Scientific Research Publishing

Natural Resources, 2025, 16(6), 193-210
https://www.scirp.org/journal/nr
ISSN Online: 2158-7086
ISSN Print: 2158-706X

Nutritional Significance of Wild Edible Mushrooms in the Mungo Department, Littoral Region, Cameroon

Anique Blonde Mboumen[1], Patrice Brice Mvogo Ottou[1], Zenabou Ndiang[1*], Teclaire Ngouondjou Foze[2], Giresse Ledoux Nanda Djoumou[1], Oscar Simplice Wamba Fotsop[1], Armand Ngueuleu Deuheula[1], Audrey Mbang Mbarga[3], Achille Nyouma[1], Jacques Bruno Ngotta Biyon[1], Charles Carnot Asseng[1]

[1]Biology and Physiology Laboratory of Plant Sciences, Faculty of Sciences, University of Douala, Douala, Cameroon
[2]Department of Medical and Health Studies, University Institute of the Gulf of Guinea (IUG), Douala, Cameroon
[3]Department of Biochemistry, Faculty of Science, University of Douala, Douala, Cameroon
Email: *ndizena@yahoo.fr

How to cite this paper: Mboumen, A.B., Mvogo Ottou, P.B., Ndiang, Z., Ngouondjou Foze, T., Nanda Djoumou, G.L., Wamba Fotsop, O.S., Deuheula, A.N., Mbang Mbarga, A., Nyouma, A., Ngotta Biyon, J.B. and Asseng, C.C. (2025) Nutritional Significance of Wild Edible Mushrooms in the Mungo Department, Littoral Region, Cameroon. *Natural Resources*, **16**, 193-210.
https://doi.org/10.4236/nr.2025.166010

Received: May 3, 2025
Accepted: June 16, 2025
Published: June 19, 2025

Abstract

This study examines the nutritional composition of wild edible mushrooms in the Mungo Department, evaluating their role in food security and public health. Wild mushrooms, especially those from the Pleurotus genus, are known for their high protein, vitamins, minerals, and bioactive compounds. An ethno-mycological survey was conducted across five towns (Loum, Manjo, Njombé, Nkongsamba, and Souza) with 153 respondents to assess local knowledge, collection, and consumption practices. Mushrooms were harvested using traditional methods, and then analyzed for macronutrients (moisture, crude fiber, protein, lipid, carbohydrates) and key minerals (calcium, iron, potassium). The results showed that the mushrooms are rich in essential nutrients, particularly proteins, fibers, and minerals, making them valuable for dietary diversity and nutrition. Statistical analysis revealed significant variations in nutrient content across species, emphasizing their potential as an alternative protein source. The findings underscore the nutritional importance of these fungi in combating malnutrition and enhancing food security, particularly in the face of climate change and economic challenges. Further research on sustainable harvesting and cultivation practices is recommended to improve availability and conservation.

Keywords

Wild Edible Mushrooms, Nutritional Composition, Mungo Department, Food Security, Ethno-Mycology

1. Introduction

Forest ecosystems serve as vital reservoirs of biological resources, encompassing fauna, flora, and fungi that significantly contribute to local subsistence and economic activities [1]. Among these resources, wild edible mushrooms, classified as non-timber forest products (NTFPs), are of considerable nutritional and economic importance. Their collection and consumption have deep cultural and historical roots, with evidence dating back to ancient civilizations [1]-[3]. Archaeological discoveries in Chile suggest that mushrooms were associated with human diets over 13,000 years ago, and records from China indicate early documentation of mushroom consumption [4]. In sub-Saharan Africa, approximately 551 edible mushroom species have been documented, highlighting their significance in nutrition, pharmacology, and economic sustenance [5]-[8]. In southern Cameroon, 94 wild edible mushroom species have been identified for their nutritional and medicinal properties [1].

Wild edible mushrooms are esteemed for their symbiotic and saprophytic relationships, culinary appeal, and medicinal properties [9]. They are recognized as excellent protein sources [10] and contain higher concentrations of vitamins, micronutrients, and trace elements than several conventional vegetables [10] [11]. Species of the Pleurotus genus, in particular, are characterized by low-fat, low-calorie, low-sodium, and cholesterol-free compositions, making them beneficial for weight management and cardiovascular health [12]. Furthermore, bioactive compounds such as non-starch polysaccharides and flavonoids present in mushrooms exhibit anticancer, antioxidant, and anti-hyperglycemic properties [13]-[15]. These attributes enhance their economic potential, fostering commercialization in both developing and industrialized nations [7] [16].

The increasing impacts of climate change on agricultural productivity, coupled with economic instability, have exacerbated protein shortages and dietary deficiencies, contributing to the rise of metabolic disorders and oxidative stress-related diseases in urban and rural populations [14] [15]. In this context, wild edible mushrooms represent a sustainable alternative protein source, often referred to as the "meat of the farmer" in African communities [7] [17]. Studies from Malawi indicate that 1.3 kg of wild mushrooms can sustain a family of four for two weeks [5], while in Mozambique, annual per capita consumption ranges between 72 and 160 kg [5]. Despite their widespread use, comprehensive data on their diversity, seasonal availability, and ecological dynamics remain limited [1].

In Cameroon, research has largely focused on cataloging and taxonomic classification of wild edible mushrooms [1] [3]. However, studies predominantly target exotic species, often overlooking indigenous fungi [13]-[15] [18]. The Mungo Department, an ecologically favorable region for mushroom growth, remains understudied in terms of the identification, nutritional profiling, and valorization of its native edible fungi. This study aims to assess the nutritional composition of select wild edible mushrooms in the Mungo Department, highlighting their potential contributions to food security and public health.

2. Materials and Methods

2.1. Materials

2.1.1. Study Site Description

The Mungo Department in the Littoral Region of Cameroon, with Nkongsamba as its administrative capital, spans 3.723 km^2 and includes 12 municipalities. Nkongsamba, Loum, and Mbanga are the primary urban centers. The region is home to diverse ethnic groups such as the Abo, Bakem, Balong, Baneka, Bareko, Bo, Bong, Keng, Elong, Mancha, and Mbo communities. Mungo experiences a tropical climate, characterized by a three-month dry season and a nine-month rainy season [19]. Its sandy soils, derived from the sandstone parent rock, exhibit high permeability and low water retention. The vegetation is predominantly lowland rainforest. (**Figure 1**)

2.1.2. Survey and Biological Materials

A semi-structured survey form with 3 headings was submitted to the population. It included information about the respondents (sex, age, ethnic group, profession, etc.), information about the mushrooms (type of mushroom, name in local language, taste, shape, habitat, etc.) and information about other uses and virtues of the mushrooms, factors that encourage their growth and factors that can alter their quality.

The biological material consisted of wild edible mushrooms harvested in the Mungo and two species of Pleurotus commonly grown in Cameroon: *Pleurotus pulmonaris* and *Pleurotus floridanus*.

2.2. Methods

2.2.1. Survey and Mushroom Collection

An ethno-mycological survey was conducted among mushroom collectors, vendors, and consumers in Loum, Manjo, Njombé, Nkongsamba, and Souza. Thirty knowledgeable respondents were selected from each town, excluding individuals with no expertise in mushroom identification. Demographic information such as age, sex, ethnicity, occupation, and marital status was collected [7]. Snowball sampling began with market vendors, who facilitated connections to harvesters and distributors. Interviews were conducted in French, English, and occasionally local languages such as Mbo'o and Bagangté.

