INVESTIGATION ON THE NUTRIENT CONTENT IN WILD MUSHROOMS OF AIZAWL DISTRICT, MIZORAM

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INVESTIGATION ON THE NUTRIENT CONTENT IN WILD MUSHROOMS OF AIZAWL DISTRICT, MIZORAM

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SUPERVISOR'S CERTIFICATE

This is to certify that the Ph.D. Thesis entitled, **"Investigation on the nutrient content in wild mushrooms of Aizawl District, Mizoram"** is a bonafide work assigned to Mr Laltanpuia Renthlei having Reg. No. MZU/Ph.D./1225 of 01.08.2018, Department of Environmental Science for partial fulfillment for the Degree of Doctor of Philosophy under Mizoram University.

The report submitted by the candidate is his own study and carried out by him and results embodied in the Thesis have not been submitted for award of any degree or any other institute or University of learning. It is recommended that this thesis be placed before the examiners for the award of the Degree of Doctor of Philosophy.

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DECLARATION

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I **LALTANPUIA RENTHLEI** hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

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Date: (LALTANPUIA RENTHLEI)

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INTRODUCTION

Chapter 1

INTRODUCTION

Fungi are an ancient group of eukaryotic organisms, though not as old as bacteria, which are believed to have existed for approximately 3.5 billion years based on fossil evidence. The earliest known fungus fossils, however, are from the Ordovician period, around 460 to 455 million years ago (Redecker et al., 2000). Fungi include molds, yeasts, and mushrooms, and can be unicellular, like yeasts, or multicellular, like molds. They are categorized based on their nutritional strategies as biotrophs, saprotrophs, or necrotrophs, and reproduce by producing and dispersing spores (Carris et al., 2012). They absorb organic compounds for nourishment through absorptive heterotrophy (Worrall, 1999). Their structure typically includes hyphae, thread-like structures with cell walls, and they mainly reproduce via spores, which may be single-celled or multicellular (Islam et al., 2017).

The fungal kingdom includes a highly diverse group of heterotrophic eukaryotes with chitinous cell walls. They have lost phagotrophic abilities and range from simple unicellular forms to complex multicellular structures (Naranjo-Ortiz and Gabaldón, 2019). The current taxonomy of fungi recognizes 9 main lineages such as Opisthosporidia, Chytridiomycota, Blastocladiomycota, Neocallimastigomycota, Zoopagomycota, Glomeromycota, Mucoromycota, Ascomycota, and Basidiomycota. These lineages collectively form the clade known as true fungi, which is closely related to amoeboid protozoans, including Nucleariida (*Nuclearia*, *Micronuclearia*, *Parvularia*) and Funticulida (*Fonticula*) (Karpov et al., 2014; Tedersoo et al., 2018). The fungal cell wall, located outside the plasma membrane, protects the cell’s contents, provides structural support, and helps in managing stress such as osmotic changes. It also facilitates environmental interactions through proteins like adhesins and receptors (Garcia-Rubio et al., 2020).

Fungi represent a significant lineage with major ecological and economic impacts. Higher fungi, in particular, are among the most diverse biological resources globally (Zhong and Xiao, 2009). They are crucial for nutrient cycling, forming symbiotic relationships, and maintaining ecosystem stability (Mueller and Bills, 2004; Niego et al., 2023). Ecologically, fungi are crucial for the biogeochemical cycling of carbon, serving as primary decomposers of organic matter. In agriculture, they function as mutualistic symbionts, pathogens, and saprophytes, aiding in nutrient mobilization, influencing the environment, and serving as bio-control agents or bio-fertilizers (Walker and White, 2005). Fungi are highly effective in breaking down complex organic substances like cellulose, lignins, and gums, and can thrive in various soil conditions, from acidic to alkaline. They play vital role in physiological processes such as mineral and water uptake, chemical transformations, and the productions of bio-stimulants like auxins, lignans, and ethylene, which help plants, manage environmental stresses including drought, salinity, heat and cold (Yuvaraj and Ramasamy, 2020). Additionally, fungal metabolism is key in detoxifying pollutants and remediating heavy metals and other persistent chemicals in the environment, including wastewater and groundwater (Mohamadhasani and Rahimi, 2022).

Fungi lack chlorophyll, unlike green plants. Consequently, they are heterotrophic organisms characterized by a thallus, which is an assemblage of vegetative cells that do not form functional tissues or differentiated organs. The absence of chlorophyll and the inability to produce their own food are the primary differences between mushrooms and higher plants (Ślusarczyk et al., 2021; El-Ramady et al., 2022). They exhibit a wide range of reproductive strategies, although nearly all species are capable of sexual reproduction, many primarily reproduce asexually. When sexual reproduction does occur, there is significant variation in the extent of inbreeding and outbreeding among different species (Nieuwenhuis and James, 2016). They reproduce by means of reproductive units called spores (Chen et al., 2018; Korman, 2020). Due to their stationary nature, fungi reproduce by forming spores for dispersal via air, water, or animals. Aquatic fungi produce flagellated zoospores, while terrestrial fungi formed hyphae and generate non-motile spores. Asexual spores fromed sporangiospores and conidia, while sexual spores include zygospores, ascospores, and basidiospores, with the latter two often ejected into the air. Sporulation requires favorable conditions such as light and temperature and involves cellular signaling and metabolic changes. As spores mature, they develop thicker walls, accumulate energy reserves, and their metabolism slows for dormancy. Upon germination, metabolic activity increases, and a germ tube emerges from the spore (Moore-Landecker, 2002). A number of fungi produce large and conspicuous fruiting bodies and are often called macro fungi or commonly known as mushrooms (Chang and Miles, 1992; Arnolds, 1992; Richards and Murray, 2003; Bates, 2006).

