

Morphology and Diversity of Wild Macro-Fungi in Yauri Metropolis Kebbi, Kebbi State

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Abstract

Wild mushrooms have been relatively well documented in various environments however; they remain significantly under-recorded in the Guinea Savanna region of southern Kebbi State due to lack of both professional and amateur mycologists conducting periodic surveys. This study aimed at studying morphology and diversity of wild mushrooms in Yauri metropolis using standard procedures between May to October, 2023. A total of eight wild mushroom species were identified, belonging to five families: Agaricaceae, Hypoxylaceae, Pleurotaceae, Polyporaceae, and Ganodermataceae. Among the species observed on various substrates, *Daldinia concentrica* (31.6), *Ganoderma applanatum* (17.1), and *Trametes versicolor* (12.8) had the highest densities. *Pleurotus tuber-regium* and *Ganoderma* spp. both recorded a density of 8.5, followed by *Agaricus* sp. with 5.1, while *Ganoderma lucidum* showed the lowest density at 4.3. This study represents a preliminary effort to document and characterize the morphological features of wild mushrooms in the area. It highlights the urgent need for a more comprehensive and systematic survey of mushroom species across Kebbi State. Accurate scientific identification of wild mushrooms is essential for understanding their distinguishing features and exploring their potential biological and economic benefits.

Keywords: Mushroom, diversity, macro and microscopic morphology

1.0 Introduction

Wild macrofungi are seasonal edible and non-edible fungi with fruiting bodies that can be seen with the naked eye, this type of fungi is known as Chiro bee in C'lela, Buran-Kare/Buran Jaki in Hausa and Kambari [1, 2]. Macrofungi, belonging to the family basidiomycetes are considered the most important fungal species in the forests and moderately thick vegetation of the Guinea savannah in Southern Kebbi state [2]. The majority of these species are found abundant during the rainy season, especially between July to September when rainfall is higher with a low relative humidity and soil pH of 6.0 to 8.0 [3]. It is reported that rainfall, substrate quality, temperature, soil composition, forest and vegetation determine the phenology and diversity of wild

mushroom [4, 5]. In developing regions, Nigeria is exclusive several anthropological upheavals caused by human and other environmental crises, affecting the abundances, richness and succession of wild macrofungi species [6, 7, 8]. Macrofungi species plays an essential role in maintaining the delicate balance of Earth planets ecosystems by providing essential services that support tropic levels and human health [9, 8].

The diversity of wild mushroom species, medicinal uses, biological potency, economic functions, ecology and taxonomic identification has recently received increasing attention in Nigeria [10, 11, 12]. Similarly, many scientific reports have shown that there are an estimated 140,000 mushroom species worldwide and only 14,000 (10%) are known [13,

14]. On the other hand, the poor state of the mushroom industry in countries, for instance, the giant of Africa, is due to lack of substantial information about wild mushroom species in Nigeria [15]. Many peoples consider wild mushrooms as natural food source for which scientists have identified thousands of macro- and microelements that stimulate or cure various human diseases [16, 17, 18, 19, 20].

The macroscopic morphology of mushroom species varies depending on the sizes, texture, color, shape, and nature of the cap, stalk, regions and substrate types. These variations are important characteristics commonly used in identifying mushrooms at the macroscopic level [21, 22, 23]. Mycologists are sometimes wary of local classifications because are based on scientifically unreliable characters [24]. Since the prehistoric times, human activities, e.g. mycophagists often have profound effects on vegetation leading to depleting and unsystematic identification. Therefore, validating the precise procedures for collection, macro-and microscopic morphology as well as species diversity of wild mushroom is one of the most challenging research areas for many researchers, especially in Kebbi state due to the fact that only the study of [2] in Southern Kebbi (Zuru) and [25] in Gwandu emirate existed. In contrast, researchers like [26] in Bauchi, [27] in Kogi, and [28] in Akwa Ibom have provided preliminary data on wild fungi diversity and macroscopic features, often overlooking microscopic analysis. In addition others concentrated on small group of edible fungi species that are commercially cultivated [20], while ignored wild edible fungi, though recently expertise of trained mycologists often documented species found in field studies [29, 30]. As a result of that, accurate identification and identifying the correct species of wild mushrooms is the surest way to ensure the scientific validity of each species and robust classification systems. Therefore, studies on the morphological and species diversity of wild fungi need to be carefully exploited to avoid recedes of identified and unidentified nomenclature through proper catalogue. However, global warming, environmental destruction and overexploitation occur around the world caused severe species extinction. This study aimed to determine the diversity and morphological characteristics (macroscopic and microscopic) of wild mushroom.

