Wild mushrooms and ethnomycological knowledge: exploring Cameroon's Adamaoua rangelands

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Research

Abstract

Background: In Cameroon, rangelands of Adamaoua region provide a wide range of goods and ecosystem services valued by society, including fodder for livestock and non-timber forest products. They also host a rich biodiversity including plants and fungi with multiple uses. The study aimed to document indigenous knowledge about mushrooms among local populations living around rangelands of the Adamaoua region.

Methods: Ethnomycological surveys were conducted between August and October 2024 in the divisions of Vina and Mbere, involving 500 participants who were randomly selected and interviewed using structured questionnaires. Participants were from diverse ethnic groups, predominantly Peuls, Gbaya, Mbororo.

Results: A total of 16 locally used fungal species were identified, belonging to 8 genera and 6 families. The most dominant families in terms of species richness were Lyophyllaceae, Agaricaceae and Russulaceae respectively. The genus *Termitomyces* with 7 species was dominant and was also highlighted for their significant nutritional and commercial importance in the region. *Chlorophyllum hortense* and *Chlorophyllum globosum* were the only sub-coprophilous fungi, reported to be used as food and in traditional medicine by the Gbaya, Mbororo, and Peul communities.

Conclusions: The population around the rangelands of Adamaoua Region knows and uses many mushroom species as sources of food, medicine and income. *Termitomyces* species are consumed across all ethnic groups, while *C. hortense* and *C. globosum* are reported to be used in traditional medicine. Further studies are needed to assess the nutritional and medicinal potentials of these species.

Keywords: Rangelands, Edible mushrooms, Ethnomycology, Adamaoua Region, Ethnic group

Background

Rangelands are lands on which the indigenous vegetation (climax or sub-climax) consists predominantly of grasses, grass-like plants, forbs, or shrubs that are grazed, or have the potential to be grazed, and which function as a natural ecosystem for the production of grazing livestock and wildlife (Allen *et al*. 2011).

According to the Rangelands Atlas (ILRI *et al*. 2021), rangelands occupy 54% of the terrestrial surface area and include deserts and xeric shrublands (35%), tropical and subtropical grasslands, savannas and shrublands (26%), tundra (15%), and temperate grasslands (13%). These ecosystems include all global drylands, which host over 2 billion people. Approximately 84% of rangelands are used for livestock production, supporting an estimated 200-500 million pastoralists worldwide (McGahey *et al*. 2014).

In Cameroon, rangelands are among the most prevalent land-use systems, covering approximately 20% of the country's territory and providing favourable conditions for livestock farming (World Bank 2009). Grazing areas are primarily dedicated to livestock production, particularly in the Adamaoua region, where the climate and altitude are favourable for animal and plant growth (Deffo *et al*. 2010). This region is the country’s principal livestock production zone: cattle account for about 86.6% of the domestic livestock population and represent more than 28% of the national herd, estimated at about 10 million head (MINPAT & UNDP 2000).

Beyond their ecological role as grazing environments, rangelands in this region provide a wide range of goods and ecosystem services valued by society, including fodder, wildlife habitat, water and mineral resources, non-timber forest products, and agricultural land.

They also host a rich diversity of plants and fungi with multiple uses, ensuring the well-being of local communities. Fungi play an important role in ecosystem functioning, particularly in the decomposition of organic matter such as animal dung, thereby enriching soils with minerals/nutrients essential for plant growth. Many of these fungi are macroscopic (mushrooms), visible to the naked eye, and grow on diverse substrates including soil, animal dung and termite mounds. They exhibit wide variation in shape, size and colour (Madiapevo *et al*. 2024). Mushrooms are also classified as non-timber forest products and are widely used by local populations as sources of food, medicine and income, contributing to a substantial reduction of poverty in rural areas (Ndong *et al*. 2011, Yorou *et al*. 2014).

They are abundant during the rainy season, which is a season when the environment becomes favourable for the fruiting and proliferation of mushroom species (Madiapevo *et al*. 2024)).

However, rangelands in the Adamaoua region are currently experiencing alarming degradation, leading to significant losses of natural resources and the ecosystem services they provide (Awalu *et al*. 2022). This degradation is associated with a decline in the diversity and availability of mushroom species, and hence also the traditional mycological knowledge. Moreover, in Adamaoua, limited knowledge of fungal diversity correlates with poor documentation of indigenous ethnomycological knowledge. This knowledge, which is increasingly at risk of being lost, is crucial for understanding and documenting the mycological diversity and may also reveal the biotechnological potential of certain indigenous mushroom species, while indirectly supporting rangeland conservation.

Despite the importance of livestock farming, agriculture, and trade, in the Adamaoua region, there is a notable lack of studies documenting the diversity of mushrooms in rangelands and the local population’s knowledge of their use. Therefore, in order to promote the sustainable management of grazing lands and their natural resources, it is essential to document useful mushroom species and the associated ethnomycological knowledge of local communities. In this perspective, an ethnomycological study appears to be a good approach to fill this gap and safeguard the ancestral knowledge that local populations have about mushrooms with a view to sustainable management. The present study was conducted, with the main objective of identifying mushroom species useful to populations living around grazing lands and documenting their

indigenous knowledge regarding their use. Specifically, the aim was to conduct an ethnomycological survey in order to document general knowledge, naming, and evolvement of locals on mushroom exploitation and to determine the systematics and ecology of macrofungi used by exploiters of rangelands

To our knowledge, this is the first study of its kind conducted in the Adamaoua region.

Materials and Methods

Study area

The study was carried out in the Adamaoua Region of Cameroon, specifically in the Vina and Mbere divisions. In Vina, data were collected in Belel, Nyambaka, Ngan-ha, and Ngaoundere subdivisions, while in Mbere, surveys were conducted in the Dir, Meiganga, Ngaoui, and Djohong subdivisions (Figure 1, Table 1).