The combination of extracellular digestion and nutrient absorption is a defining the characteristics of the fungal way of life. In the course of evolution, fungi have conquered an amazingly wide range of habitats, fulfilling important roles in diverse ecosystems (Dix and Webster, 1995). Relationship between fungi's absorptive heterotrophy and plants' photoautotrophy has given rise to various trophic interactions. These interactions include symbiotic relationships, where fungi and plants coexist closely, and saprotrophic interactions, where fungi decompose dead plant material, aiding in soil formation and nutrient cycling. These interaction types are systematically distributed across different fungal and plant phylogenies, reflecting their unique evolutionary paths (Lutzoni et al., 2018).

The exact number of fungal species on Earth is unknown, but there have been estimates over the past two decades suggesting a range from 1.5 to 6 million species (Hawksworth, 1991; Hawksworth and Lücking, 2017). Advancements in DNA sequencing technologies have revolutionized taxonomy and diversity of fungi, resulting in revised species - extending from 2.2 to 3.8 million based on host associations, and from 11.7 to 13.2 million using high-throughput sequencing techniques. Despite these high estimates, only about 1,50,000 fungal species have been formally described, suggesting that the true diversity of fungi is vastly underestimated (Hyde, 2022; Phukhamsakda et al., 2022). India lies in the tropical belt; favourable environmental conditions for fungal growth are seen throughout the year. As of 2005, India has documented over 29,000 fungal species (Manoharachary et al., 2005). However, recent reports on fungal biodiversity and taxonomy indicate that many species, including new discoveries, have been described since 2005. It is anticipated that numerous additional species will continue to be identified and described from 2005 to 2024. Fungi are morphologically and ecologically diverse kingdoms but remain less explored from a global perspective and India has the highest number of publications on lichens, whereas China leads with publications on wild mushrooms (Fang et al., 2023).

Northeast India is a part of the Indo-Burma biodiversity hotspot, an area known for its rich variety of plant and animal species, including numerous fungi. The states in northeast region, such as Arunachal Pradesh, Assam, Manipur, Mizoram, Meghalaya, Nagaland, Sikkim, and Tripura, report different species of fungi. There are reports of more than 733 species of macrofungi occurring in Northeast India, distributed across 267 genera, 21 orders, and 94 families. However, this comprehensive checklist covers only a small aspect of the North East India's vast biodiversity. North East India, with its diverse ecosystems and unique climatic conditions, serves as a hotspot for fungal biodiversity (Roy et al., 2022; Chawngthu et al., 2023; Thachunglura et al., 2024)

Mushrooms are intricately connected to nearly all parts of living plants within terrestrial ecosystems. Mushrooms play crucial roles in dynamic and complex communities of plants, animals, and microorganisms. They decompose dead organic matter and interact with evergreen plants, serving as key regulators of carbon and nutrient cycling, which is essential for maintaining biodiversity (Bell et al., 2022). They are commonly found in soil, dead organic matter, animal droppings, nectar, and sap flows. Some mushrooms act as aggressive plant pathogens, causing wood decay and are parasitic to insects and animals (Reeleder, 2003; Frąc et al., 2018; Chawngthu et al., 2021). Several timber trees and many ornamental plants rely symbiotically on ectomycorrhizal fungi, although some mushrooms function as pathogens to plants or other fungi. Fruiting mushrooms on woody substrates are typically either saprobes or plant pathogens (Mueller et al., 2007; Policelli et al., 2020; Yamada, 2022). From an ecological perspective, mushrooms fall into three primary categories: saprophytes, parasites, and symbiotic (mycorrhizal) species. These fungi serve as important indicators of the health of forest ecosystems. Observing whether they are present or absent can provide significant information about the state of the ecosystem, such as whether it is damaged or mature (Egli, 2011; Ediriweera et al., 2022). The visibility of their fruiting bodies makes it easier to study their ecology compared to micro fungi (Tang et al., 2015; Senanayake, 2020).

Mushrooms play a crucial role in recycling both natural and industrial forest waste by breaking down complex polymers like lignin and cellulose, as well as decomposing dead organic matter, they degrade lignocellulosic substrates through lignocellulosic enzyme production and utilize the degraded products to produce their fruiting bodies (Kumla et al., 2020; Singh and Vyas, 2022; Mujtaba et al., 2023). In the biological world, mushrooms hold a prominent position due to their diversity, economic value, and environmental significance (Ayimbila and Keawsompong, 2023). They are vital for several reasons, including their role in nutrient cycling, soil structure formation, and serving as food within detritivore food webs in forests and forest streams. Fungi also contribute to habitat creation through fungal pathogens and mycorrhizal mutualisms (Yuvaraj and Ramasamy, 2020; Doley and Borde, 2021; Potapov et al., 2022). Soil mushrooms, which develop within the soil, rely on both living (biotic) and non-living (abiotic) factors. Key biotic factors include organisms like algae, fungi, bacteria, actinomycetes, and nematodes, which play essential role in breaking down organic material and releasing nutrients. Macro fungi play a vital role in soil creation and maintaining its fertility, with the richness of the soil being greatly influenced by the variety of fungal species present (Frac et al., 2018; Liu et al., 2021).