Mushroom specimens were collected by local harvesters using traditional methods, with efforts made to preserve key morphological features for accurate identification [1] [9]. Fresh samples were described and photographed in situ before being transported to the laboratory for analysis. Some were preserved in 50% ethanol [1].

2.2.2. Nutritional Analysis

Macronutrient composition (moisture, dry matter, crude fiber, protein, lipids, and carbohydrates) was analyzed using standard methods. Moisture and dry matter were determined via thermogravimetry [20], and crude fiber through digestion

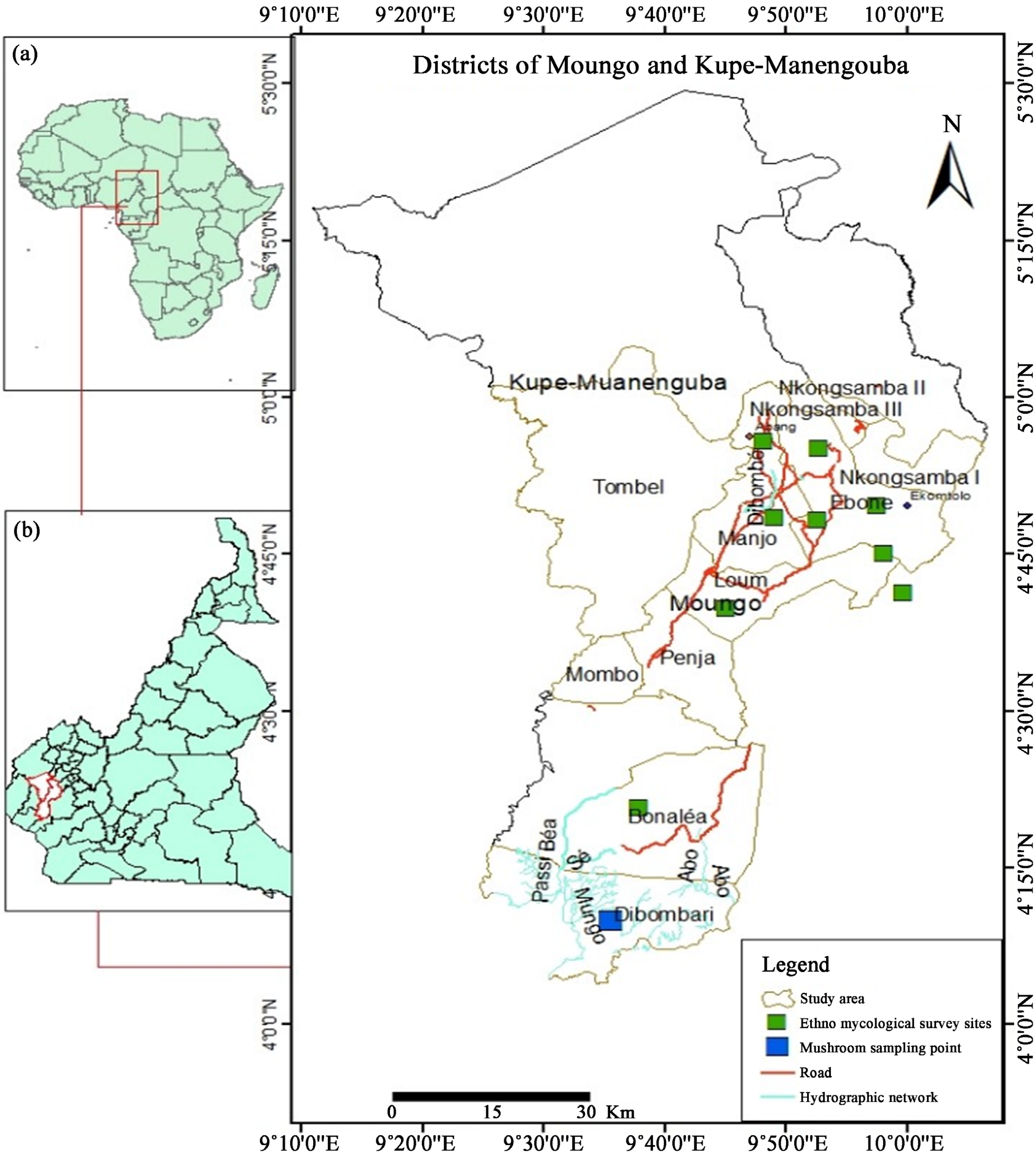

Figure 1. Areas covered by surveys and mushroom harvests. (Source: the author)

with sulfuric acid and sodium hydroxide [21]. Protein content was measured by the Kjeldahl method [22], and lipids were extracted using a Soxhlet apparatus [23]. Carbohydrate content was derived by difference [22]. Mineral analysis was performed through incineration at 450˚C, followed by atomic absorption spectrometry for Ca, Mg, Fe, and Mn, and flame emission spectrometry for K and Na [22] [24].

2.2.3. Statistical Analysis

Experiments were conducted in triplicate, with data presented as mean ± standard deviation (SD). Statistical analyses were performed using STATGRAPHICS Centurion XV version 17.1.12. One-way ANOVA, followed by Fisher's Least Significant Difference (LSD) post-hoc tests, was applied, with significance set at $p < 0.05$.

3. Results

3.1. Indigenous Knowledge of Wild Edible Mushrooms

3.1.1. Profile of Respondents

The breakdown of survey respondents by site was based on criteria such as gender, age, ethnicity, and profession. The majority of survey respondents were adults (52.28%), with 51.00% of them being women and 49.00% men. The respondents belonged to four main ethnic groups, the most represented of which were the Western High Plateau Forest people (55.55%). Survey respondents were primarily traders (51.63%) or farmers (47.50%) (**Table 1**).

The data includes respondents from various localities, categorized by gender, age, ethnic group, and profession. The survey respondents were primarily young, adult, and elderly individuals, with men and women from diverse ethnic backgrounds including the Mbo'o, Bakaka, and other local ethnicities. Their professions primarily involved trading, cultivating crops, and driving.

Table 1. Socio-demographic characteristics of survey respondents.

Survey sites	Characteristics of respondents											
	Sex		Age			Ethnic group				Profession		
			Young	Adults	Old	Littoral	West	No	Centre	T	Cul	D
Souza	M	12	0	8	4	8	2	2	0	6	6	0
	W	18	3	9	6	8	7	2	1	10	8	0
Njombe	M	24	2	18	4	16	7	1	0	4	20	0
	W	6	0	5	1	4	1	1	0	1	5	0
Loum	M	10	1	2	7	0	10	0	0	6	4	0
	W	20	1	4	15	0	15	5	0	10	10	0
Manjo	M	17	3	10	4	6	11	0	0	9	6	2
	W	16	3	10	3	5	10	1	0	11	5	0
Nkongsamba	M	12	1	8	3	2	8	2	0	12		0
	W	18	9	6	3	4	14		0	10	8	0
Total		153	23	80	50	53	85	14	1	79	72	2

NW = North-West, M = Men, W = Women, T = Traders, Cul = Cultivators, D = Driver.