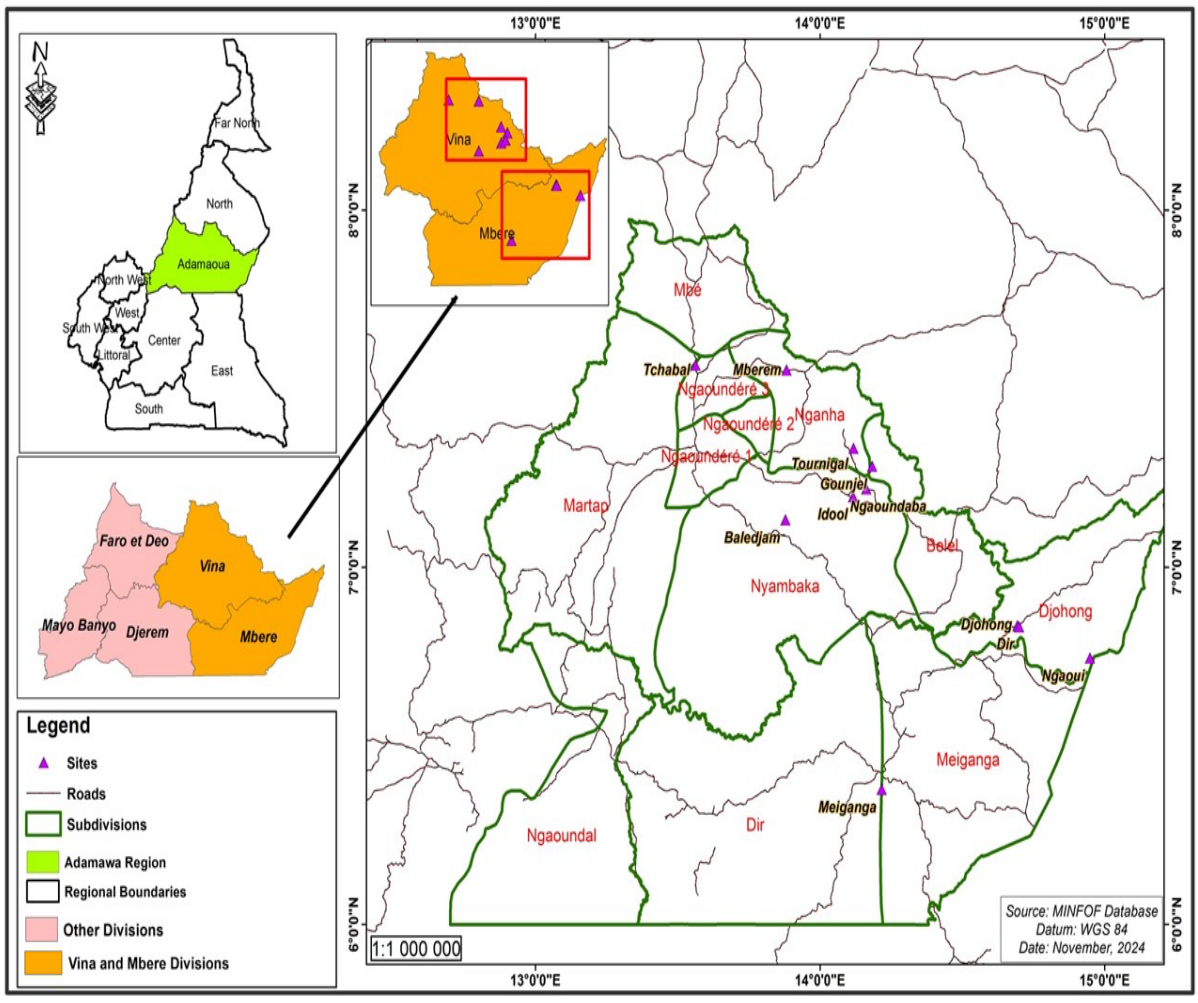

Figure 1. Map showing the location of Adamaoua Region in Cameroon and the study area within the region

The Adamaoua Highland Plateau, located in central Cameroon, covers 17% of the national territory, with a surface area of about 64 000 km², making it the third largest region of the country (Awalu & Nformi 2022). It lies between latitudes 6° and 8° North and between 11 and 15 East longitude, with elevations ranging from 900 to 1 500 m, and an average altitude of 1 100 m (INS 2025). The region is characterized by rugged soils and sparse population density, as much of the land is devoted to cattle rearing.

The climate is a Sudanian subtype of tropical climate, with two distinct seasons: a dry season from November to March and a long rainy season from April to October. Annual rainfall ranges between 1600 and 1800 mm, the relative humidity of the atmosphere varies from 40 - 60%, and the annual average temperature is 23°C (Awalu & Nformi 2022). The vegetation consists of tropical woodlands, with a mosaic of savannah and forest species, and landscapes dominated by dense shrub and tree savannah stretching over large areas (Mapongmetsem *et al*. 2017). The Adamaoua Region is inhabited by diverse ethnic

groups, with Peuls, Mbororo, Mboum, and Gbaya being the most dominant. According to the 2015 general population and housing census, the population was estimated at 1 200 095 inhabitants (INS 2025). This population relies mainly on natural resources, including plants and fungi, for nutrition and health.

Table 1. Description of the selected study villages

Division	Sub-division	Name of Village	Area (km²)	No. of population	No. of respondents involved in the study
Vina	Ngaoundere	Tchakbal, Mbé	65.2	978	63
	Ngan-ha	Mbang foulbé, Mberem	56.93	854	60
	Nyambaka	Baledjam, Ngaoumdaba	77.87	1,168	62
	Belel	Idool, Tournigal	38.6	579	65
Mbere	Dir	Kaladi	46	690	63
	Meiganga	Nandeke	65.2	978	62
	Ngaoui	Bawaka	45.27	679	63
	Djohong	Yarmbang	51	765	62
Total			**446.07**	**6,691**	**500**

Collection of qualitative ethnomycological data

Data were collected between August and October 2024 through individual interviews. Respondents were subdivided into four age groups: under 20 years, 21-40 years, 41-60 years, and over 60 years. Bouayyadi *et al*. (2015) further note that informants aged 20 years and above can recall events that occurred at least a decade earlier. A total of 500 people, including 250 in the Vina division and 250 in the Mbere division, were selected at random, and a structured survey was carried out using pre-designed questionnaires. The questions were open-ended, closed-ended and, in some cases, leading, and were accompanied by specimen-assisted or photographs of samples collected at other study sites. Although several tribes were represented, this study focused on the majority groups based on respondent numbers: Peuls, Gbaya, and Mbororo.

The questionnaire sought information on socio-demographic identification of respondents (ethnicity, locality, identity, sex, age, function, level of education), knowledge on the local taxonomy of mushrooms (vernacular names, meanings, and recognition criteria), local uses of species (food, traditional medicine, trade and other uses), ecological knowledge (fruiting period, substrates, and growth areas). Particular attention has been paid to documenting the nutritional and medicinal value of these species. In each locality, authorization to conduct interviews was obtained from the traditional rulers, who were informed of the survey objectives. Respondents were also briefed on the purpose and importance of the study, and their consent was obtained prior to participation. The questionnaire was designed in French, and interpreters assisted when respondents were unable to read or write in French.

Identification of useful mushrooms in the study area

To identify useful mushrooms, samples of wild macrofungi were collected at various study sites with the assistance of local inhabitants. These informants provided vernacular names of the species as well as information on their local uses (food, traditional medicine, trade and others) or potential toxicity. Each specimen was photographed in situ using a digital camera before being carefully collected with a knife. Samples were put in labelled paper envelopes and then transferred to a collection basket. Field observations, including ecological and environmental characteristics, were recorded in a field notebook. After fieldwork, the samples were described macroscopically before being dried using a fruit and legume dryer (Food dehydrator/Saachi, NL-FD-4935). The dried samples were preserved individually in zip-lock bags. All exsiccates are stored at the Centre of Competence for the study of Antimicrobial Natural Products from Fungi (CECANAPROF) Laboratory of the Higher Teacher Training College of Yaounde I. Duplicate specimens of selected species were deposited at the Research Unit in Tropical Mycology and Plant-Soil Fungi Interactions (Mytips) in Parakou, Benin. Identification was based on macro-morphology using documentation on tropical African fungi (Ndong *et al*. 2011, Onguene *et al*. 2018, Piepenbring *et al*. 2020). However, for samples that could not be identified using these characters up to genus level, microscopic observations were performed to observe microscopic features including spores, basidia and cystidia. Species were cross-checked against Index Fungorum website (https://www.indexfungorum.org) to confirm their current name and family.

Quantitative analyses of ethnomycological data

To quantify the importance of macrofungi and compare the ethnomycological knowledge among the ethnic groups, several ethnobotanical parameters and indices were calculated following Fandohan *et al*. (2017). These included the use value (UV), the relative frequency of citation (RFC), and the Sorensen similarity index of species use among the tribes. For the UV, three

use categories were considered: food, medicine, and commerce. For each respondent, the individual use value (UV_i) was determined by assigning a score of 1 for each use mentioned and a score of 0 for no use mention, then summing the total according to Hoffman & Gallaher (2007). Thus, for each respondent, the UV_i varies from 0 to 3. For each tribe, the UV was calculated as the average of all UV_i using the following formula:

$$UV = \sum_i \frac{UV_i}{N}$$

where UVi is the use value for each individual (i), and N is the total number of informants interviewed in the tribe.