The study of mushrooms has long intrigued scientists due to their significant role in various aspects of human life. They are widely used in agriculture, medicine, the food industry, textiles, bioremediation, natural nutrient cycling, and the decomposition of dead organic matter (Valverde et al., 2015; Chugh et al., 2022; Bhambri et al., 2022). Beyond these applications, mushrooms are also employed in soil and litter management, serving as biofertilizers, and contributing to the development of sustainable agricultural practices. Furthermore, they play a crucial role in ecosystem restoration and have potential uses in creating biodegradable materials and producing biofuels (Elsakhawy et al., 2022; Llanaj et al., 2023; Upadhyay et al., 2024). Many wild mushrooms have been used as food and medicine in many parts of the world since time immemorial (Stamets and Zwickey, 2014).

Wild edible mushrooms have been widely valued around the globe for their nutritional benefits and medicinal properties. Mushrooms are regarded as functional foods due to their high nutritional, culinary, and medicinal values. Their consumption has been increased in due course of time, both as part of the regular diet and in the form of dietary supplements. This is largely due to their rich content of vitamins, minerals, proteins, and bioactive compounds that offer numerous health benefits (Dimopoulou et al., 2022; Demirtas et al., 2024; Senila et al., 2024). Mushrooms possess a low fat and high protein content and are rich in several vitamins, including B, C, D, and K. They also provide essential minerals such as potassium and phosphorus, as well as trace elements like selenium and copper. Additionally, mushrooms are a good source of dietary fiber, which aids in digestion and promotes a healthy gut (Gupta et al., 2019; Khumlianlal et al., 2022; Assemie and Abaya, 2022; Ravikrishnan and Sridhar, 2023). Mushrooms contain moderate to strong antioxidants properties, including ergothioneine and glutathione to combat oxidative stress and human well being. Moreover, mushrooms have been found to contain bioactive compounds like beta-glucans and polysaccharides that can enhance the immune system and potentially have anti-cancer properties (Badalyan, 2003; Lesa et al., 2022; Mazzola et al., 2024).

False identification of mushrooms is a significant risk, as many edible species closely resemble toxic ones. Careful identification is crucial to avoid potentially severe health consequences, including poisoning (Jo et al., 2014; He et al., 2022). Mushroom species identification has traditionally relied on observing phenotypic characteristics. This involves examining macroscopic features such as the cap shape, cap margins, surface structures on the cap, stipe shape, and stipe position. Microscopic analysis of spores, including their shape, color, and size, is performed under a microscope. Spores can also be studied through spore printing, a technique commonly used for mushrooms with distinct caps (Giusti et al., 2020). Additionally, observing the habitat and growth conditions, such as whether the mushroom grows on wood, soil, or leaf litter, can provide important clues (Fischer and Money, 2010). The season and geographic location are of utmost importance, as certain mushrooms only appear at specific times of the year or in a particular region. Consulting reliable field guides, seeking expertise from experienced mycologists, and using modern techniques like DNA sequencing can further enhance identification accuracy (Hyde, 2013; Kozel and Wickes, 2014; Lücking et al., 2020). Given these complexities, proper education and caution are imperative when foraging for wild mushrooms. Mushrooms hold significant potential for future use and management in supporting sustainability initiatives across agriculture, conservation, and ecosystem restoration. These considerations are particularly relevant in this time of global change and widespread depletion of natural resources (Field et al., 2020).

Mizoram is located in an Indo-Burma biodiversity hotspot and hosts a wide variety of fungi. The state's rich and diverse ecosystems provide an ideal environment for the proliferation of wild mushrooms. In Mizoram, past researchers conducted studies on soil and wood-rotting fungi and reports approximately 40 to 50 reported wild edible mushroom species. (Zothanzama, 2011; Bisht, 2011; Lalrinawmi et al., 2017; Vabeikhokhei et al., 2019; Zohmangaiha et al., 2019; Chawngthu et al., 2021). However, there is paucity of information on the nutritional value of edible wild mushrooms in Mizoram. The available literature on the nutritional value of a few species depicts that most of the edible species in Mizoram possess good nutritional value, offering potential health benefits for the local population (Thachunglura et al., 2023; Zohmangaiha et al., 2023; Thachunglura et al., 2024). However, majority of mushroom species are unexplored with regards to their nutritional properties such as protein content, carbohydrates, fiber, fats, and trace minerals. To this end, comprehensive studies on the nutritional qualities of wild edible mushrooms are urgently needed. Indigenous people in the area would be better able to use these mushrooms as a dependable and effective food source.

OBJECTIVES

The major objectives of study envisage the following:

1. Morphological identification of wild mushrooms.
2. Analysis of Macro Nutrient content in wild mushrooms.
3. Analysis of Micro Nutrient content in wild mushrooms.

CHAPTER-2

REVIEW OF LITERATURE

Chapter 2

REVIEW OF LITERATURE

North East India consists of eight states such as Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. It shares international borders with Bangladesh, Bhutan, China, Myanmar, and Nepal. Geographically, it is located between 22° and 29°5' N latitude and 88° and 97°30' E longitude. This area is a part of the Indo-Burma mega biodiversity hotspot (Myers et al. 2000).

Mushrooms are the fleshy spore-bearing fruiting bodies of fungi (Celestine et al., 2013). Mushrooms have a great nutritional value since they are rich in protein, with an important content of essential amino acids and fibers, poor in fat and high in vitamins and minerals (Racz et al., 1996; Khumlianlal et al., 2022). In general, mushroom fruiting bodies, on a dry weight basis, contain about 39.9% carbohydrate, 17.5% protein and 2.9% fats, the rest being the minerals (Demirban 2001). Approximately 1,40,000 species of mushrooms have already been catalogued all over the world, about 2000 being considered safe for human consumption and about 700 have therapeutic properties (Lull et al., 2005; Valverde et al., 2015). Gupta (1986) reported that the mushroom can substantiate malnutrition as they contain protein, vitamins and essential amino acids. In a short period of time, edible mushrooms can produce more protein per unit area than crops. However, thousands of mushroom species known worldwide, only about 20 species are cultivated commercially (Chang, 1990). Mushrooms are recognized as an alternative source of good quality protein and are capable of producing highest quantity of protein per unit area and time from the worthless agro-wastes (Chadha and Sharma, 1995).