3.1.2. Wild Edible Mushrooms Mentioned in Mungo

The people of Mungo described eight varieties of mushrooms based on characteristics such as size, colour, habitat, and fruiting period (**Figure 2**). In Souza, all 30 interviewees mentioned size, colour, and habitat to describe four edible wild mushrooms. In Njombé, 40.00% of interviewees described two species according to size, recognizing small and large mushrooms. In Loum, 33.33% of interviewees described four mushrooms, including those growing on rotting palm tree trunks, decomposing wood, and during the August and April fruiting periods. In Manjo, 40.63% of interviewees described two mushrooms based on criteria such as colour (black and white) and size (small and large).

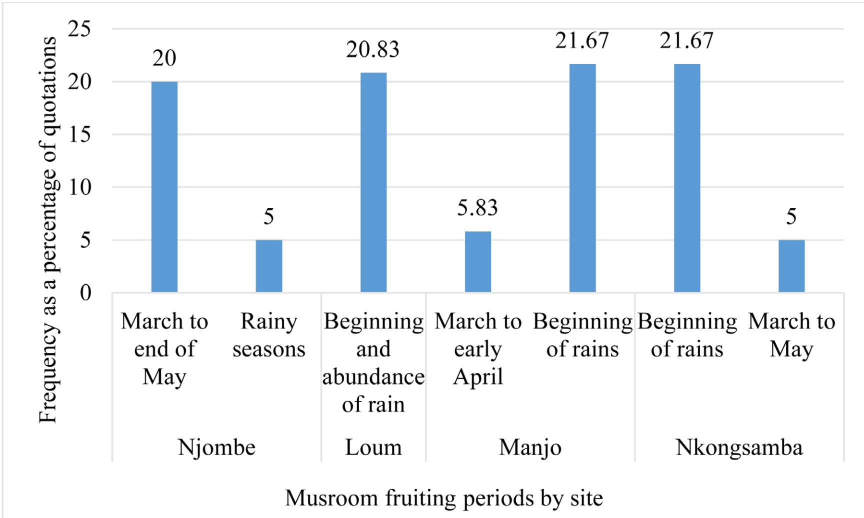

Figure 2. Mushroom fruiting period in different towns.

In Nkongsamba, 40.00% of interviewees described two mushrooms using colour (white and/or black) and size (small and large) (**Table 2**). The table outlines the number of mushroom species recognized by respondents from each locality and their respective recognition criteria, such as size, colour, habitat, and fruiting period, as well as the vernacular names used by the ethnic groups. Fields were commonly recognized as the biotopes for mushroom fruiting. In Njombé, fallow fields (33.33%) and fields with termite mounds (33.33%) were considered favourable for mushroom growth. In Manjo, 33.00% of respondents mentioned the presence of termite mounds, while 40.00% noted the abundance of fungi in maize and cassava fields. In Loum, respondents (60.00%) mentioned well-cleaned fields with termite mounds as ideal for fungal growth. In Nkongsamba, some respondents (38.50%) emphasized the presence of fungi in palm groves, particularly under palm trees and nut stalks.

Regarding the appearance and abundance of wild edible mushrooms, respondents in Njombé (80.00%) stated that mushrooms bear fruit from March to May. In Loum, respondents (80.00%) indicated that mushrooms typically appear and are abundant at the beginning of the rains.

3.1.3. Harvesting Wild Edible Mushrooms

The majority of respondents (79.00%) stated that harvesting wild edible mushrooms was simple and easy. They noted that anyone could harvest them as long as they followed the correct technique, which involves carefully pulling the mushroom from the ground using a knife or machete, depending on the size of the

Table 2. Different species of edible wild mushrooms by locality.

Localities	NC	F (%)	Recognition criteria	VEG
Souza	4	100.00	Size (small and big) Colour (white, black) Habitat (decaying tree trunks, palms/or nut stalks, termite mounds)	No vernacular name used
Njombe	2	40.00	Size (small and large)	- Kounda and/or Shuen (Mbo'o) - Yo'or (Bakaka)
	3	20.00	Colour (white, black)	
	4	20.00	Habitat (rotting tree trunks, maize fields, palms/or nut stalks, termite mounds)	
	8	20.00	No recognition criteria mentioned	
Loum	1	16.67	No recognition criteria mentioned	- Ojueng (Bamenda) - Puoh (Dschang) - Po'o (Mbouda)
	2	16.67	No recognition criteria mentioned	
	3	16.67	No recognition criteria mentioned	
	4	33.33	Fruiting period (April, August) Habitat (rotten palms, decaying tree trunks)	
	5	16.67	No recognition criteria mentioned	
Manjo	1	31.25	Colour (white and/or black) Size (big and/or small)	- Kokobianko (Badjoun) - Broug (Bagangté) - Kounda (Mbo'o) - Yor (Mbo'o) - Linguepo'o and /or Po'o (Mbouda)
	2	40.63	Colour (white, black) Size (big and small)	
	3	15.63	Colour (white, black) Habitat (woods, oil palms and maize fields)	
	4	9.38	Habitat (palm trees, woods, cocoa and maize fields) Colour (white and black)	
	5	3.13	Habitat	
Nkongsamba	2	40.00	Colour (white and black) Size (small and big)	- Po'o (Mbouda and Bangou) - Kounda (Mbo'o) - Broug (Bagangté)
	3	6.67	Colours (black and white) Size (small and big)	
	4	13.33	Habitats (decaying wood, termite mounds, palms)	
	5	6.67	No recognition criteria mentioned	

NC = Number of CSCs, FPC = Frequencies as a percentage of citations, VEG = Vernacular Names by Ethnic Group.

mushroom (Figure 3).

For 52.50% of interviewees, the best time to harvest mushrooms depended on the type of mushroom. This period was typically within 24 hours of the appearance of the carpophores, as they deteriorate quickly. However, some respondents indicated that the appearance of carpophores did not necessarily indicate the maturity of the mushrooms. In Njombé, for instance, 50.00% of interviewees recommended harvesting mushrooms 3 to 4 days after the appearance of the carpophores, while

50.00% said that the mushrooms should be left to mature for a week. Factors such as maggots, caterpillars, and ants were cited by interviewees as potential threats to the quality of mushrooms (**Figure 4**).

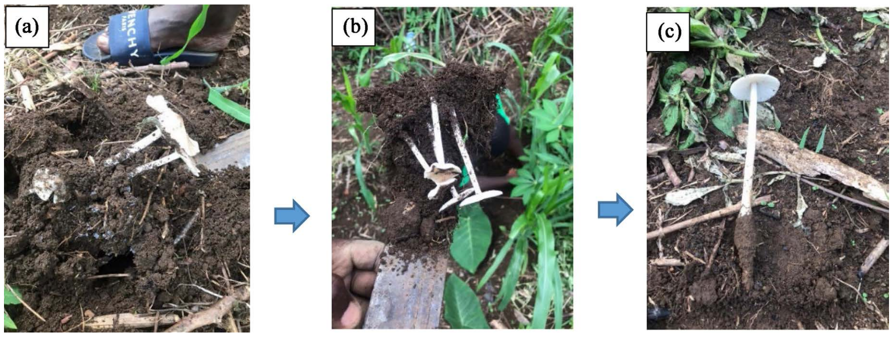

Figure 3. Illustration of the harvesting of a mushroom as indicated by a harvesting respondent. (a) Use of the machete to remove the mushroom with its entire foot from the ground; (b) mushrooms removed from the ground; (c) mushroom isolated from the substrate.