The RFC for each use category in each tribe was calculated using the formula:

$$RFC_U = \frac{n_u}{N}$$

where RFC_U is the relative frequency of citation for a use category "U", n_u the number of informants who mentioned that particular category, and N the total number of informants in the tribe.

The Sorensen similarity index was calculated to compare the species used by the different tribes to define whether there is similarity among mushroom species that they use. It was calculated thanks to the formula below where "a" is the number of species commonly used by both tribe "b" and "c", **"**b**"** is the number of species used only by members of the tribe "b" and "c" the number of species used only by members of the tribe "c".

$$S = \frac{100 \text{ x } 2a}{(b + c)}$$

All data were compiled in Excel 2016 and analyzed using XLSTAT 2 to generate descriptive statistics and comparative indices.

Results

Socio-demographic characteristics of informants

Table 2 shows the distribution of respondents by socio-cultural background. A total of 24 ethnic groups were represented, reflecting the cultural diversity of the Adamaoua region. However, the most represented groups were the Gbaya, Peuls and Mbororo. Other tribes, each with fewer than six respondents per division, were grouped under "Other tribes". These included the Bassa, Diir, Dourou, Fali, Haoussa, Kapsiki, Kari, Laka, Mada, Mafa, Mandja, Mambay, Massa, Mayine, Mboum, Mofou, Mundang, Sara, Toupouri and Zulgo. Among these, only Diir and Mboum are small native tribes of the Adamaoua region; the others originated from different regions of Cameroon.

The Peuls, who are the leading community in the area, dominated, with 50% of the total informants, followed by the Gbaya (29.8%). The Mbororo, represented by 5.4% of the sampled population, are nomadic, and many of them live in very remote and not easily accessible areas (mountainous areas). The age group 21-40 was the most represented, with 56.6% of respondents, followed by the 41-60 age group with 19.8%, while the age group 61 and above was the lowest. Regarding gender, females dominated, accounting for 55.2% of the total population surveyed. Educationally, the majority of respondents had only primary education (45.2%), and 34.8% had no formal education. Only 18.8% reached the level of secondary school and 1.2% the level of higher education. The main economic activities of the respondents were livestock farming (32%), followed by agriculture (26.4%) and trade (20.6%).

Table 2. Socio-demographic characteristics of respondents

Region				**Adamaoua**
Division		**Vina**	**Mbere**	
Sex	Male	86	138	224 (44.8%)
	Female	164	112	276 (55.2%)
Age	] 15-20]	40	53	93 (18.6%)
	[21; 40]	133	150	283 (56.6%)
	[41-60]	61	38	99 (19.8%)
	[60+ [	16	9	25 (5%)

Region				Adamaoua
Religion	Muslim	143	139	282 (56.4%)
	Christians	107	111	218 (43.6%)
Educational Level	No formal education	89	85	174 (34.8%)
	Primary	123	103	226 (45.2%)
	Secondary	36	58	94 (18.8%)
	Higher education	2	4	6 (1.2%)
Most Representative Tribes	Peul	173	77	250 (50%)
	Gbaya	22	127	149 (29.8%)
	Mbororo	9	18	27 (5.4%)
	others tribes	46	28	74 (14.8%)
Activities	Agriculture	36	96	132 (26.4%)
	Livestock	118	42	160 (32.0%)
	Commerce	42	61	103 (20.6%)
	Other activities	54	51	105 (21.0%)

General knowledge, naming and evolvement of locals on mushroom exploitation

According to the findings, 98% of respondents (comprising 216 men and 274 women) were familiar with mushrooms as living organisms. A small proportion of respondents (10 respondents) reported no knowledge of mushrooms; these were 8 men and 2 women. Those unfamiliar with mushrooms were members of the Zulgo and Massa tribes, originally from the Far North region of Cameroon, and were between 21 and 40 years old. They argued that mushrooms seem like a mystery and they have never heard of them or seen them. Almost all informants who had knowledge about mushrooms claimed that they gained it through transmission from their ancestors. According to respondents, during the rainy season, women and children often form small groups to collect mushrooms in the forest or the savannah after completing farm and household work. In contrast, men typically collect mushrooms occasionally during their herding cattle activities in the rangelands.

Ethnotaxonomy of mushrooms

As shown in Table 3, mushrooms have a common name in the native languages of most ethnic groups present in the rangelands, with the exception of the Zulgo, whose representatives reported no knowledge of mushrooms. These names vary across ethnic groups. Moreover, in most of these languages, there are names or expressions to differentiate edible/good and toxic/bad mushrooms globally. In addition, the Gbaya, Mboum, Mbororo, and Peul communities each possess distinct names for some locally important species, such as *Agaricus* sp, *Agaricus campestris, Chlorophyllum globosum*, *Chlorophyllum hortense*, *Termitomyces aurantiacus*, *Termitomyces schimperi*, *Termitomyces umkowaani*, *Termitomyces microcarpus, Termitomyces striatus*, *Cantharellus congolensis*, *Pleurotus pulmonarius*, *Russula ochrocephala*, *Termitomyces globulus* and *Volvopluteus gloiocephalus* (Table 4).

Table 3. Different naming of mushrooms by ethnic group

Tribes	Common Name of Mushrooms	Common name of edible Mushrooms	Common name of toxic mushrooms	Specific names recorded
Peuls	Ahoum	Ahoum	Mbadornaii	Yes
Gbaya	Buà	buà-mbom	Dan- buà	Yes
Mbororo	Konton	Konton	Guinadjii	Yes
Mboum	Ahoum	Ahoum	Bouenaii	Yes
Laka	Bway	bway-go	bway-mbè	No
Dii	Mbè	mbè-go	mbè-vo	No
Mada	kwa-kwa	kwa-kwa	kwa-kwa-mbe	No
Toupouri	Hèpbe	Hèpbe	hwa'a-yiri	No
Dourou	Mbè	mbè-gÒ	mbè-vo	No
Mandja	Goudou	Goudou	goudou-oro	No
Kapsiki	Kwakwa	Kwakwa	kwakwa-mbe	No
Kari	Bwoya	Bwoya	bwoya-ngbe	No
Haoussa	Amunu	Amunu	Gangar-zomo	No

Table 4. Mushroom species, traditional uses, and their local names according to ethnic groups

Peul[1], Mbororo[2], Gbaya[3], Mboum[4]