Edible mushrooms have been used as food and food supplements since time immemorial. They are increasingly being recognized as one of the important food items for their significant role in human health, nutrition and diseases (Chang and Buswell, 1996). Bano et al., (1963) determined the nutritive value of *Pleurotus flabellatus* as 0.974% ash, 1.084% crude fibre, 0.105% fat, 90.95% moisture, 0.14% non-protein nitrogen and 2.75% protein on fresh weight basis. Verma et al., (1987) also reported that mushrooms are very useful for vegetarian because they contain some essential amino acids which are found in animal proteins. The digestibility of *Pleurotus* mushroom protein is as that of plants and meat (Bano and Rajarathnam, 1988).

Nanba (1993) reported that mushrooms can be used to bridge the protein malnutrition gap due to high amount of proteins. Mushrooms are considered functional foods and are often used in nutritional supplements to boost the immune system. Their low starch and cholesterol content makes them suitable for individuals with diabetes and heart conditions. One third of the iron in the mushrooms is in available form (Dimopoulou et al., 2022). Buswell (1996) reported that mushrooms can provide balancing diet in sufficient quantities for human nutrition, and contain medicinal compounds.

Alam et al., (2007) reported that minerals that found in mushroom are Calcium, Iron, Manganese, Magnesium, Zinc and Selenium. Compared to other animal and plant foods, edible mushrooms have a higher protein content, fewer carbohydrates (and not in the form of starch, but rather glycogen), low fat, and sufficient amounts of vitamins and minerals. They are also of higher quality than vegetables and fruits. Mushrooms are good source of high quality fibers and low calorie food (Kakron et al., 2012).

Fruiting bodies of mushrooms are appreciated, not only for texture and flavour but also for their chemical and nutritional characteristics (Manzi et al., 2001). Mushrooms are valuable, healthy and nutritious foods, low in calories and high in vegetable proteins, vitamins, iron, zinc, selenium, sodium, chitin, fibres and minerals (Mendil et al., 2004; Ouzouni, 2004; Ouzouni and Riganakos, 2007; Ouzouni et al., 2007; Racz et al., 1996). In general, the fruiting bodies of mushrooms, on dry weight basis, contain about 56.8% carbohydrate, 25.0% protein, 5.7% fats and 12.5% of ash (Demirbas, 2002; Latiff et al., 1996; Mendil et al., 2004; Paraskevi et al., 2009). Many people believe that eating mushrooms offers health benefits, and this notion is bolstered by the fact that mushrooms have been known for their therapeutic powers since ancient times. Scientific research has also begun to identify several bioactive chemicals in mushrooms that promote health and wellness (Stamets and Zwickey, 2014).

Mushrooms are a globally widespread group of organisms. The main body of a fungus is not the visible mushroom but rather a vast network of tiny, branching filaments known as hyphae. This interconnected web of hyphae is called a mycelium. What we typically identify as a mushroom is actually a reproductive structure formed by tightly organized hyphae, which emerges from the mycelium the vegetative part of the fungus that grows within soil, leaf debris, or rotting wood. The hyphae absorb essential nutrients and water to support fungal growth. When environmental conditions, such as temperature and humidity, are suitable, the mycelium produces one or more fruiting bodies—commonly called mushrooms. These structures generate countless microscopic spores, enabling long-distance dispersal through wind currents. Although mushrooms are the most noticeable part of fungi, they represent only a small fraction of this highly successful evolutionary group. The true fungal organism lies hidden within its substrate as an expansive mycelial network.

Fungi thrive in almost every environment imaginable, from freshwater and marine ecosystems to all types of terrestrial habitats. Remarkably, their total biomass is estimated to be twice that of all animal life on earth combined. There are many enthusiasts of mycophagy (fungus eating) in Japan, where more than one hundred types of wild mushrooms are popular (Ueda et al., 1992). In Britain the population is not noted for consumption of specialty mushrooms (cultivated mushrooms other than *Agaricus bisporus* and *A. bitorquis*), and keen mycologists have struggled to assemble a similar list, eventually coming up with only twenty commonly eaten wild mushrooms (Legg 1990). In countries such as Australia, New Zealand, England, and the United States, mushrooms such as the delicious giant puffball (*Calvatia gigantea*) and porcini (*Boletus edulis*) are more likely to receive a swift dispatch with the end of a boot than to be picked as a delicacy (Hall et al., 2003). The consumption of wild edible mushrooms is increasing, even in the developed world, due to a good content of proteins as well as a higher content of trace minerals (Thimmel and Kluthe, 1998). Wild edible mushrooms are a common food source among the indigenous people of Mizoram, Northeast India. High humidity level during the monsoon season starting from May to September provides ideal atmosphere for the growth of many saprophytes, including the mushrooms.