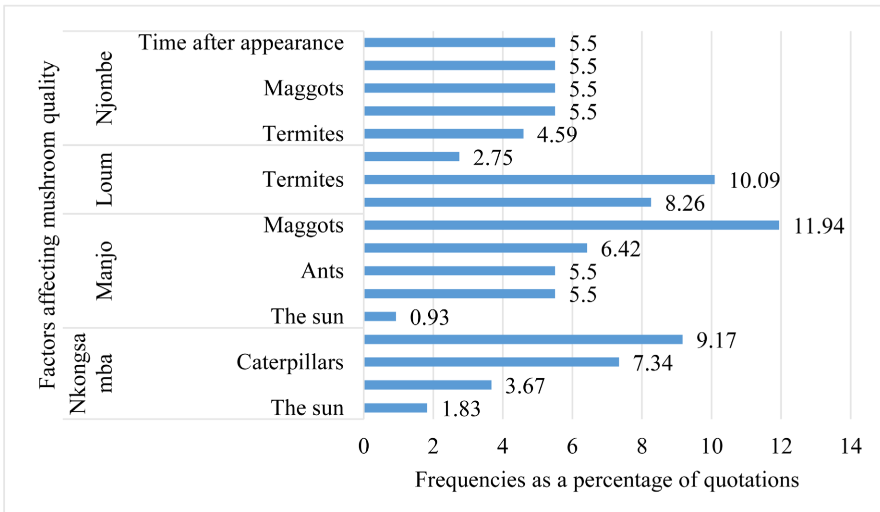

Figure 4. Factors affecting mushroom quality.

3.1.4. Description and Identification of Wild Edible Mushrooms

Several wild edible mushroom species were identified based on their macroscopic characteristics (**Figure 5**). These fungi can be described as follows:

- *Armillaria heimii* Pegler (Physalacriaceae): A saprophytic fungus that grows on dead wood, exhibiting a cespitose lifestyle. The cap, slightly depressed at the center, starts dark brown and lightens to orange-brown, with the center remaining dark. The white lamellae have pinkish hues, and the flesh is thin and creamy white. The cylindrical, hollow stalk is white at the top and brownish-orange at the base, measuring 3 to 5 cm long. The mushroom emits a strong odor (**Figure 5(a)**).

- *Auricularia cornea* Ehrenb. (Auriculariaceae): This fungus grows in clusters on decaying tree trunks. The ear-shaped cap is smooth, sticky, and has a cartilaginous, elastic consistency. Initially shiny, it turns powdered white. The mushroom lacks lamellae and has no distinct odor. The foot is short or nearly absent (**Figure 5(b)**).

- *Marasmiellus inoderma* (Berk.) Singer (Marasmiaceae): This fungus grows in groups on decaying tree trunks, including oil palms (*Elaeis guineensis*). The cap starts convex and then flattens with a hollow center. It has a smooth, powdery coating that changes color from orange to white with a pinkish tint. The spaced, flexible lamellae are white, turning pale yellow as they dry. The fibrous, white flesh has a strong, pleasant odor. The short stalk is sub-central and cylindrical (**Figure 5(c)**).

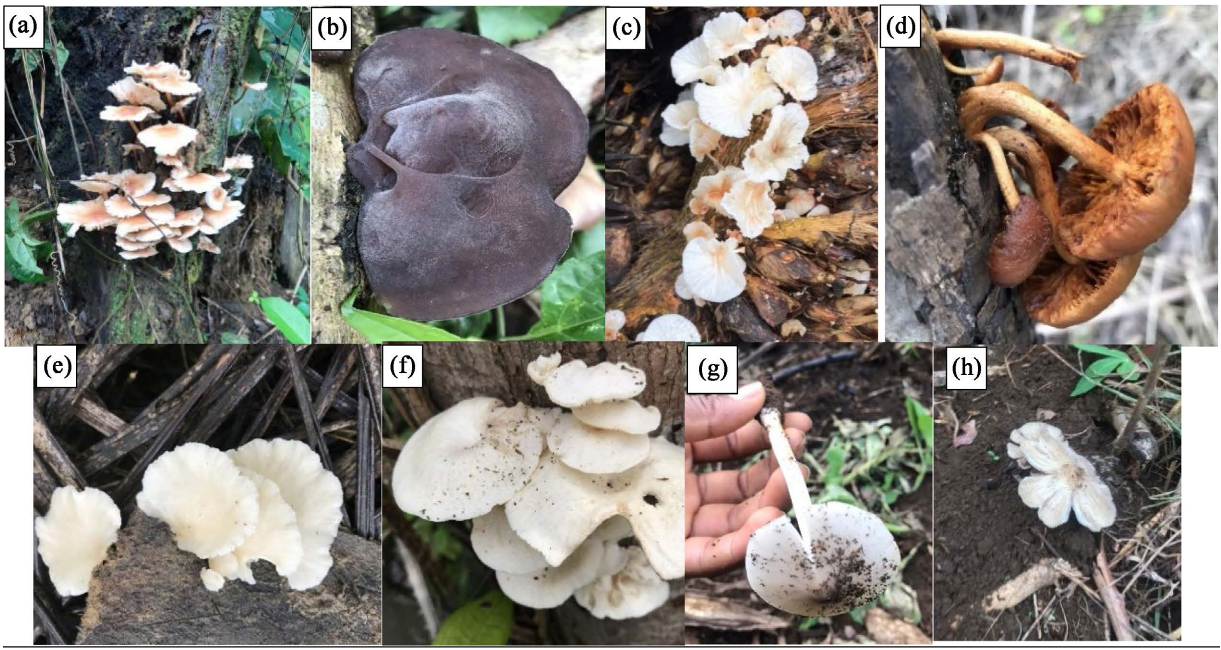

Figure 5. Various edible mushrooms known to Mungo populations. (a) *Armillaria heimii*; (b) *Auricularia cornea*; (c) *Marasmiellus inoderma*; (d) *Phylloporus rhodoxanthus*; (e) *Pleurotus pulmonarius*; (f) *Pleurotus squarrosulus,* (g) *Termitomyces fragilis*; (h) *Termitomyces striatus*.

- *Phylloporus rhodoxanthus* Schwein. (Bres.) (Boletaceae): A saprophytic fungus growing in clusters on palm stalks. The initially convex cap flattens with age, forming a small depression and developing cracks when ripe. The yellow flesh turns reddish quickly. The stalk is long and yellow from ring to base (**Figure 5(d)**).

- *Pleurotus pulmonarius* (Fr.) Quél (Pleurotaceae): This fungus grows in groups on decaying tree trunks. The large, initially convex cap flattens out, and the decurrent lamellae are prominent. The stipe is very short, slightly offset from the center of the cap (**Figure 5(e)**).