2.0 Materials and Methods

2.1 Study Area

Yauri is situated southwards of Kebbi state on the eastern bank of the famous River Niger, between latitudes 10° 42'N and 11° 13'N and longitudes of 4° 09'E. The area is characterized by medium thick forest vegetation bounded by Koko/Besse and Shanga local areas in the north, Ngaski local government area and Niger state in the south and Bagudo local government in the west. It has a fluctuated mean annual temperature of 21°C - 38°C or above between the months of March to April. But the annual rainfall is about 13000 in the month of June to September in which around August the average reached 240mm [31].

2.2 Field Survey

Field surveys were conducted in the study area, to ascertain the ecological distribution of wild mushroom species. A simple surveyed protocol was adopted with the aimed of providing necessary and broad-based information on wild mushroom occurrence; local names, date, habitations, location, color, consumption pattern and status were used as described by [32].

2.3 Collection of Wild Mushrooms Species

The wild mushroom species encountered were collected during 2023 rainy season using a modification of the standard procedure adopted by [33] a forager's guide to wild mushrooms in Britain, Ireland and Europe. Wild mushrooms on wooden bases (such as fallen logs, tree stumps, bark and decaying branches) were collected by plucking with a sharp pocket knife, while mushrooms living on the ground are harvested with a small trowel. Small brushes were used to dusted-off foreign spores and soil debris/dirt on each species collected to keep contamination levels to a minimum. During mushroom collections, a face mask and rubber gloves were wear properly to take safety precautions and record information such as collection date, location, habitat, substrate type, smell, local name, condition, shape and color of each wild mushroom encountered were documented in a field notebook to facilitate morphological research before collection. Photographed of wild mushrooms encountered were clearly taken at close view in the field before the collection [2]. All the collected mushrooms were taken to the Department of Plant Science and Biotechnology Laboratory,

Abdullahi Fodio University of Science and Technology, Aliero for identification, microscopic and macroscopic examination.

2.4 Macroscopic Identification and Description of Wild Mushrooms

The local name and status of each species were provided by the locality of each village visited while the classification and taxonomic description were carried out by the Professor of Mycology at the herbarium section, Department of Plant Science and Biotechnology, Abdullahi Fodio University of Science and Technology, Aliero. Identification was based on reproductive structures visible to the naked eye above the ground and morphological characteristics such as size, shape, odor, texture and color. Other morphological features such as decoration on the surface of the pileus and stipe, presence of a ring on the stipe and volva at the base of the stipe were also observed and compared with the colored Mushroom Field Guide Book [34].

2.5 Microscopic Identification

Forceps were used to create gill fragments from collected freshly identified mushroom samples. Slides were prepared from the collected spores by mounting the spores onto a clean glass slide with a drop of lacto phenol cotton blue smear, covered with a coverslip, and viewed under a microscope (model Nikon Eclipse E200) under Ocular micrometer (x40) magnification. The characteristics and size of the spores were observed and compared with previously documented information in different literatures as adopted by [25] with slightly modification.

2.6 Habitat, distribution and diversity of Encountered Wild Mushroom

The frequency and density of encountered wild mushroom species were calculated using the following formulas;

$$\text{Frequency (\%)} = \frac{\text{Number of site in which the species is present}}{\text{Total number of sites}} \times 100$$

$$\text{Density} = \frac{\text{Total no. of individual of a particular species}}{\text{Total number of species}} \times 100$$

3.0 Results

A total of eight wild mushroom species were identified namely; *Agaricus* sp., *Ganoderma applanatum*, *Ganoderma tsugae*, *Ganoderma lucidum*, *Daldinia concentrica*, *Pleurotus tuber-regium* and *Trametes versicolor* belonging to five families: Agaricaceae, Hypoxylaceae, Pleurotaceae, Polyporaceae, and Ganodermataceae (Table 1).

Table 2 presents images of mature fruiting bodies, visible pore structures in certain species, spore characteristics, and the scientific names of the mushroom species identified within the study area.

The analysis of mushroom species frequency and density revealed that *Daldinia concentrica* was the most frequently occurring species, with a frequency of 37 and a density of 31.6%. This was followed by *Ganoderma applanatum*, which recorded a frequency of 18 and a density of 17.1%. *Trametes versicolor* ranked next with a frequency of 15 and a density of 12.8%, while *Ganoderma tsugae* was recorded 14 times, accounting for 12% of the total density. *Agaricus* had the lowest occurrence, with a frequency of 5 and a density of 5.1%, making it the least common species documented in the study as seen in Table 3.