Edible mushrooms are known for their low lipid content and a higher proportion of polyunsaturated fatty acids, which contributes to their low caloric value. Unlike other foods, mushrooms do not contain cholesterol; instead, they have ergosterol, which serves as a precursor for Vitamin D synthesis in the human body (Dimopolou et al., 2022; Khumlianlal et al., 2022). While the protein content in edible mushrooms is generally high, it can vary significantly, with crude protein levels ranging from 12% to 35%, depending on the species (Beelman et al., 2003; Usman et al., 2021; Assemie and Abaya, 2022). It is known that mushrooms are a good nutritional choice for diabetics since they are low in calories, high in protein, and have high potassium-to- salt ratio. Their low starch and sugar content makes them especially ideal. Mushrooms are also low in fat, high in linoleic acid, and cholesterol-free, making them suitable for people with obesity, hypertension, and atherosclerosis. Their alkaline ash and high fiber content are especially beneficial to persons suffering from hyperacidity (Chinara and Mahapatra, 2020).

Many edible mushrooms are not consumed by local populations, as there are numerous species that remain unknown in different regions. This lack of knowledge about mycology leads to lack of awareness in rural communities for edible wild mushrooms. As a result, some people avoid consuming certain edible mushrooms (Ramírez-Terrazo et al., 2021; Hussain et al., 2023). This varies by region, for instance, *Schizophyllum commune* is commonly consumed in many parts of the Northeast India (Ao and Deb, 2019; Zothanzama, 2011; Lalrinawmi et al., 2018), but people in many Western regions are less likely to eat it. Similarly, in Mizoram, there is a general reluctance to consume Amanita mushrooms due to the perceived risks, despite their nutritional value and health benefits being recognized in other parts of the world. However, Amanitas are often classified as inedible or poisonous due to their potential to cause fatal poisoning. There are numerous reports of mushroom poisoning cases worldwide, highlighting the need for caution (Wennig et al., 2020; Li, et al., 2021). Consulting experts is crucial for safely identifying edible mushrooms and avoiding poisonous ones.

In Mizoram, a variety of wild mushrooms grow naturally and are highly valued by local communities especially the order Russulales and Agaricales. During the monsoon season, when these fungi flourish, foragers gather them from the wild, making them a staple in traditional cuisine. These mushrooms not only add flavor and nutrition to meals but also hold cultural significance as a seasonal delicacy. In spite of the immense popularity of this food in the region, data regarding the nutritive value of the wild mushroom varieties available in the northeastern region are very insufficient (Aghar-Murughar, 2004).

Edible mushrooms are treated as a delicacy which can be taken regularly as part of the human diet, healthy food or as functional foods (Thachunglura et al., 2023). Mushrooms can also be designed to supplement the human diet not as regular food, but for the enhancement of health and fitness which can be classified into the category of dietary supplements known as mushroom nutraceutical (Mattila et al., 2001; Thachunglura et al., 2024).

In Mizoram, a study on the nutritional properties of wild edible mushrooms was conducted, assessing the nutritional value of several species. Thachunglura et al., (2023) reported that *Pleurotus giganteus* contains significant amounts of minerals and protein. This species was identified using molecular analysis, and it has a large fruiting body, making it a viable food source. Chawngthu et al., (2023) also examined the nutritional value of *Lentinula edodes*, commonly known as shiitake mushroom highlighting its beneficial properties, though the mineral content was not assessed in this specimen. Additionally, Thachunglura et al., (2024) evaluated ten other mushroom species from Mamit and Champhai districts, and reported that some species have considerable amounts of nutrients and minerals. However, no edible mushroom species from Aizawl district has been reported for their nutritional value.

CHAPTER-3

MATERIALS AND METHODS

Chapter 3

MATERIALS AND METHODS

3.1 Study area, climate and vegetation

Mizoram covers an area of 21,081 sq. km and geographically lies between the coordinates of 23.1645° N, 92.9376° E. Mizoram is also recognized as a biodiversity hotspot, owing to its remarkable diversity of plant and animal species. The tropic of Cancer passes through the state at 23.500° N. In the summer, the temperature ranges from 25-35 °C, and in the winter 11-21 °C. The sample collection site Aizawl district covers an area of 3,577 sq. kilometres, is positioned to the north of the tropic of Cancer in the northern region of the state. For detailed investigation, a total of 3 sites were selected for the collection of sample, mainly, Mizoram University campus, Hlimen forest and Lungleng Forest (Figure 3.1).

3.1.1 Mizoram University Campus

Mizoram University is located approximately 18 kilometers west of Aizawl, the state capital. The campus spans about 980 acres and is situated between the coordinates 23° 45'25'' N to 23° 43'37'' N latitude and 92° 38'39'' E to 92° 40'23'' E longitude. The elevation ranges from 330 meters to 880 meters above sea level and a temperature ranging from 12ºC–30ºC. The forested areas have porous, sandy loam, and humus-rich soils, while the open areas feature coarse, friable, and lateritic sandy soils with top-soil often eroded by runoff. The climate is humid and tropical, with short winters and long summers. The common tree species in the campus of Mizoram University include *Castanopsis tribuloides* (Thingsia), *Schima wallichii* (Khiang), *Aporusa octandra* (Chhawntual*)*, *Alseodaphne petiolaris* (Bul), *Styrax serrulatum*, *Michelia champaca*, *Rhus semialata*, *Saurauia punduana* (Tiar), *Lithocarpus xylocarpa* (Then), *Macaranga indica* (Hnakhar), *Callicarpa arborea* (Hnakiah), *Aganope thyrsiflora* (Hulhu), *Albizia odoratissima* (Thingri), *Anogeissus acuminata* (Zairum), *Archidendron monadelphum* (Ardah), *Colona floribunda* (Hnathap), *Desmodium triangulare* (Sebehliang), *Elaeocarpus aristatus* (Theikelek), *Engelhardtia spicata* (Hnum), *Erythrina stricta* (Fartuah), *Eurya cerasifolia*

(Sihneh), *Ficus hirta* (Sazutheipui), *Glochidion khascium* (Thingpawnchhia), *Ilex umbellulate* (Thinguihahni), *Lepionurus sylvestris* (Anpangthuam), *Litsea lancifolia* (Hnapawhte), *Morus macroura* (Lungli), *Syzygium cumini* (Lenhmui), *Syzygium grandis* (Theichawl), and *Tabernaemontana divaricata* (Par arsi).