Collection number	Species	Index Fungorum number	Indigenous Names	Substrate	Lifestyle of fungi	Traditional uses	Treated Disease
MNZ041	*Agaricus campestris* L.	356498	Ahoum[1], Konton[2], Mboua[3]	Soil	Saprotrophic	Food[1,2]	
MNZ039	*Agaricus* sp.		Ahoum[1], Konton[2], Mboua[3]	Soil	Saprotrophic	Food[1,2,3]	
MNZ095	*Cantharellus congolensis* Beeli	261705	Ngadjiri[1], ndoordayé[2], Dardou[3]	Soil	Ectomycorrhizal	Food[1,3]	
MNZ001	*Chlorophyllum globosum* (Mossebo) Vellinga	374394	Ahoum[1], Konton[2], Mboua[3]	Soil	Sub-coprophilous	Food/ Traditional medicine[2,3]	Typhoid and gastric pain
MNZ040	*Chlorophyllum hortense* (Murrill) Vellinga	374396	Ahoum[1], Konton[2], Mboua[3]	Soil	Sub-coprophilous	Food/ Traditional medicine[1,2]	Stomach ache, treat indigestion
MNZ062	*Lactifluus gymnocarpoides* Verbeken	564612	Ahoum[1], Konton[2], Mboaba[3]	Soil	Ectomycorrhizal	Food[1]	
MNZ032	*Pleurotus pulmonarius* (Fr.) Quél.	143543	Magoum[1], Mbagou[2], Beuzouk[3],	Wood	Saprotrophic	Food[1,3]	
MNZ060	*Russula ochrocephala* Buyck	136454	Ngapbou[4]	Soil	Ectomycorrhizal	Food[4]	
MNZ050	*Termitomyces aurantiacus* R. Heim	324477	Ahoum[1], Konton[2], Mboua[3]	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ036	*Termitomyces globulus* R. Heim & Gooss. Font	306767	Mambaye[1], Mbodjoum[2], Magouoh[3]	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ079	*Termitomyces letestui* (Pat.) R. Heim	291353	Ahoum[1], Konton[2], Mgori[3]	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ074	*Termitomyces microcarpus* (Berk & Broome) R. Heim	521639	Ahoum[1], Konton[2], Mboua[3]	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ112	*Termitomyces schimperi* (Pat.) R. Heim	291356	Woudere[1], Konton[2], Mbaii	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ053	*Termitomyces striatus* (Beeli) R. Heim	291357	Ahoum[1], Konton[2], Mboua[3]	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ051	*Termitomyces umkowaani* (Cooke &Massee) D.A. Reid	328298	Ahoum[1], Konton[2], Maayouoh[3]	Termite Mounds, Soil	Symbiotic with termites	Food, Commerce[1,2,3]	
MNZ078	*Volvopluteus gloiocephalus* (DC.) Vizzini, Contu & Justo	518592	Ahoum[1], Konton[2], Niazezing[3]	Soil	Saprotrophic	Food[1,3]	

Local knowledge by gender and age

Figure 2 illustrates that knowledge of mushrooms in the study area increases with age, while women demonstrated greater familiarity with these organisms when considering the number of species cited as useful. The number of edible species reported by respondents in the age groups 21-40, 41-60, and 60+ years was 11.5, 13.5 and 15, respectively. Respondents below 20 years had less knowledge, with several species reported of 4. Indeed, respondents aged 60+ years reported having the greatest endogenous knowledge of the largest number of species (women: 16 species; men: 14 species). This suggests that respondents in this age group possess more knowledge than those in other age groups.

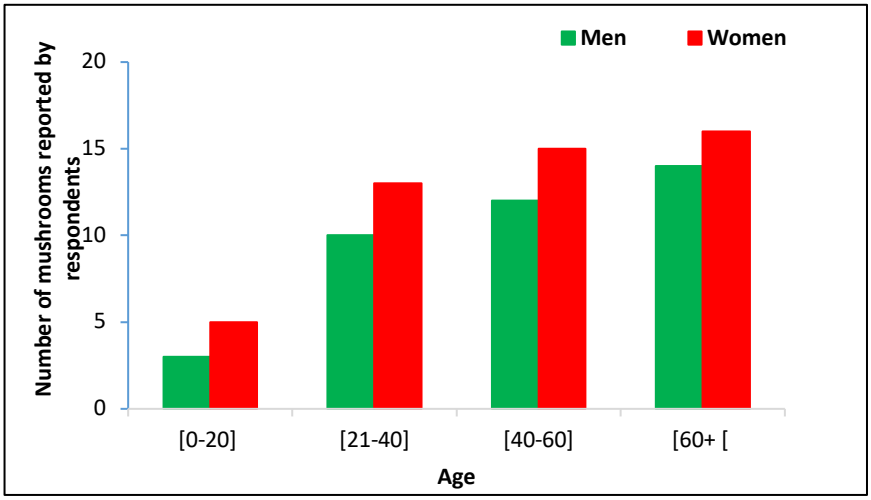

Figure 2. Levels of knowledge of useful mushrooms as a function of age and gender

Uses of mushrooms from rangelands

In the Adamaoua Region, mushrooms are primarily used for three purposes: food, commerce, and medicine. As a food source, local populations consume a variety of mushroom species (Table 4). Notably, *Russula ochrocephala*, known as «Ngapbou» among the Mboum people, is consumed exclusively by members of this ethnic group. Mushroom consumption is particularly high during the rainy season, which corresponds to the most favourable growth and fruiting period. During this time, mushrooms constitute a major component of meals in the majority of households of the rangelands. Concerning commerce, only species belonging to the genera *Termitomyces* and *Chlorophyllum* are sold in local markets and along roadsides (Table 4). In addition, children often engage in street vending within towns and villages. Mushrooms are generally consumed and sold fresh; however, during periods of high abundance, they are dried and preserved. The drying process involves cleaning, cutting the collected fruiting bodies into pieces that are boiled for 10 to 15 minutes, allowing them to cool down for nearly 5 minutes, cleaning them again, and finally drying them in sunlight for 3 to 5 days, before storage for future consumption or sale.

Traditional medicinal uses mainly involve *Chlorophyllum globosum* and *Chlorophyllum hortense* (Table 3), which are also valued as food and an income source. The Mbororo women of the region use *Chlorophyllum hortense* growing on soil dung-enriched or soil of grazing land to treat stomachache and indigestion. *Chlorophyllum globosum*, also a sub-coprophilous species, is used in Gbaya's traditional medicine to treat gastric pain in adults. It is also combined with other plants such as *Carica papaya* root and leaves of *Cymbopogon citratus* to treat typhoid.

Systematics and ecology of macrofungi used by exploiters of rangelands

According to our results, up to 16 species of macrofungi are used by people living in the rangelands of the Adamaoua region (Table 4). These species belong to 8 genera and 6 families. *Termitomyces* (family Lyophyllaceae) is the best represented with 7 species. All other families were represented by a single genus, except Agaricaceae and Russulaceae, which included two genera (Figure 3A). Photographs of the useful species are presented in Figure 4.

Informants reported that mushrooms grow in savannas, forest galleries, farms, and prairies during the rainy season. Harvesting of useful mushrooms begins in March and continues throughout the rainy season until October. However, the period of greatest abundance and diversity of fruiting bodies occurs between July and October, with a peak in September (Figure 3B). Locally used species include both saprotrophic and symbiotic fungi (Table 4). Saprotrophic species comprise wood-inhabiting, soil inhabiting, and sub-coprophilous fungi, while symbiotic species include ectomycorrhizal taxa (*Lactifluus*

and *Russula*) associated with *Isoberlinia doka* and *Uapaca guineensis*, as well as termite-associated species of the genus *Termitomyces*.

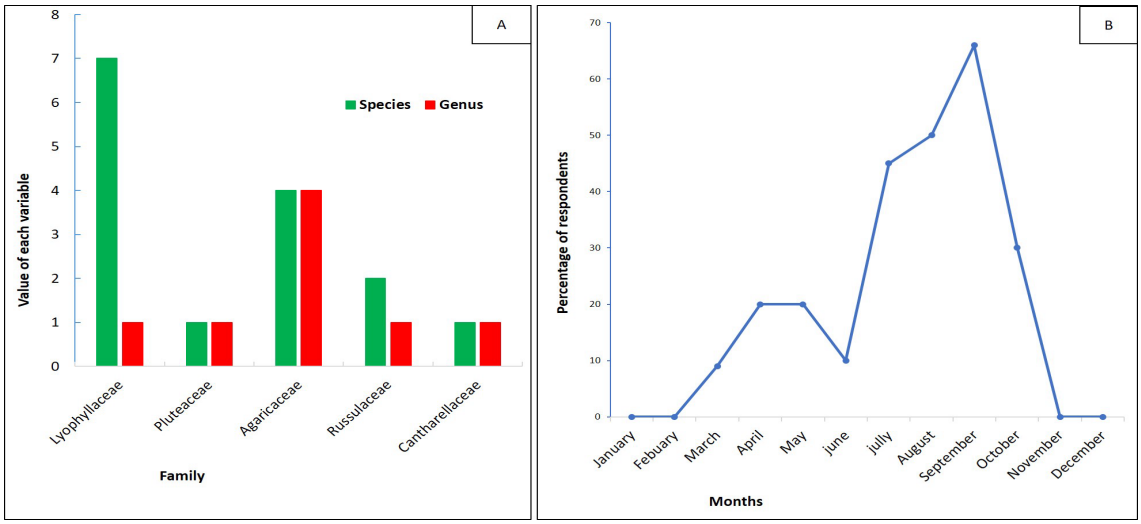

Figure 3. Taxonomic richness and phenological dynamics of fungi. A) Number of species and genus by family. B) Months with high abundance of mushrooms in Adamaoua Region according to the respondents