Table 1: Habitat and Morphological Features of the Identified wild mushrooms Collected in Yauri metropolis

Family	Scientific name	English name	Local name	Habitat	Features					
					Texture	Colour	Stipe	Pileus shape	Pores spacing	Pores color
Agaricaceae	<i>Agaricus</i> sp	Agaricus specie	Arada kpage	Dead decay litter of tamarin tree	Abit-soft	White and dark-brown	Present	Umbrella-like	Scattered	Dark-brown
	<i>Ganoderma applanatum</i>	Reishi Mushroom	Shiva udanga	On wood of locos bean tree	Woody and tough	Dark-brown	Pseudo Stipe	Flat	Crowded	White
Ganodermataceae	<i>Ganoderma tsugae</i>	Hemlock/Varnish shelf	Aliwan aralu	on decayed root	Woody and tough	Dark brown and white	Small	Flat	Crowded	White
	<i>Ganoderma lucidum</i>	Reishi Mushroom	Aliwan Udanga ushili	log of wood	Corky to Woody	Dark-red with white boader	Absent or Short	Flat	Crowded	Whitish
Hypoxylaceae	<i>Daldinia concentrica</i>	Cramp ball/ King Alfred's cake	Kumbura	On dead woods Mango tree and locos bean wood	tough and brittle	Pinkish Brown	Pseudo stipe	Cushion shaped	Crowded	Black
Pleurotaceae	<i>Pleurotus tuber-regium</i>	Pleurotus	Aliwan aralu	On decayed root	Fleshy	Dark-brown skin with Inner white	Present	Cup-like shape	Crowded	Dark brown
Polyporaceae	<i>Tremetes versicolor</i>	Turkey tail (bracket fungi)	Aliwa udanga	On Locos bean wood	Brittle and woody	Dark violet	Pseudo stipe	Concave	Crowded	White

Table 2: Photograph and microscopic features of wild mushroom encountered

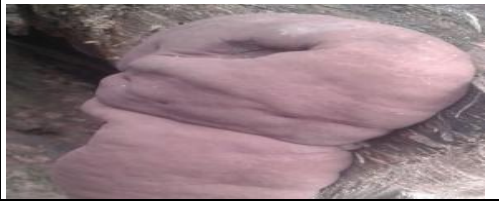
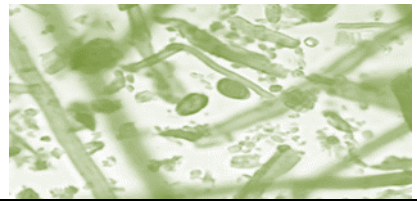



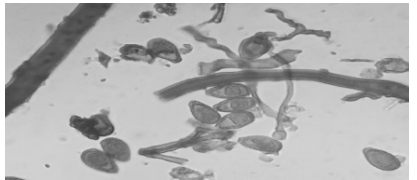

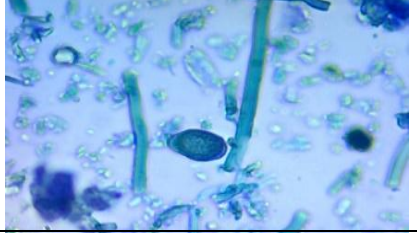

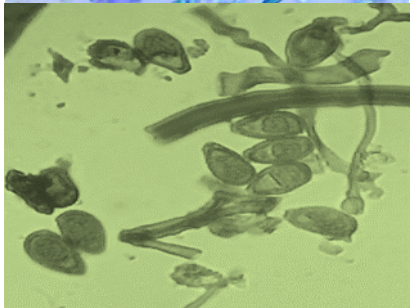

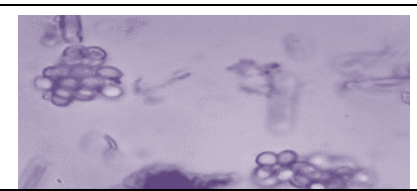

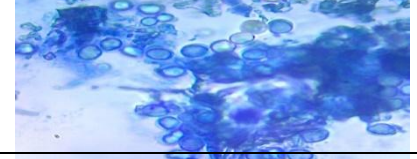


Fruiting Body	Photomicrographs	Species
		<i>Daldinia concentrica</i>
		<i>Tremetes versicolor</i>
		<i>Ganoderma applanatum</i>
		<i>Ganoderma tsugae</i>
		<i>Pleurotus turber-regium</i>
		<i>Ganoderma lucidum</i>
		<i>Ganoderma</i> spp
		<i>Agaricus</i> spp