3.1.2. Hlimen forest

Hlimen forest is located approximately 7 kilometers south of Aizawl, the capital of Mizoram, in a village named South Hlimen. The area is situated between latitudes 23° 40' and 23° 40' 944" N and longitudes 92° 42' and 92° 42' 985" E. It covers a rectangular area with a length of 243.84 meters and a breadth of 396.34 meters, totaling approximately 96,643.54 square meters. The landscape is hilly, with altitude ranging from 1000 to 1100 meters above sea level. The study area records temperature ranging from 12ºC–27ºC. The region is primarily composed of Tertiary rocks from the Bhuban sub-group. The highest point in the study area reaches 1065 meters above sea level. Hlimen forest is known for its dense and vibrant canopy, which provides habitat for numerous species of birds, insects, and mammals, contributing to the ecological balance of the region. Lalsavunga Park, which opened on October 3, 2018, offers visitors a chance to explore the rich natural environment of Mizoram, making Hlimen forest a prominent area for conservation efforts and ecotourism. The common tree species in Hlimen Forest include *Aporusa octandra* (Chhawntual), *Lithocarpus xylocarpa* (Then), *Macaranga indica* (Hnakhar), *Callicarpa arborea* (Hnakiah), *Albizia chinensis* (Vang), *Anogeissus acuminata* (Zairum), *Archidendron monadelphum* (Ardah), *Desmodium triangulare* (Sebehliang), *Emblica officinalis* (Sunhlu), *Erythrina stricta* (Fartuah), *Ficus hirta* (Sazutheipui), *Ficus racemose* (Theichek), *Glochidion khascium* (Thingpawnchhia), *Lepionurus sylvestris* (Anpangthuam), *Lithocarpus elegans* (Thingpuithing), *Litsea monopetala* (Nauthak), *Morus macroura* (Lungli), *Oroxylum indicum* (Archangkawm), *Sterculia villosa* (Khaupui).

3.1.3. Lungleng forest

Lungleng is a village situated near Aizawl in Mizoram. It holds historical significance as the home of Mr. Khamliana Sailo, a notable Mizo Chief who was one of the first literate leaders among the Mizo and authored the first official message in the Mizo language. The village is 1011 meters above sea level, with coordinates 23°39'57" N and 92°39'41" E, south of Aizawl city. Temperature of the area ranges from 12ºC – 30ºC with a relative humidity ranging from 58-76%. Lungleng forest is positioned on a hill-top and is surrounded by a narrow belt of dense community reserve forest, which includes sub-tropical broadleaved evergreen mixed forest and secondary forest areas outside the reserve. The village experiences an average annual rainfall of about 2500 mm. The common tree species in Lungleng forest include *Castanopsis tribuloides* (Thingsia), *Michelia champaca*, *Saurauia punduana* (Tiar), *Lithocarpus xylocarpa* (Then), *Macaranga indica* (Hnakhar), *Callicarpa arborea* (Hnakiah), *Anogeissus acuminata* (Zairum), *Archidendron monadelphum* (Ardah), *Desmodium triangulare* (Sebehliang), *Elaeocarpus aristatus* (Theikelek), *Engelhardtia spicata* (Hnum), *Erythrina stricta* (Fartuah), *Eurya cerasifolia* (Sihneh), *Ficus hirta* (Sazutheipui), *Glochidion khascium* (Thingpawnchhia), *Ilex umbellulate* (Thinguihahni), *Lepionurus sylvestris* (Anpangthuam), *Lithocarpus elegans* (Thingpuithing), *Litsea lancifolia* (Hnapawhte) and *Litsea monopetala* (Nauthak).