- *Pleurotus squarrosulus* (Mont.) Singer (Pleurotaceae): This species grows in clusters on decaying tree trunks. The cap, depressed in the center, is fleshy and brittle when dry. The flesh is elastic in the cap and leathery in the stem. The decurrent lamellae are arched, tight, and uneven. The central, ringless foot is sometimes stained brown at the base, with a pronounced, agreeable odor (**Figure 5(f)**).

- *Termitomyces fragilis* L. (Lyophyllaceae): A symbiotic fungus growing in soil with decomposing litter, often under termite nests. The conical cap flattens at maturity, with a small obtuse perforatorium. It has a brownish-grey or greyish-brown surface, darkening at the center with white filamentous streaks. The flesh is white to cream, fibrous in the cap, and leathery in the stem. The cylindrical, central foot is root-shaped (**Figure 5(g)**).

- *Termitomyces striatus* (Beeli) Heim (Lyophyllaceae): Another symbiotic species, *Termitomyces striatus* grows on termite mounds. The firm, fleshy cap starts conical and becomes nearly flat before becoming depressed around the perforatorium, which is sharp. The cap has radial tears up to mid-radius, and the coating is separable at the perforatorium. The uneven, tight lamellae are loose. The white flesh is soft in the cap and fibrous in the stem. The central foot is massive, smooth, fibrous, and lacks a ring (**Figure 5(h)**).

3.1.5. Frequency of Appearance of Wild Edible Mushrooms

The eight species of wild edible mushrooms were not equally known to all the populations across the sites visited. Only the people of Njombé were familiar with all eight species. The same vernacular name was sometimes used to refer to multiple species, and vice versa. *Armillaria heimii* was known as 'Linguepo'o' and/or 'Po'o' in Mbouda, while *Marasmiellus inoderma* was called 'Po'o' in Mbouda and 'Puoh' in Dschang (**Table 2**).

The species *Auricularia cornea* and *Pleurotus pulmonarius* were found across all sites, with *Auricularia cornea* being the most widely consumed and known species, appearing in 24.67% of citations. The populations of Souza and Loum were the most frequent consumers of this species. *Pleurotus pulmonarius* was the second most cited species, appearing in 19.33% of citations, and it was particularly popular among respondents in Souza (**Table 3**).

This table outlines the number of citations for each species of mushroom by locality, with specific vernacular names provided for each ethnic group.

Table 3. Number of citations per fungus.

Scientific names	VEG	Souza	Njombe	Loum	Manjo	Nkongsamba	Total	FPC
Armillaria heimii	Linguepo'o et/ou Po'o (Mbouda)	-	2	10	-	4	16	10.67
Auricularia cornea	Kokobianko (Badjoun), Yo'or (Bakaka)	10	7	8	6	6	37	24.67
Marasmiellus inoderma	Po'o (Mbouda), Puoh (Dschang)	6	3	-	2	-	11	7.33
Phylloporus rhodoxanthus	Kokobianko (Bandjoun)	-	3	2	-	5	10	6.67
Pleurotus pulmonarius	Kounda et/ou Shuen (Mbo'o)	8	4	5	5	7	29	19.33
Pleurotus squarrosulus	Shuen (Mbo'o)	-	1	-	-	8	9	6.00
Termitomyces fragilis	Kounda (Mbo'o), Ojueng (Bamenda)	-	5	5	8	-	18	12.00
Termitomyces striatus	Broug (Bagangte), Puoh (Dschang)	6	5	-	9	-	20	13.33

3.2. Importance of Wild Edible Mushrooms

3.2.1. The Therapeutic Importance of Edible Wild Mushrooms

In Loum, 40.00% of respondents stated that wild edible mushrooms were used in decoctions to treat stomach aches and clear mucus from the kidney girdle. They also noted that broths made with fresh mushrooms were beneficial for diabetics and hypertensives. In Manjo, 43.00% of interviewees suggested that mushrooms should be prioritized in the diet of the elderly, while 12.00% recommended mushrooms for people in the early stages of cancer. In Nkongsamba, 12.50% of respondents believed that mushrooms were beneficial for hypertensive patients, 5.88% for diabetics, and 12.50% for the elderly. Most interviewees (69.00%) reported no undesirable effects from consuming mushrooms, but some mentioned issues such as bloating (18.00%), indigestion (10.00%), and allergies (03.00%) when consumed excessively.

3.2.2. Nutritional Values of Edible Wild Mushrooms

The two species most frequently cited by the populations were *Auricularia cornea* and *Pleurotus pulmonarius*. These species were also the most abundant in terms of fresh material harvested, with *Auricularia cornea* yielding 900 g and *Pleurotus pulmonarius* 580 g. The nutritional comparison between these wild mushrooms and cultivated species such as *Pleurotus pulmonarius* and *Pleurotus floridanus* revealed several differences.

The dry matter content of cultivated mushrooms was significantly higher than in wild species, with cultivated *Pleurotus pulmonarius* and *Pleurotus floridanus* showing values of 98.50% and 98.37%, respectively, compared to 88.00% for both wild *Pleurotus pulmonarius* and *Auricularia cornea*. Similarly, the fibre content was much higher in cultivated mushrooms (42.00% and 98.50%) than in wild mushrooms (3.57% and 5.60%). In contrast, crude protein content was significantly higher in mushrooms harvested in the wild (16.57% and 5.62%) compared to cultivated mushrooms (2.17% and 2.33%). Table compares the dry matter, fibre, ash, protein, fat, and carbohydrate content of wild and cultivated mushroom species, showing significant differences in their nutritional composition (**Table 4**).

Table 4. Nutrient and energy content of edible wild mushrooms.

Nutrients	*P. pulmonarius* at NE	*A. cornea* at NE	*P. floridanus* C	*P. pulmonaris* C
Dry matter	88.00 ± 0.33^b	88.00 ± 0.33^b	98.37 ± 0.12^a	98.50 ± 0.00^a
Fibre (%)	3.57 ± 0.06^d	5.60 ± 0.10^c	42.00 ± 0.10^b	98.50 ± 0.10^a
Ash (%)	5.50 ± 0.50^d	6.47 ± 0.50^c	14.47 ± 0.06^a	9.47 ± 0.15^b
Protein (%)	16.57 ± 0.07^a	5.62 ± 0.38^b	2.17 ± 0.01^d	2.33 ± 0.01^c
Fat (%)	17.41 ± 0.52^a	15.20 ± 0.34^b	16.83 ± 0.01^a	17.24 ± 0.02^a
Carbohydrate (%)	48.84 ± 0.77^d	60.70 ± 0.28^c	64.96 ± 0.01^b	69.53 ± 0.03^a

Means with the same letter are not significantly different. NE = Natural environment, C = Cultivated.

The potassium content of cultivated *P. pulmonarius* and *P. floridanus* (1957.48 ± 0.03 and 2088.70 ± 0.10 mg/100g) was significantly higher than that of wild *P. pulmonarius* (1447.25 ± 2.38 mg/100g) and *A. cornea* (1891.09 ± 0.91 mg) (Table 5).