Table 3: Frequency and density of encountered wild mushroom in the study area

Species	Frequency	Density
<i>Daldinia concentrica</i>	37	31.6
<i>Tremetes versicolor</i>	15	12.8
<i>Ganoderma applanatum</i>	18	17.1
<i>Ganoderma tsugae</i>	14	12
<i>Ganoderma lucidum</i>	5	4.3
<i>Pleurotus turber-regium</i>	10	8.5
<i>Agaricus</i> sp.	6	5.1
<i>Ganoderma</i> spp.	10	8.5

4.0 Discussion

There is a keen interest always in a small group of valuable wild fungi that cannot be cultivated or utilize to fight food insecurity such as malnutrition and boost the income of people but the main problem is naming and recognizing of this species. In the present research (8) wild mushroom belonging to five (5) families were identified and documented for the first time in the study area. Similarly a morphological species structure has been documented by several researchers in different parts of the world [35, 36, 2, 38, 2, 28]. Also, the microscopic features observed in all the species are in line with the findings of [25] and [12] that showed the photomicrographic feature of *Agaricus alphitochrous*. According to [38] the exact process by which early humans identified mushroom species those that were safe and suitable to eat is unclear, but there is little doubt it was by trial and error, a common approach used for wild plants and other living things that were hunted or gathered for food. Small amounts were tentatively tasted, before smell, texture, and lack of any adverse reaction decided which mushrooms could be eaten. An accurate fungal identification remains a persistent and critical challenge within biological sciences, traditionally dependent on the observational skills and taxonomic expertise of trained mycologists [39].

Ganodermataceae family was found with the highest number of species, this harmony with the study of [40] on exploitation and diversity of edible macrofungi in Mount Harriet National Park, Andaman and Nicobar Islands. Also, high number of these species under this family observed in the current study could be due to the availability of Locos bean wood that provide essential carbohydrate or decayed roots which serve as good substrate for diversifications of this species. As a result, the findings of [37] Menge District, Asossa

Zone, Benshangul Gumuz Region, Ethiopia, [28] almost matched with our findings, who has found different species of *Ganoderma* on dead wood. In other hand, this finding is analogical with the findings of [41], [42] on diversity and identification of Mushrooms in Nagaland, India and South Lampung. Some of the variations found are probably due to the variation of vegetation, climatic and organism's anthropological agitations as suggested by [43]. Thus, dead wood is the most common conducive for wild mushrooms growing environments probably due to the symbiotic relationship between them. Interestingly, species of *Daldinia concentrica* and *Ganoderma tsugae* were recorded with the highest density (Table 3) although *Daldinia concentrica* was found growing on mango tree while *Ganoderma tsugae* on decayed root. In spite of this, [44] reported the prevalence of these species on different decayed stump in Atewa forest reserve and Bia Biosphere, Ghana.

The increasing interest in foraging and the commercial importance of edible mushrooms collected from the wild emphasize the need for reliable information on the properties of species. Unfortunately, in accurate taxonomy, lack of knowledge, or simply personal opinions have resulted in numerous conflicting reports on which mushrooms are edible and which are not safe to eat, creating a need for consensus of how to determine edibility and which species are in fact safe to eat. Generally, as noted by [45], various approaches are used to identify fungal species, including Morphological Species Recognition (MSR), Phylogenetic Species Recognition (PSR), and Genealogical Concordance. Despite decades of taxonomic refinement and morphological categorization, the vast diversity of mushroom species, coupled with their often subtle phenotypic variations, continues to complicate efforts toward definitive classification. This reliance on expert knowledge, while invaluable, poses limitations in

scalability and consistency especially in Kebbi state and entire Nigeria with limited access to specialized training. As global concerns around biodiversity, there is an increasing need for innovative, accessible and accurate methods of mushroom identification that transcend the constraints of traditional taxonomy.

5.0 Conclusion

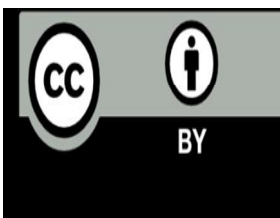
The system of scientific names aims to remove doubt about the fungus being record or described, hence it the most useful way of determining the status such as edibility or poisonous, medicinal as well as other crucial details. Thus, the research documented and shows the photo-macrographs and photomicrographs of *Daldinia concentrica*, *Ganoderma applanatum*, *Tremetes versicolor*, *Pleurotus turber-regium*, *Ganoderma* spp., *Agaricus* sp. and *Ganoderma lucidum* mushroom species with their local names that are belonging to the Agaricaceae, Hypoxylaceae, Pleurotaceae, Polyporaceae and Ganodermataceae families for the first time in the study area. The rate of discovery and identified wild mushrooms in the study area need attention of mycological expertise in order to provide molecular information of these species that could lead to the authentic and valid in scientific name of these documented species for checklist purpose.

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