Figure 4. Useful mushrooms by Peuls, Mbororo and Gbaya tribes in Adamaoua Region.
A: *Agaricus campestris*, **B:** *Agaricus* sp, **C:** *Chlorophyllum hortense*, **D:** *Lactifluus gymnocarpoides,* **E:** *Cantharellus congolensis,* **F:** *Chlorophyllum globosum***, G:** *Pleurotus pulmonarius*, **H:** *Russula ochrocephala*, **I**: *Termitomyces aurantiacus*, **J**: *Termitomyces globulus,* **K:** *Termitomyces schimperi*, **L:** *Termitomyces striatus,* **M:** *Termitomyces letestui*, **N:** *Termitomyces microcarpus*, **O:** *Termitomyces umkowaani*, **P:** *Volvopluteus gloiocephalus*

Variation of ethnomycological knowledge among Peul, Mbororo, and Gbaya

Variation in the criteria of the identification of mushrooms

The criteria for identification of mushrooms reported by the respondents are mainly three characteristics: size (small, medium, and large), colour (white, spotted with black, brown, pink, multicolour, black, etc.), and the type of substrate on which the mushrooms grow (soil, dead wood, termite mounds, and dung). Figure 5 illustrates the trends in the use of these criteria across the three major tribes. It was observed that the Gbaya and Mbororo considered mainly substrates when differentiating mushroom species, in contrast to the Peul, who do not rely on a single criterion in their identification.

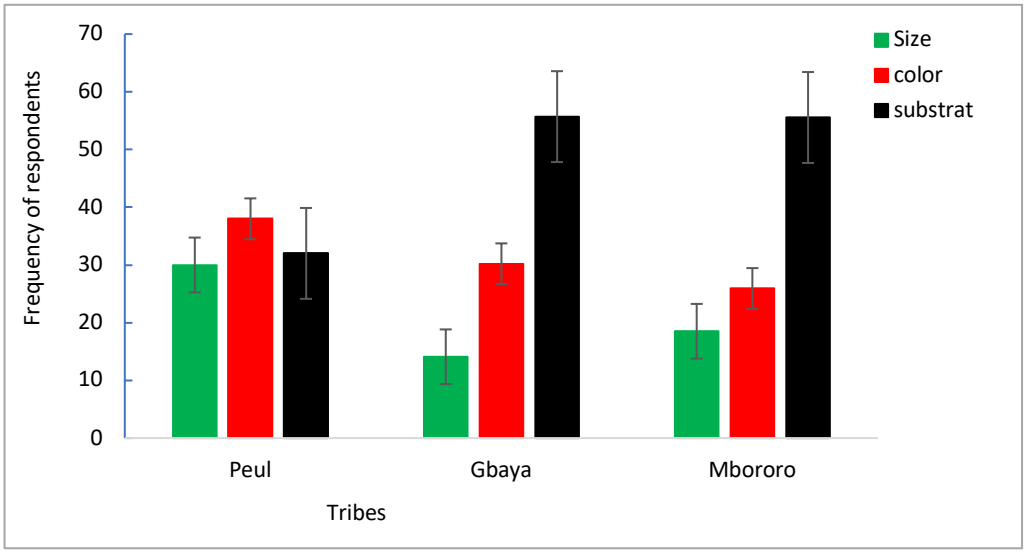

Figure 5. Criteria of differentiation of mushroom species according to different tribes

Variation in the preferred use categories

To assess and compare the importance of wild mushrooms across the three main ethnic groups, ethnomycological use values (UV) and the relative frequency of citation (RFC) were calculated for each use category and by ethnic group. The Mbororo people have a wide variety of uses for mushrooms, with a use value index of 2.04, followed by the Gbaya with 1.45 (Table 5). Across all three tribes, the UV and the RFC for food use were the highest, indicating strong consensus on the nutritional importance of mushrooms within these communities. In contrast, the UV and RFC for medicinal use was the lowest, particularly among the Peul. This suggests that knowledge of the medicinal potential of mushrooms is limited, and only a few species are employed for therapeutic purposes.

Table 5. Use value and relative frequency of citation for different category among the main tribes

Tribe	Total number of respondent "N"	Number "n" of citation per category			UV	Relative Frequency Citation		
		Food	Medicine	Commerce		Food	Medicine	Commerce
Peul	250	245	10	32	1.15	0.98	0.04	0.13
Gbaya	149	146	32	38	1.45	0.98	0.21	0.26
Mbororo	27	27	11	17	2.04	1.00	0.41	0.63

Similarity among mushroom species use by the three ethnic groups

The Sorensen's similarity analysis shows that the matching of species used between tribes varies from 78.26 to 92.3 between Gbaya and Mbororo and between Gbaya and Peul respectively (Table 6). These similarities above 50%, demonstrates that members of the three ethnic groups almost use similar species.

Table 6. Sorensen similarity index between the sociolinguistic groups taken in pairs

Couple of tribes	**Gbaya and Mbororo**	**Gbaya and Peul**	**Mbororo and Peul**
Sorensen Similarity (%)	78.26	92.3	88

Multiple factorial correspondence analysis (Figure 6) reveals a clear structuring of mushroom uses according to ethnic groups, explaining 42.60% of the total variance. The first factorial plane highlights three distinct poles: a central core associating the Gbaya and Peul with predominantly food-related uses (Food). Meanwhile, the Mbororo stand out clearly due to their preference for medicinal uses (Medicine). The Gbaya also differ from the Peul in their affiliation with commerce.