The micronutrient composition of the wild and cultivated mushrooms showed no trace of copper (Cu) or manganese (Mn). The highest iron (Fe) content (27.06%) was found in *Pleurotus pulmonaruis*, one of the two cultivated mushrooms, while zinc (Zn) was only found in CSCs harvested in the wild (Table 6).

Table 5. Macro-mineral content of edible wild mushrooms.

Nutrients	*P. pulmonarius* at NE	*A. cornea* at NE	*P. floridanus* C	*P. pulmonaris* C
Potassium (mg/100g)	1447.25 ± 2.38^d	1891.09 ± 0.91^c	2088.70 ± 0.10^a	1957.48 ± 0.03^b
Phosphorus (mg/100g)	526.80 ± 2.78^a	353.53 ± 1.31^c	323.53 ± 0.15^d	411.87 ± 0.02^b
Calcium (mg/100g)	440.67 ± 1.15^a	333.00 ± 7.00^b	44.10 ± 0.10^c	40.10 ± 0.05^d
Magnesium (mg/100g)	48.37 ± 0.25^c	39.56 ± 0.60^d	130.93 ± 0.08^a	97.40 ± 0.05^b
Sodium (mg/g)	112.16 ± 0.70^a	31.90 ± 0.28^b	22.19 ± 0.01^c	22.20 ± 0.01^c

Means with the same letter are not significantly different.

Table 6. Microelement content of edible wild mushrooms.

Nutrients	*P. pulmonarius* at NE	*A. cornea* at NE	*P. floridanus* C	*P. pulmonaris* C
Copper (mg/100g)	/	/	/	/
Manganese (mg/100g)	/	/	/	/
Iron (mg/100g)	16.54 ± 0.23^b	3.96 ± 0.08^d	27.06 ± 0.01^a	7.47 ± 0.02^c
Zinc (mg/100g)	1.71 ± 0.08^a	1.73 ± 0,05^a	/	/

Means with the same letter are not significantly different.

4. Discussion

4.1. Mushroom Diversity and Local Knowledge

The populations interviewed in the four towns of the Department of Mungo identified eight species of edible wild mushrooms (CSC), belonging to two trophic groups. These species belong to six families, with Pleurotaceae and Lyophyllaceae being the most represented, each with two species. Onguené *et al.* [1] also identified these six mushroom families in their work on the inventory of edible wild mushrooms in the rainforests of southern Cameroon. Termitomyces, edible and highly appreciated species from the Lyophyllaceae family, are widely consumed. Similarly, species from the Pleurotus genus are well-known and loved. Edible wild mushrooms fruit on various substrates, including palm trees (*Elaeis guineensis*), mango (*Mangifera indica*), avocado (*Persea americana*), and decomposing *Piptadeniastrum africana*. *Pleurotus squarrosulus* and *Auricularia cornea* colonize freshly felled trees, while *Pleurotus pulmonarius* prefers decaying wood. Other species grow on the ground, in natural vegetation, and in fields. The genus Termitomyces is found exclusively on termite mounds. Eyi-Ndong *et al.* [7] found similar results, showing that CSCs from the dense forests of Central Africa, such as *Marasmiellus inoderma*, grow on decomposing wood. Bâ *et al.* [25] [26]; Onguené *et al.* [1] report that *Marasmiellus inoderma* is abundant on palm stalks. The people in Mungo recognize the various CSC species, attributing similar importance to all of them. *Auricularia cornea*, *Pleurotus pulmonarius*, *Termitomyces fragilis*, and *Termitomyces striatus* are highly appreciated by local farmers, who follow these species as soon as they appear and view them as vital food during periods of abundance. Djomene *et al.* [27] have shown that CSCs are a significant source of nutrition for these populations, and they have learned to control their different fruiting periods. However, some species are eaten in specific villages but not in others. For instance, *Marasmiellus inoderma* is very popular in Souza but little known elsewhere. Similarly, *Phylloporus rhodoxanthus*, consumed in Londo Bwapaki (a village in Souza), is considered poisonous in other regions. Ethnomycological knowledge thus varies from one ethnic group to another and is passed down through generations. Although ethnomycological knowledge is more prominent among people aged 40 and above, some younger individuals (15.03%) show interest in growing and gathering edible mushrooms, recognizing them as a potential source of income [28].

4.2. Nutritional Value and Composition of Wild Mushrooms

Fungi are an important source of macro- and micronutrients [3]. Nutritional analyses were conducted specifically on *Auricularia cornea* and *Pleurotus pulmonarius*, two species that grow on decaying wood, and compared to two cultivated species. The differences in nutritional values between wild and cultivated mushrooms could be attributed to the substrate on which these mushrooms grow. Studies by Guillamân *et al.* [29] and Teke *et al.* [3] [30] show that the chemical composition of mushrooms varies depending on the substrate, species, harvest period, and post-harvest storage conditions. Teke *et al.* [3] found that soil-dwelling fungi tend to have a higher nutrient content than their woody counterparts. Fungi are bioaccumulators, meaning they accumulate minerals and other nutrients as they grow, storing them in their tissues. The bioaccumulation capacity of fungi is influenced by the nature and composition of the substrate [29]. Wild mushrooms harvested from the forest have lower dry matter and carbohydrate content than cultivated mushrooms. However, their protein content is much higher. Edible wild mushrooms are seen as a valuable source of energy and nutrients [11] [31]. The protein content in mushrooms can vary based on the species' genetic structures, the substrate's physical and chemical characteristics, and the mushrooms' developmental stage. The wild mushrooms in this study have higher lipid contents than those studied by Adejumo and Awosanya [31], Barros *et al.* [32], and Teke *et al.* [11]. In comparison, wild mushrooms harvested from their natural habitat are a richer source of proteins and carbohydrates compared to cultivated mushrooms. Nutritional values can vary not only from species to species but also for the same species, depending on the harvesting conditions and techniques used [33].

4.3. Role of Wild Edible Mushrooms in Preventing Nutritional Deficiencies

Scientific studies increasingly recognize the role of nutrition in determining chronic diseases such as cancer, cardiovascular disease, diabetes, obesity, osteoporosis, and neurological disorders [33]-[36]. Deficiencies in elements like potassium, phosphorus, magnesium, calcium, iron, and zinc can impair immune function and contribute to diseases like osteoporosis, dementia, atherosclerosis, and cancers. Edible mushrooms are a valuable source of these macro and microelements. Potassium and sodium are abundant in wild edible mushrooms [11] [33] [36] [37]. Potassium is an essential electrolyte, reducing the effects of salt on blood pressure [11]. Phosphorus, abundant in wild mushrooms, contributes to ossification, energy metabolism, and pH regulation in the blood. Wild mushrooms are also richer in calcium compared to cultivated mushrooms, corroborating findings by Adejumo and Awosanya [31], who noted high calcium levels in *Lactarius triviralis* and *Termitomyces mammiformis*. Numerous studies have reported low calcium levels in cultivated mushrooms, regardless of substrate or fruiting stage [11] [38]. Calcium is vital for bone and tooth formation, muscle contraction, blood clotting, and enzyme functioning. Adequate calcium intake can prevent bone demineralization, osteoporosis, and even colorectal cancer [34] [39]. An increased calcium intake during pregnancy can also help prevent eclampsia. Wild edible mushrooms are thus an excellent source of calcium, offering potential benefits for various health conditions. Calcium supplements derived from wild mushrooms have been shown to help lower blood pressure in pregnant women [40].