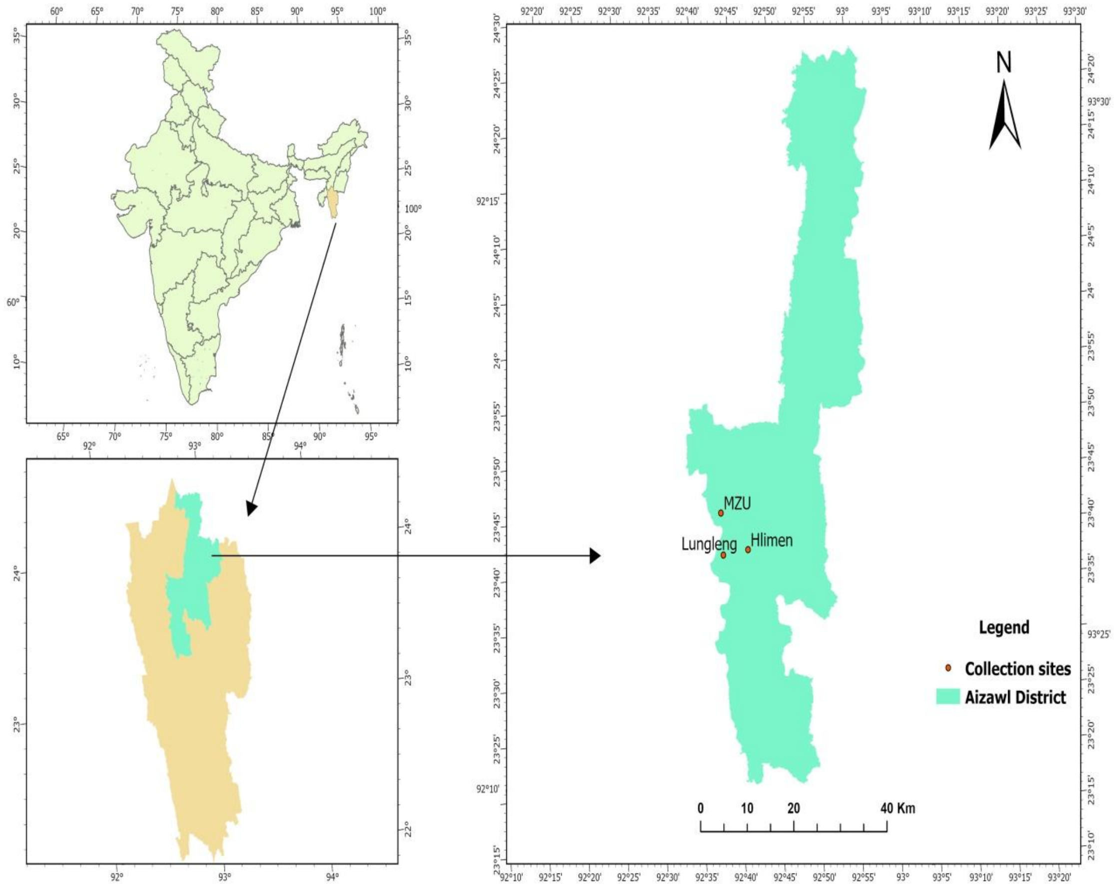

Figure 3.1: Map showing the location of study sites

3.2. Collection of specimen

The samples were collected from various locations within Aizawl district during the rainy season, from May to October, over the years 2019 to 2022. The primary collection sites included Mizoram University Campus, Hlimen Forest, and Lungleng Forest. Each site was carefully chosen to represent different ecological zones within Aizawl district.

The specimens were collected from various substrates, including ground soil, dead woods and trees across the study sites. The collected specimens were thoroughly cleaned to remove forest debris and other extraneous materials. They were then carefully transported back to the laboratory for further analysis. To ensure proper identification, photographs of each sample were taken both in the field and in the laboratory. The samples were stored in plastic bottles and bags to preserve their integrity until analysis. Additionally, they were preserved through air drying and deep freezing to maintain their condition and prevent deterioration.

3.3. Identification of specimen

The morphological characters like color of the fruiting body (stipe and pileus), size, shape, coordinates and collection site of the mushrooms were recorded carefully. The collected specimens were subsequently identified based on micro and macro-morphological characteristics with the help of appropriate literature (Arora, 1986; Gilbertson and Ryvarden, 1986; Phillips et al., 2010; Bisht, 2011; Sawhasan et al., 2011; Furtado et al., 2016; Tarafder et al., 2017). Spore print of the collected mushroom specimen were taken by cutting off the cap/pileus and placing it in a piece of white paper for about 30 minutes to overnight, then, the color of the spore print was noted (Surcek, 1988). Nomenclature, taxonomic position and author names follow the databases: Index Fungorum- IFS (http://www.indexfungorum.org), the International Plant Names Index – IPNI (http://www.ipni.org) and MycoBank (http://www.mycobank.com).

For microscopic examination, thin sections of the dried specimens were carefully prepared using a sharp razor blade. These sections were initially mounted in a 3% potassium hydroxide (KOH) solution and stained with 2% aqueous phloxine for better visibility of structures. Additional mounts were made using Lactophenol or a mixture of 60% lactic acid and cotton blue. Spore prints were obtained by cutting a portion of the pore surface and placing it on white paper, which was then covered to allow spores to deposit (Zohmangaiha et al., 2019).

Reagents for staining:

Melzer's reagent: Iodine - 0.5g, Potassium Iodide (KI) - 1.5g Chloral hydrate - 20g, Distilled water - 20ml.

Eosin and Phloxine (1 or 2%): 1 or 2g Eosine or Phloxine in 100ml water.

Cotton blue: Cotton blue in 60% lactic acid.

Lactophenol: 5g lactic acid, 5g phenol, 10g glycerin and 5ml water

Potassium hydroxide (KOH): 2 - 5% KOH in water

3.4. Morphology and Terminology

This section covers the macroscopic and microscopic characteristics of mushrooms and the scientific terms used to describe their taxonomic details.

Macroscopic Characters

Macroscopic features of mushrooms are crucial for taxonomy and are discussed here along with their significance.

The Pileus

The pileus or cap supports the spore-producing surface and is described by its size, shape, margin, moisture content, texture, color, and other surface features. These characteristics are important for immediate identification and classification.

• Size and Shape: The size and shape of the pileus vary with age and can include flat, convex, concave, parabolic, conical, cylindrical, bell-shaped, funnel-shaped, centrally depressed, or umbonate forms.

• Margin: Margins may be smooth, wavy, crenate, striate, zoned, incurved, inrolled or straight.

• Moisture: Pileus surface may be dry/moist, and gelatinized caps can be glutinous (slimy) or viscid (sticky).

• Color: The color of the pileus can range from white to various shades including yellow, orange, red, brown, pink, and more. Colors can change with age, cutting, bruising, or environmental factors.

• Surface: The surface may be smooth, wrinkled, striate, slimy, viscid, scaly, hairy, or cracked.

• Flesh: The flesh color, texture, thickness, odor, and taste are significant for species identification.