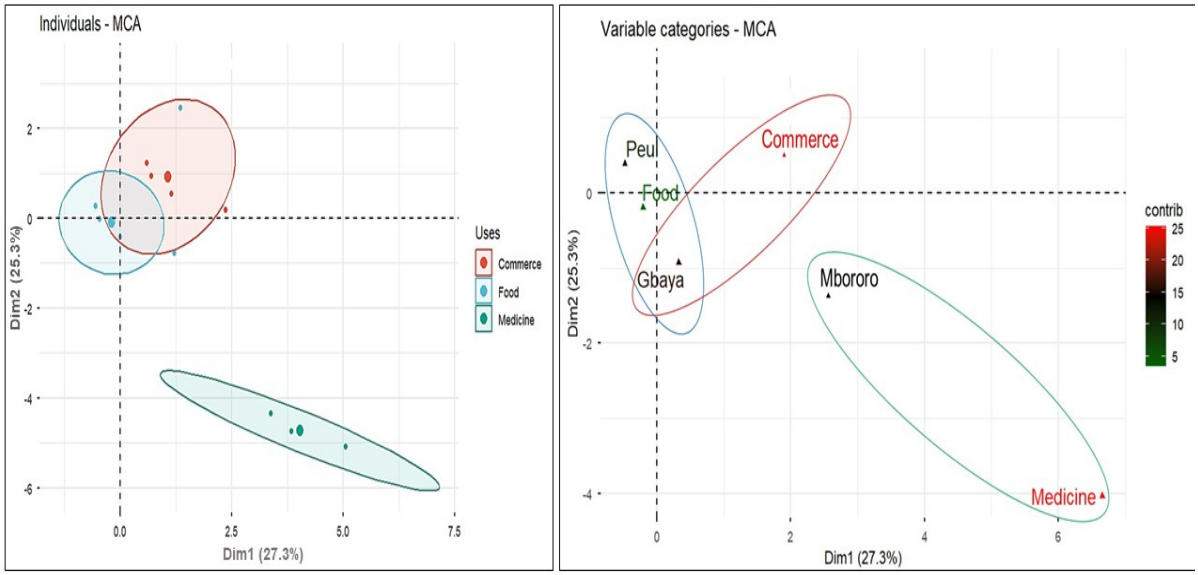

Figure 6. Multiple factorial correspondence analysis (MCA) by ethnic group

Discussion

The surveyed population was highly diversified, confirming that rangelands constitute an important land-use system for communities in the Vina and Mbere divisions. The ecosystem services provided by these rangelands are shared by a wide range of individuals, with Peul and women dominating. The prevalence of Peul respondents reflects their demographic dominance in the region, while the strong representation of women aligns with findings from Yafetto & Osei-Bonsu (2017) and Despe *et al*. (2023). In this context, women are more involved in family nutrition and education, and thus play a central role in collecting natural resources, including mushrooms, for food, health, and income.

This study on useful mushrooms in the grazing areas of the Adamaoua region of Cameroon indicates that the level of knowledge about mushrooms varies among ethnic groups. Indigenous knowledge is mainly transmitted from generation to generation, and most of this knowledge is held by older individuals above 40 years of age, who are more likely to have a good knowledge of the uses of different species (Tsobou *et al*. 2013). This transmission from generation to generation is known in several regions of Cameroon, across Africa, and around the world, where parents pass on knowledge to the younger generation in order to preserve local indigenous knowledge about mushrooms (Kamgoue *et al*. 2024). Unfortunately, this knowledge is increasingly threatened by the weakening of intergenerational communication, as young people tend to migrate to urban areas in search of better opportunities. Similar patterns have been reported in Argentina, Indonesia and Benin (Molares *et al*. 2020, Yusran *et al*. 2024, Fadeyi *et al*. 2025). Globally, the results show that most people in the Adamaoua region recognize mushrooms as living organisms, and that women are relatively more involved in their exploitation. The tendency of women to be relatively more involved and even to have a better knowledge of mushrooms has been observed in Africa South of the Sahara (Rammeloo & Walleyn 1993) and other regions of Africa, especially in Kenya (Nelima *et al*. 2021) and Congo (Ndolo Ebika *et al*. 2024) and Benin (Adjimoti *et al*. 2025).

Each ethnic group possesses a specific mycological nomenclature system, including general names for mushrooms, distinctions between edible and toxic species, and specific names for important taxa. The presence of mushroom names in nearly all local languages, with clear differentiation between edible and toxic types, highlights the secular relationship between these communities and fungi, primarily for nutritional purposes. Similar ethnotaxonomic systems have been documented in Cameroon (Njouonkou *et al*. 2016, Teke *et al*. 2018, Fongnzossie *et al*. 2020) and other African countries such as Benin (Fadeyi *et al*. 2025). The fact that all tribes had a general name for toxic or bad mushrooms shows that they are aware about the existence of such species even though they did not name any particular toxic species in the area. In general, locals are reluctant to use any mushroom species that have never been introduced to them by their ascendants as edible or medicinal to be toxic. In the area species such as *Panaeolus papilionaceus*, *Deconica coprophila*, *Coprinus disseminatus* are considered as toxic or bad without any explanation. Similarly, they are rejecting species including *Lentinus cladopus* that is known to be edible and used as food in Africa (Bastos *et al*. 2023).

In the study area, mushrooms are exploited in three categories including food, trade and medicine, consistent with previous ethnomycological studies (Adjimoti *et al*. 2025). Here, food had the highest value as mushrooms are known worldwide primarily for their contribution in nutrition. Species of the genus *Termitomyces* were the most popular edible and commercialised species, as observed across tropical Africa (Qwarse *et al*. 2021, Kamgoue *et al*. 2024, Madiapevo *et al*. 2024, Dejene *et al*. 2025). However, no species of this genus were cited for medicinal use in this study, unlike reports from other regions (Ayodele & Idoko 2011, Kadhila-Muandingi & Chimwamurombe 2012, Njouonkou *et al*. 2016, Onguene *et al*. 2018, Fongnzossie *et al*. 2020). Instead, sub-coprophilous mushrooms (*Chlorophyllum hortense* and *Chlorophyllum globosum*), rarely cited as useful in Cameroon, were highly valued by respondents for food, commerce, and medicine. These species are particularly appreciated by the Mbororo and Peul, who live in close contact with cattle and thus encounter dung-associated fungi more frequently. In contrast, the Gbaya, primarily crop producers and traders, reported less familiarity with sub-coprophilous species. Other notable edible species include *Lactifluus gymnocarpoides, Cantharellus congolensis,* and *Russula ochrocephala,* which are the only ectomycorrhizal mushrooms consumed in the area. While other ectomycorrhizal taxa, such as *Amanita* and *Russula* are widely used in West Africa (Yorou *et al*. 2014), Ghana (Boa 2006), Nigeria (Nwordu *et al*. 2013), Senegal (Bâ *et al*. 2011) and even in Cameroon (Njouonkou et al. 2016), they were not reported by respondents in this study.

In total, 16 mushroom species were documented as used by population of the Adamaoua Region. This number is lower than that reported in other regions of Cameroon, such as the Noun division with 37 species (Njouonkou *et al*. 2016) and the South Region with 94 species (Onguene *et al*. 2018), as well as other countries in Africa, including the Democratic Republic of Congo, Tanzania, Ethiopia, Central African Republic with 31, 32, 51, and 53 species, respectively (Mikobi *et al*. 2023, Qwarse *et al*. 2021, Dejene *et al*. 2025, Kouagou 2024). The lack of knowledge about several fungi may be due to the local culture being geared towards pastoral farming (consumption of beef and milk) rather than mushroom picking. Despite all this, the number of species documented here is higher than that reported for the Kilum-Ijim mountain forest and in the Northwest Region of Cameroon (Teke *et al*. 2018, Fongnzossie *et al*. 2020). To differentiate between these mushroom species, the Peul, Gbaya, and Mbororo relied on three main criteria: size, shape, and substrate. The Gbaya and Mbororo emphasized substrate more strongly, while the Peul used all three criteria with similar frequency. This approach is comparable to identification practices in the Yayo Coffee Forest Biosphere Reserve, Ethiopia (Dejene *et al*. 2025).

While observing closely, if the UV per use category was calculated, similar result would have been obtained with that of RFC. This is due to the fact that the UV per use category according use it would have been determined thank to the “Uses Totaled Category Limited” allocating zero for individuals that did not mention the use in the category and one for those who mentioned the use (Hoffman & Gallaher 2007). This logically generated similar data like those of RFC that is simply the ratio of respondent who mentioned the category to the total number of informants. The two results would have been different if the subjective allocation was used considering major and minor uses for each use mentioned. This suggests that globally in ethnobotany, using “Uses Totaled Category Limited” to calculate UV per use category is analogous to calculate the RFC for a use category.