4.4. Zinc, Iron, and the Health Benefits of Wild Mushrooms

Both wild and cultivated mushrooms are rich in iron. However, only wild mushrooms are high in zinc, with levels ranging from 1.46 to 83.5 mg/100g [41]. Zinc plays a crucial role in boosting immune function, and its deficiency can lead to growth delays, hypogonadism, and immune dysfunction, making individuals more susceptible to infections [42]. In many developing countries, zinc deficiency is common due to diets primarily based on cereals, leading to issues such as stunted growth, delayed mental development, and vulnerability to infectious diseases. Correcting zinc deficiency could significantly improve health, particularly in populations relying heavily on cereals. Edible wild mushrooms offer a valuable alternative source of zinc, helping to address these deficiencies.

5. Conclusions

This study on wild edible mushrooms in the Department of Mungo underscores their importance as a nutritional resource for local populations. Based on the findings, the following key outcomes emerge:

- Diverse species of wild mushrooms: Eight species of edible wild mushrooms belonging to various trophic groups and six different families were identified, with *Pleurotaceae* and *Lyophyllaceae* being the most represented. Edible wild mushrooms are seasonal, and their fruiting is very often conditioned by the appearance of the first rain.

- Nutritional value: Wild mushrooms offer higher protein, lipid, and mineral content than cultivated varieties. Notably, they are rich in essential elements like calcium, potassium, iron, and zinc.

- Cultural significance: These mushrooms are valued by local populations, who track their seasonal availability and incorporate them into their diet, particularly in times of abundance. The knowledge and consumption of these mushrooms vary by village and ethnic group.

- Health benefits: The high nutrient content of wild mushrooms, including bioactive compounds, supports immune function, and bone health and could alleviate nutritional deficiencies prevalent in the region, particularly for those dependent on cereal-based diets.

The findings of this study emphasize the importance of incorporating edible wild mushrooms into local diets and promoting sustainable harvesting practices. Replicating such studies in other regions could further demonstrate the potential of these mushrooms as a key source of nutrition and health improvement in similar environments.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Onguene Awana, N., Tchudjo Tchuente, A.N. and Kuyper, T.W. (2019) Biodiversité des macrochampignons sauvages comestibles de la forêt humide du Sud-Cameroun. *Bois & Forets des Tropiques*, **338**, 87-99. https://doi.org/10.19182/bft2018.338.a31679

[2] Yorou, S.N. and Kesel, A.D. (2001) Connaissances ethnomycologiques des peuples Nagot du centre du Benin (Afrique de l'Ouest). *Systematics and Geography of Plants*, **71**, 627-637. https://doi.org/10.2307/3668707

[3] Teke, N.A., Kinge, T.R., Bechem, E., Nji, T.M., Ndam, L.M. and Mih, A.M. (2018) Ethnomycological Study in the Kilum-Ijim Mountain Forest, Northwest Region, Cameroon. *Journal of Ethnobiology and Ethnomedicine*, **14**, Article No. 25. https://doi.org/10.1186/s13002-018-0225-8

[4] FAO (2006) Champignons sauvages comestibles. Vue d'ensemble sur leurs utilisations et leurs importances pour la population. Viale delle Terme di Caracalla 00100 Rome, Italie, 96.

[5] Boa, E.R. (2006) Produits forestiers non ligneux 17. Champignons comestibles sauvages. Vue d'ensemble sur leurs utilisations et leur importance pour les populations. FAO, 96 p. mailto:copyright@fao.org

[6] Ndoye, O., Awono, A., Preece, L. and Toirambe, B. (2007) Marchés des produits forestiers non ligneux dans les provinces de l'Équateur et de Bandundu: Présentation d'une

enquête de terrain. In: Croizer, C. and Trefon, T., Eds., *Quel avenir pour les forêts de la République démocratique du Congo*, Coopération Technique Belge (CTB), 68-70.

[7] Eyi-Ndong, H., Degreef, J. and De Kesel, A. (2011) Champignons comestibles des forêts denses d'Afrique centrale. Taxonomie et identification. Abc Taxa, 10, 254.

[8] Fadeyi, O.G., Badou, S.A., Aignon, H.L., Codjia, J.E., Moutouama, J.K. and Yorou, N.S. (2017) Études ethnomycologiques et identification des champignons sauvages comestibles les plus consommés dans la région des Monts-Kouffe au Bénin (Afrique de l'Ouest). *Agronomie Africaine*, **29**, 93-109.

[9] Gévry, M.F., Simard, D. and Roy, G. (2009) Champignons comestibles du Lac-Saint-Jean. Bibliothèque et Archives nationales du Québec, 62.

[10] Kouame, K.B., Koko, A.C., Diomande, M., Konate, I. and Assidjo, N.E. (2018) Caractérisation physicochimique de trois espèces de champignons sauvages comestibles couramment rencontrées dans la région du Haut-Sassandra (Côte d'Ivoire). *Journal of Applied Biosciences*, **121**, 12110-12120. https://doi.org/10.4314/jab.v121i1.2

[11] Teke, A.N., Manju, E.B., Ndam, M.L. and Tonjock, R.K. (2020) Nutrient and Mineral Contents of Wild Edible Mushrooms from the Kilum-Ijim Forest, Cameroon. *Nutrition And Food Science Journal*, **3**, Article 128.

[12] Zhang, J., Li, X., Ying, Y. and Yao, X. (2019) Effects of the *Camellia oleifera* Shell Substrate on the Yield and Nutritional Composition of *Pleurotus geesteranus*. *Agricultural Sciences*, **10**, 1298-1311. https://doi.org/10.4236/as.2019.1010096

[13] Etoundi, O.C.B., Mbang-Mbarga, A.J., Kayo-Tayou, C.V. and Gouado, I. (2018) Study of Antiradical and Anti-Hyperglyceamic Activities of Mushrooms *Pleurotus pulmonarius* and *Pleurotus floridanus* Currently Consumed in Cameroon. *Sciences Tecnologies et Developpement*, **20**, 19-25.

[14] Omgba Cunégonde Blanche, E. (2019) Study of Acute Toxicity and the Effect of the Aqueous Extract of a Formulation of Three Edibles Mushrooms on Oxidative Stress Induced in Rats. *World Journal of Food Science and Technology*, **3**, 6-13. https://doi.org/10.11648/j.wjfst.20190301.12

[15] Mbang Mbarga, A.J., Etoundi Omgba, C.B., Djessissem, R. and Kana Sop, M.M. (2020) Evaluation of the Activity of *α* Amylase and Antioxidant Potential Formulations of Three Varieties of Oyster Mushrooms: Pulmonarius, Floridanus and Sajor-Caju. *Journal of the Cameroon Academy of Sciences*, **15**, 151-162. https://doi.org/10.4314/jcas.v15i3.1

[16] Yian, G.C., Pitta, M.B.S. and Tiébré, M.S. (2020) Champignons Sauvages Comestibles et Pharmacopée Traditionnelle en Zone Forestière de la Côte d'Ivoire. *Journal of Pharmacy and Biological Sciences*, **15**, 35-45.

