked

## 4. Discussion

During this study, it was found that five species (*Volvariella volvacea*, *Daldinia concentrica*, *Psathyrella tuberculata*, *Auricularia auricula-judae* and *Termitomyces le-testui*) are an integral part of the macromycetes used in the traditional pharmacopoeia to treat certain pathologies. Yian *et al* (2020) revealed the presence of eleven species used in the traditional pharmacopoeia in the Ivorian forest zone. These are *Auricularia cornea*, *Coprinus africanus*, *Gymnopilus zenkeri*, *Collybia aurea*, *Lentinus squarrosulus*, *Pleurotus tuberregium*, *Psathyrella tuberculata*, *Termitomyces le-testui*, *Termitomyces medius*, *Termitomyces schimperi*, *Volvariella volvacea*.

Hama *et al* (2012) in their work on the use of some species of macromycetes in the traditional pharmacopoeia in western Niger, cited three species of macromycetes (*Ganoderma colossus*, *Phellinus allardii* and *Podaxis pistillaris*) that are widely used in the traditional pharmacopoeia. Indeed, *Ganoderma colossus* and *Phellinus allardii* are used as aphrodisiacs and in the treatment of dizziness and cardiovascular disorders. *Podaxis pistillaris* is used in the treatment of wounds and intestinal worms.

Guissou et al. (2014), in this research on mycotherapy in Burkina Faso, presented eight (08) therapeutic mushrooms. These are : *Daldinia eschscholzii*, *Ganoderma lucidum*, *Ganoderma resinaceum*, *Phellinus pachyphloeus*, *Podaxis pistillaris*, *Lentinus squarrosulus*, *Lycoperdon* sp. e t *Scleroderma* sp. In Nigeria, Ayodele et al. (2009) and Oyetayo (2011) identified about ten (10) species of therapeutic mushrooms during a survey among the Ibos people of the southeast and the Igalas of north central Nigeria. These are: *Pleurotus tuberregium*, *Lentinus squarulosus*, *Termitomyces microcarpus*, *Calvatia cyathiformis*, *Ganoderma lucidum*, *G. resinaceum*, *G. applanatum*, *Schizophyllum commune*, *Volvariella volvacea* and *Daldinia concentrica*.

The age of the practitioners has no influence on the knowledge of mycotherapy. Most of the actors of traditional medicine in Daloa were inspired by empirical knowledge received from former practitioners or grandparents. According to Guissou *et al* (2008) and Yorou *et al* (2002), knowledge is transmitted from generation to generation. In Daloa, the use of these mushrooms varies from one practitioner to another. Some practitioners use the decoction of mushrooms 2 to 3 times a day in the treatment of pathologies. Others combine this mushroom with plants to make an enema. *Psathyrella tuberculata* is used to treat asthma. It is mixed with kaolin and herbs and applied to the diaphragm of the patient. The lightly salted broth is used to treat dry cough and lung infections. According to Hama *et al* (2012), the preparation of mushrooms in Niger requires that the carpophore be softened by soaking in water for several hours. It is then boiled in water. The resulting broth is administered several times during the day. According to Yian *et al* (2020), *Psathyrella tuberculata* is used in the Gagnoa and Soubré region to treat sexual weakness, malaria, coughs, stomach pains, earaches and eye problems. The mushroom is kneaded and then a few drops are applied to the affected area. In Benin, *Psathyrella tuberculata* is indicated in the treatment of bilharzia and epilepsy (Codjia and Yorou 2014).

In Daloa, *Daldinia concentrica* is used in the treatment of the following pathologies: Prostate, Stomach ulcers, sexual insufficiency, fibroids, umbilical hernia, navel pain of newborns. According to Guissou *et al* (2014), *Daldinia eschscholzii* is recommended for navel pain in newborns. In Burkina Faso and Côte d'Ivoire species of the genus *Daldinia* are involved in the treatment of navels of newborns. In the Haut-Sassandra region, *Termitomyces le-testui* is indicated for the treatment of the following conditions: nerve problems and high blood pressure. In the regions of Gagnoa, Soubré and Abidjan, *Termitomyces le-testui* is used to treat blood pressure and general fatigue. The mushroom is prepared in sauce and given to consume (Yian *et al.*, 2020). This indicates that *Termitomyces le-testui* is a mushroom used in Côte d'Ivoire to treat blood pressure. *Volvariella volvacea* is mixed with kaolin or herbs to treat Burili ulcer. The resulting mixture is applied to the wound of the patient. According to studies conducted in the Agboville region, the decoction of *Volvariella volvacea* is used to treat anemia (N'Guessan, 2008). The use of therapeutic mushrooms varies according to the species.

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## 5. Conclusion

This study on macromycetes used in traditional medicine in Daloa has identified five species that are widely used by practitioners. These species are the following: *Volvariella volvacea*, *Auricularia auricula-judae*, *Psathyrella tuberculata*, *Termitomyces le-testui* and *Daldinia concentrica*. The five fungi presented are involved in the following cases: Burili ulcer, asthma, dry cough, lung infections, prostate, kidney failure, hemorrhoids, sexual failure, umbilical hernia, fibroid, nerve problem, high blood pressure and navel ache of babies. The method of use of these species varies according to the pathology. The age of the practitioner does not influence the knowledge of mycotherapy. Most of the actors of traditional medicine in Daloa were inspired by empirical knowledge received from old practitioners or grandparents.

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

There is no conflict of interest

### *Statement of informed consent*

Informed consent was obtained from all individual participants.

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