The Mbororo emerged as the ethnic group with the highest UV showing that they have the most extensive practical and cultural knowledge on mushrooms in the area. Their close relationship with rangeland ecosystems likely explains this depth of knowledge. It had been observed that people living permanently within or closely to savannas or forests ecosystems tend to possess richer endogenous knowledge on the uses of mushrooms than other groups (Codjia & Yorou 2014, Kouagou *et al*. 2016). The high similarity index was observed between communities. This demonstrates that as members of these tribes are sharing the same ecosystem, they have been exchanging their experiences on the various useful mushroom species growing in the area.

Conclusion

This study provides a preliminary overview of the ethnomycological knowledge of populations in the Adamaoua region of Cameroon. It documents the use of at least 16 mushroom species, including two sub-coprophilous species, as sources of food, medicine, and income. Species of the genus *Termitomyces* are consumed across all ethnic groups, while *Chlorophyllum hortense* and *Chlorophyllum globosum* are the only sub-coprophilous fungi reported to be used in traditional medicine. The importance of mushrooms is reflected in vernacular names and ethnoecological knowledge systems that distinguish edible from toxic species. Knowledge varies among ethnic groups, with the Mbororo demonstrating the highest ethnomycological knowledge compared to the Peul and Gbaya. This highlights the cultural dimension of mushroom use and the role of traditional ecological knowledge in sustaining local livelihoods.

By documenting local interests and practices related to useful mushrooms, this study establishes a baseline for promoting ethnomycological awareness and conservation of mushroom diversity in the region. It also underscores the potential of mushrooms to contribute to food security, health, and income generation. Future rigorous studies should focus on characterizing the nutritional and medicinal properties of these species, thereby enhancing their role in sustainable resource management and improving community well-being.

Declarations

List of abbreviations: CECANAPROF: Centre of Competence for the Study of Antimicrobial Natural Products from Fungi; INS: National Institute of Statistics; MCA: Multiple factorial correspondence analysis; MINPAT: Ministry of Economy, Planning, and Land Management; Mytips: Tropical Mycology and Plant-Soil Fungi Interactions; RFC: Relative frequency of citation; UNDP: United Nations Development Programme; UV: Use value; VLIRUOS: executive agency of the Flemish Interuniversity Council.

Ethics approval and consent to participate: Research Attestation issued by Department of Biological Sciences of University of Ngaoundere, PO BOX 454 Ngaoundere on the 18th June 2024. We also obtained verbal authorization from the Senior Divisional Officers of the Vina and Mbere Divisions respectively. In addition, in each village where the study was carried out, the authorization of the traditional rulers was obtained after presenting research attestation and explaining the purpose of the research.

Consent for publication: Not applicable.

Availability of data and materials: Specimens are held at CECANAPROF laboratory in Yaoundé Cameroon and doubles of some specimens are conserved at Mytips herbarium in Benin.

Competing interests: The authors declare that they have no competing interests.

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Author contributions: ZNM: Contributes in research design, ethnobotanical survey, structuring the methodology, sample collection and identification, in data analysis and interpretation; manuscript writing. **JT**: Contributes in research coordination, verification and quantitative valorization, interpretation of results, manuscript review and editing. **EM**: Contribute in data analysis and interpretation; manuscript writing and handling of revisions. **ALN**: Contributes in conception and coordination of the research work, Identification of mushroom species, literature search, manuscript preparation, submission, and handling of revisions. **RBT**: Contributes in research conception, manuscript revision and manuscript editing. **AV**: Contributes in critical revision of the manuscript, improvement of the English language. **NSY**: Study design and valorization of the results obtained. **SFK**: Supervision and coordination of the work, active correction, improvement and revision of the manuscript. **PMM**: Research concept and design, general supervision and manuscript revision. All authors read, examined and approved the final version of the manuscript

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Literature cited

Adjimoti WK, Fadeyi OG, Ndolo Ebika ST, Cathy S, Minter D, Yorou NS. 2025. Fungal Resources for Human Well-being: Implications for Poverty and Gender Inequality in Sub-Saharan Africa. Ethnobiology and Conservation 14: 1-27. doi: 10.15451/ec2025-11-14-35-1-27

Allen VG, Batello C, Berretta EJ, Hodgson J, Kothmann M, Li X, McIvor J, Milne J, Morris C, Peeters A, Sanderson M. 2011. An international terminology for grazing lands and grazing animals. Grass and Forage Science 66: 2-28. doi: 10.1111/j.1365-2494.2010.00780.x

Awalu MA, Nformi MI. 2022. Rangeland Degradation and Rehabilitation: Indigenous Ecological Knowledge and Perceptions of Pastoralists in the Adamawa High Plateau of Cameroon. International Journal of Horticulture, Agriculture and Food Science 6(4): 1-24. doi: 10.22161/ijhaf.6.4.1

Ayodele SMK, Idoko ME. 2011. Antimicrobial activities of four wild edible mushrooms in Nigeria. International Journal of Sciences 2: 55-58.

Bâ A, Duponnois R, Diabaté M, Dreyfus B. 2011. Ectomycorrhizal fungi of forest trees in West Africa. Marseille: IRD Edition.

Bastos C, Liberal A, Moldão M, Catarino L, Barros L. 2023. Ethnomycological prospect of wild edible and medicinal mushrooms from Central and Southern Africa-A review. Food Frontiers 4: 549-575. doi: 10.1002/fft2.215

Boa E. 2006. Wild edible mushrooms. Overview of their uses and importance to people. Non Timber Forest Products 17. Rome, FAO.

Bouayyadi L, El Hafian M, Zidane L. 2015. Floristic and ethnobotanical study of medicinal flora in the Gharb region, Morocco. Journal of Applied Biosciences 93: 8760-8769.

Codjia J, Yorou NS. 2014. Ethnicity and gender variability in the diversity, recognition and exploitation of Wild Useful Fungi in Pobè region (Benin, West Africa). Journal of Applied Biosciences 78: 6729-6742. doi: 10.4314/jab.v78i0.14

Deffo V, Ombionyo M, Pamo TE, Lieugomg M, Tchotsoua M. 2010. Seasonal variation of the nutritive value of natural forage and effect on cattle performances in Cameroon. Advances in Animal Biosciences 1. doi: 10.1017/S2040470010000737

Dejene T, Semere M, Gebeyehu D, Yohannes Y, Martín-Pinto P. 2025. Ethnomycology of Yayo Coffee Forest Biosphere Reserve, southwest Ethiopia. Forest Systems 34: 1-16. doi: 10.5424/fs/2025343-21034

Despe A, Plimaco SMY, Japos MI, Niez L. 2023. Ethnomycological Survey of Wild Mushroom Species Utilized by the Subanen Tribes in Selected Barangays in Tangub City, Misamis Occidental, Philippines. Research Square. doi: 10.21203/rs.3.rs-3066317/v1

Fadeyi OG, Olou BA, Tadagbé ADM, Piepenbring M, Yorou NS. 2025. Comparative Analysis of Naming Criteria for Wild Edible Mushrooms across Linguistic Families in Benin. Open Journal of Applied Sciences 15: 13-32. doi: 10.4236/ojapps.2025.151002

Fandohan AB, Gouwakinnou GN, Tovissode CF, Bonou A, Djonlonkou SFB, Houndelo LF, Assogbadjo AE. 2017. Traditional uses and economic value of *Synsepalum dulcificum* in southern Benin. Bois Forets Tropiques 332: 17-30.

Fongnzossie EF, Nyangono CFB, Biwole AB, Ebai PNB, Ndifongwa NB, Motove J, Dibong SD. 2020. Wild edible plants and mushrooms of the Bamenda Highlands in Cameroon: ethnobotanical assessment and potentials for enhancing food security. Journal of Ethnobiology and Ethnomedicine 16(12): 2-10. doi: 10.1186/s13002-020-00362-8

Hoffman B, Gallaher T. 2007. Importance Indices in Ethnobotany. Ethnobotany Research and Applications 5: 201-218. www.ethnobotanyjournal.org/vol5/i1547-3465-05-201.pdf

ILRI, IUCN, FAO, WWF, UNEP, ILC. 2021. Rangelands Atlas. International Livestock Research Institute. Nairobi Kenya. https://www.rangelandsdata.org/atlas/sites.