[17] Kinge, T.R., Nji, T.M., Ndam, L.M. and Mih, A.M. (2014) Mushroom Research, Production and Marketing in Cameroon: A Review. *Issue in Biological Sciences and Pharmaceutical Research*, **2**, 69-74.

[18] Djomene, Y.S., Fon, D.E., Foudjet, A.E. and Feudjio, D.C. (2016) Apport économique et valorisation de la culture des champignons comestibles au Cameroun. *Revue Scientifique et Technique Forêt et Environnement du Bassin du Congo*, **8**, 65-72.

[19] Moukam, S.G. (2021) Le département du Moungo au Cameroun: Opportunité ou obstruction au développement local? *Revue Roumaine de Géographie*, **11**, 2247-2290.

[20] de Laeter, J.R., Böhlke, J.K., De Bièvre, P., Hidaka, H., Peiser, H.S., Rosman, K.J.R., *et al.* (2003) Atomic Weights of the Elements. Review 2000 (IUPAC Technical Report). *Pure and Applied Chemistry*, **75**, 683-800. https://doi.org/10.1351/pac200375060683

[21] Wolff, J.P. (1968) Manuel d'analyse des corps gras. Paris-Azoulay, 115.

[22] Association of Official Analytical Chemists (AOAC) (2005) Official Methods of Analysis of the Association of Official Analytical Chemists International. 17th Edition, Association of Official Analytical Chemists, 945, 16.

[23] Bourely, J. (1982) Observation sur le dosage de l'huile des graines de cotonnier. *Coton et fibres tropicales*, **37**, 183-196.

[24] Asean Manual of Food Analysis (AMFA) (2011) Regional Centre of ASEAN Network of Food Data System. Institute of Nutrition, Mahidol University Thailand, 188.

[25] Bâ, A., Duponnois, R., Diabaté, M. and Dreyfus, B. (2011) Les champignons ectomycorhiziens des arbres forestiers en Afrique de l'Ouest. IRD Éditions. https://doi.org/10.4000/books.irdeditions.10404

[26] Bâ, A.M., McGuire, K.L. and Diédhiou, A.G. (2014) Ectomycorrhizal Symbioses in Tropical and Neotropical Forests. CRC Press.

[27] Djomene, Y.S., Foudjet, E.A., Fon, D.E. and Ninkwango, T.A. (2017) La commercialisation des champignons comestibles au Cameroun. Revue *Scientifique et Technique*, *Forêt et Environnement du Bassin du Congo*, **8**, 65-71.

[28] Codjia, J.E.I. (2013) Diversité et usage des champignons sauvages comestibles. Mémoire de Licence professionnelle à l'ENSTA-KETOU, Université d'Abomey-Calavi (UAC), 66 p.

[29] Guillamón, E., García-Lafuente, A., Lozano, M., D'Arrigo, M., Rostagno, M.A., Villares, A., *et al.* (2010) Edible Mushrooms: Role in the Prevention of Cardiovascular Diseases. *Fitoterapia*, **81**, 715-723. https://doi.org/10.1016/j.fitote.2010.06.005

[30] Teke, N. (2017) Macro-fungal Diversity in the Kilum-Ijim Forest, Cameroon. *Studies in Fungi*, **2**, 47-58. https://doi.org/10.5943/sif/2/1/6

[31] Adejumo, T.O. and Awosanya, O.B. (2005) Proximate and Mineral Composition of Four Edible Mushroom Species from South Western Nigeria. *African Journal of Biotechnology*, **4**, 1084-1088.

[32] Barros, L., Cruz, T., Baptista, P., Estevinho, L.M. and Ferreira, I.C.F.R. (2008) Wild and Commercial Mushrooms as Source of Nutrients and Nutraceuticals. *Food and Chemical Toxicology*, **46**, 2742-2747. https://doi.org/10.1016/j.fct.2008.04.030

[33] Bernas, E., Jawarska, G. and Lisiewska, Z. (2006) Edible Mushrooms as a Source of Valuable Nutritive Constituants. *Acta Scientiarum Pplonorum Technologia Alimentaria*, **5**, 5-20.

[34] Garland, C., Barrett-Connor, E., Rossof, A., Shekelle, R., Criqui, M. and Paul, O. (1985) Dietary Vitamin D and Calcium and Risk of Colorectal Cancer: A 19-Year Prospective Study in Men. *The Lancet*, **325**, 307-309. https://doi.org/10.1016/s0140-6736(85)91082-7

[35] Hercberg, S. and Chantal, J. (2013) Propositions pour un nouvel élan de la politique nutritionnelle française de santé publique dans le cadre de la Stratégie Nationale de Santé-1ere partie: Mesures concernant la Prévention nutritionnelle. Rapport du Ministère des Affaires Sociales et de la Santé sur le Programme National Nutrition Santé (PNNS) et du Plan Obésité (PO) Juin 2013, 126 p.

[36] Etoundi-Omgma, C.B., Mbang-Mbarga, A.J., Tuem, S. and Gouado, I. (2017) Study of Toxicity and Antidiabetic Activity of Ethanolic and Hydroethanolic Extracts of *Pleurotus pulmonarius* and the Aqueous Extract of *Pleurotus floridanus*. *Journal of Food*, *Nutrition and Population Health*, **1**, 2-20.

[37] Mattila, P., Könkö, K., Eurola, M., Pihlava, J., Astola, J., Vahteristo, L., *et al.* (2001) Contents of Vitamins, Mineral Elements, and Some Phenolic Compounds in Culti-

vated Mushrooms. *Journal of Agricultural and Food Chemistry*, **49**, 2343-2348. https://doi.org/10.1021/jf001525d

[38] Falandysz, J. and Borovička, J. (2012) Macro and Trace Mineral Constituents and Radionuclides in Mushrooms: Health Benefits and Risks. *Applied Microbiology and Biotechnology*, **97**, 477-501. https://doi.org/10.1007/s00253-012-4552-8

[39] Lipkin, M. and Newmark, H. (1985) Effect of Added Dietary Calcium on Colonic Epithelial-Cell Proliferation in Subjects at High Risk for Familial Colonic Cancer. *New England Journal of Medicine*, **313**, 1381-1384. https://doi.org/10.1056/nejm198511283132203

[40] Belizán, J.M., Villar, J., Zalazar, A., Rojas, L., Chan, D. and Bryce, G.F. (1983) Preliminary Evidence of the Effect of Calcium Supplementation on Blood Pressure in Normal Pregnant Women. *American Journal of Obstetrics and Gynecology*, **146**, 175-180. https://doi.org/10.1016/0002-9378(83)91049-9

[41] Tüzen, M. (2003) Determination of Heavy Metals in Soil, Mushroom and Plant Samples by Atomic Absorption Spectrometry. *Microchemical Journal*, **74**, 289-297. https://doi.org/10.1016/s0026-265x(03)00035-3

[42] Imoberdorf, R., Rühlin, M. and Ballmer, P. (2010) Zinc un oligoélément vital à grand potentiel. *Forum Médical Suisse—Swiss Medical Forum*, **10**, 764-768. https://doi.org/10.4414/fms.2010.07322