INS (Institut National de la statistiques/Cameroun). 2025. Annuaire statistiques de la region de l'Adamaoua. Edit. INS Cameroun. https://ins-cameroun.cm/wp-content/uploads/2025/09/Annuaire-statistique-AD-Ed-2024-Fr.pdf

Kadhila-Muandingi P, Chimwamurombe P. 2012. Uses of *Ganoderma* and other mushrooms as medicine in Oshana and Ohangwena regions of Northern Namibia. Journal of Research in Agriculture 1: 146-151.

Kamgoue NYB, Sumer SR, Sudhanshu M, Donkeng VSM, Prashakha JS, Nanda DGL, Ladoh YCF, Essouman EPF, Wamba FO, Asseng CC. 2024. Ethnomycological Investigation and Domestication of Wild Edible Mushrooms from the Department of Bamboutos (West Cameroon). International Journal of Scientific Research & Engineering Trends 10(6): 3235-3243.

Kouagou RY, Tsopmbeng GN, Njouonkou AL. 2016. Diversité et ethnomycologie des champignons sauvages utilisés dans la préfecture de la Lobaye en République Centrafricaine. Bulletin Scientifique sur l'Environnement et la Biodiversité 1: 30-38.

Kouagou RY. 2024. Étude taxonomique et ethnomycologiques des macromycètes en République centrafricaine. Thèse de Doctorat en Biologie végétale. Université de Lille, France.

Madiapevo SN, Worowounga X, Ndotar M, Semboli O, Mandago JB. 2024. Diversity and Ethnomycological Knowledge of Wild Mushrooms Consumed by Indigenous People Living Near the Botambi Classified Forest in the Central African Republic. American Journal of Food Science and Technology 12: 167-176. doi: 10.12691/ajfst-12-5-5.

Mapongmetsem PM, Djomba E, Fawa G, Oumarou Z, Dangai Y, Bellefontaine R. 2017. Vegetative propagation of *Vitex doniana* Sweet from root segments cuttings: Effects of substrate and length of cuttings on the rooting ability. Annals of Experimental Biology 5(1): 18-24.

McGahey D, Davies J, Hagelberg N, Ouedraogo R. 2014. Pastoralism and the Green Economy - a natural nexus? Status, challenges and Policy implications. International Union for Conservation of Nature and Natural Resources, United Nations Environment Programme. www.iucn.org/wisp/resources/publications/

Mikobi CM, Tipi E, Kashiki BKN, Makanua ID, Kasali JL, Michel B. 2023. Diversité et usages des macromycètes de la Réserve de Biosphère de Luki (Kongo Central /République démocratique du Congo). Vertigo - la revue électronique en sciences de l'environnement: 1-12. doi: 10.4000/vertigo.39434

MINPAT, UNDP. 2000. UNDP-OPS Project CMR/98/005/01/99. Regional socio-economic studies in Cameroon: poverty eradication, improvement of social data. Adamaoua Province. Tunis: UNDP-OPS.

Molares S, Toledo CV, Stecher G, Barroetaveña C. 2020. Traditional mycological knowledge and processes of change in Mapuche communities from Patagonia, Argentina: A study on wild edible fungi in Nothofagaceae forests. Mycologia 112: 9-23. doi: 10.1080/00275514.2019.1680219

Ndolo Ebika ST, Moungouya-Moukassa CL, Wawa J, Atikani GB, Koubouana F. 2024. Wild harvesting of Termite Mushrooms (*Termitomyces* spp.) in Kitengué, Republic of the Congo. Economic Botany 78: 433-444. doi: 10.1007/s12231-024-09619-9

Ndong EH, Degreef J, De Kesel A. 2011. Champignons comestibles des forêts denses d'Afrique centrale. http://www.abctaxa.be

Nelima M, Nyakundi A, Achoka J. 2021. Evaluation of cost-benefits of oyster mushroom production using innovative water hyacinth substrate for sustainable development of SMEs, Kenya. International Journal of Finance and Accounting 6: 16-31. doi: 10.47604/ijfa.1310.

Njouonkou AL, De Crop E, Abdoulayi MM, Tonjock RK, Biyé EH, Verbeken A. 2016. Diversity of Edible and Medicinal Mushrooms Used in the Noun Division of the West Region of Cameroon. International Journal of Medicinal Mushrooms 18(5): 387-396.

Nwordu ME, Isu RU, Ogbadu GH. 2013. Catalogue and Identification of Some Wild Edible Macro-fungi in Nigeria. Online International of Food Science 2: 1-15.

Onguene AN, Tchudjo T, Kuyper TW. 2018. Biodiversity of wild edible macrofungi in the rainforest of southern Cameroon. Bois et Forets des Tropiques 338: 87-99. doi: 10.19182/bft2018.338.a31679

Piepenbring M, Maciá-Vicente JG, Codjia JE, Glatthorn C, Kirk P, Meswaet Y, Minter D, Olou BA, Reschke K, Schmidt M, Yorou NS. 2020. Mapping mycological ignorance - checklists and diversity patterns of fungi known for West Africa. IMA Fungus 11. doi: 10.1186/s43008-020-00034-y

Qwarse M, Moshi M, Mihale MJ, Marealle AI, Sempombe J, Mugoyela V. 2021. Knowledge on utilization of wild mushrooms by the local communities in the Selous-Niassa Corridor in Ruvuma Region, Tanzania. Journal of Yeast and Fungal Research 12: 8-19.

Rammeloo J, Walleyn R. 1993. The edible fungi of Africa south of the Sahara: A literature survey. Ministry of Agriculture, Administration of Agricultural Research, National Botanic Gardens of Belgium. Scripta Botanica Belgica 5: 1-62.

Teke NA, Kinge TR, Bechem E, Nji TM, Ndam LM, Mih AM. 2018. Ethnomycological study in the Kilum-Ijim mountain forest, Northwest Region, Cameroon. Journal of Ethnobiology and Ethnomedicine 14(25): 1-12. doi: 10.1186/s13002-018-0225-8

Tsobou R, Mapongmetsem PM, van Damme P. 2013. Medicinal plants used Against typhoid fever in Bamboutos Division, Western Cameroon. Ethnobotany Research and Applications 11: 163-174.

World Bank. 2009. World Development Indicators. World Bank, Washington D.C. www.data.worldbank.org/indicator (accessed 14 June 2026)

Yafetto L, Osei-Bonsu V. 2017. Ethnomycological survey of Cape Coast Metropolis, Ghana. Current Research in Environmental & Applied Mycology 7(4): 258-266. doi: 10.5943/cream/7/4/2

Yorou NS, Koné NA, Guissou ML, Guelly AK, Maba DL, Ekué MRM, De Kesel A. 2014. Biodiversity and Sustainable Use of Wild Edible Fungi in the Sudanian Centre of Endemism: A Plea for Valorisation. In: Bâ AM, McGuire K, Diédhiou AG (eds) Ectomycorrhizal Symbioses in Tropical and Neotropical Forests. CRC Press, Boca Raton, pp. 241-270.

Yusran Y, Erniwati, Rukmi R. 2024. Ethnomycology of Wild Edible Mushrooms by the Bunggu Tribe in West Sulawesi, Indonesia. International Journal of Design & Nature and Ecodynamics 19(6): 2097-2107. doi: 10.18280/ijdne.190626