The Lamellae

The lamellae or gills are thin, radiating structures on the underside of the pileus that produce spores.

• Attachment: Lamellae can be recurrent, adnate, free, sinuate, or adnexed.

• Shape and Width: Lamellae can be narrow, broad, or ventricose, and their edges may be fringed, toothed, or smooth.

• Color: Lamellae colors can vary and change with exposure or cutting.

• Lamellulae: Short gills extending partially from the pileus margin, important for taxonomic classification.

The Stipe

The stipe or stalk supports the cap and can vary in shape, size, color, texture, and consistency.

• Shape and Size: The stipe may be cylindrical, tapering, clavate, or bulbous.

• Attachment and Position: It can be central, eccentric, or lateral.

• Color: Stipe color may vary and is significant for identification.

• Texture and Consistency: It can be smooth, scaly, fibrous, hollow, solid, or chambered.

• Veil: The veil protects the developing mushroom and may form a partial or universal veil, which can contribute to identification.

• Annulus: The ring formed by the veil after breaking, important for identification.

• A cup-like structure at the base of the stalk, formed from the remnants of the universal veil.

Mycelium

Mycelium is a mass of threadlike cells or hyphae, often visible as rhizomorphs.

Spore Color and Spore Print

Spore color is stable for each species and can be observed by taking spore prints. It is a key character for identification.

Chemical Color Reactions

Chemical reactions with reagents on various mushroom parts can reveal color changes, aiding in identification.

Habitat

The growth habit of mushrooms, including whether they grow solitarily, in clusters, or in fairy rings, provides important taxonomic information.

Microscopic Characters

Microscopic details, including internal texture and arrangement, are crucial for taxonomy. Key features include:

• Basidiospores: Characteristics like shape, size, and ornamentation are essential for identification.

• Basidia: Spore-producing cells that vary in shape and size.

• Clamp Connections: Special structures at the septa of hyphae that show taxonomic variation.

3.5. Nutritional analysis of selected wild edible mushroom

Processing of specimen:

The collected specimens were immediately cleaned with a sharp knife to remove forest debris and wood substrates. The specimens were carefully labeled at the collection site and placed in air-tight containers before transporting back to the laboratory. The freshly collected mushroom samples were oven dried at 40º C to 60º C for three consecutive days and grounded into a fine powder for further bio chemical analysis.

Analytical methods:

The analytical methods for estimation of moisture content, fat content, fiber, protein, carbohydrates and micro-nutritional properties (minerals) includeing calcium (Ca), iron (Fe), magnesium (mg), potassium (K), zinc (Zn) and manganese (Mn) are as follows:

3.5.1 Moisture content

According to Association of Official Agricultural Chemists (AOAC, 1995) 5 grams of the samples was taken and initial weight was recorded first, and then kept in hot air oven at 105ºC till the constant weight was obtained. The moisture content was calculated with the formula:

Moisture (%) = *Fresh weight (g) – dry weight (g) / fresh weight (g) x 100*

3.5.2 Fat content

10 grams of the mushroom sample was extracted with petroleum ether in an extraction apparatus for 16 hours. The extract was then dried, cooled in desiccators, weighed and recoded (AOAC, 1995).

Fat content was calculated with the following equation

Fat (%) = *100 (weight of Soxhlet flask with extracted fat – weight. of empty Soxhlet flask) /Weight of sample*

3.5.3 Protein content

Oven dried samples of 0.5 g from each substrate was separately put into 30 ml Kjeldahl flask and 15 ml conc. sulphuric acid (H_2SO_4) added. The mixture was cautiously heated in a fume hood until a greenish clear solution appeared. The digest was allowed to cool for 30 minutes and 10 ml distilled water added to prevent caking. The digested sample was distilled and 35 ml of the distillate was collected in a receiver flask. This was titrated with 0.01 M hydrochloric acid (HCI) until a pink color emerged.

Percentage protein was calculated using the following method (AOAC, 1990).

Protein (%) = *Percentage of nitrogen x 6.25*.

3.5.4 Fibre content

According to Association of Official Agricultural Chemists (AOAC, 2005) 1 gram of the mushroom sample was allowed to boil with 1.25% dilutes sulphuric acid (H_2SO_4), and washed with water, and further boiled with 1.25% dilute sodium hydroxide (NaOH) and the remaining residue after digestion was taken as crude fibre. 1 gram of moisture and fat free sample was weighed and kept in the fibre bags. The glass spacer was put in to the bags. The bag in the sample carousel was loaded at the previewed positions (positions 1-12). The sample carousel was put into the glass container carefully. The glass container was placed axial on the previewed position of the hot plate. A method was created to estimate crude fiber. The programme was started in the fibretherm. After completion of the programme, the fibre bags were removed. The residue was transferred to weighed crucible (W1) and dried over night at 80 ^oC - 100 ^oC and weighed (W2). The crucible was heated in muffle furnace at 600 ^oC for 2 to 3 hours and then cooled in desiccator and weight of the crucible was taken after cooling (W3).

Observations

Weight of the sample = W1 g

Weight of the crucible + sample before heating at 600 ^oC = W3 g

Weight of the crude fibre = (W2 –W3) g

Crude fibre (%) = 100 - (*moisture + fat)* x *weight of fibre / Weight of the sample taken* (*Moisture and fat free*) (*W1*)

3.5.5 Ash content

According to the Association of Official Agricultural Chemists (AOAC, 2003) 2 grams of the dried samples was weighed into crucible and ignited in a muffle furnace at 550 ^oC until white ash was obtained. The crucible was then transferred to a desiccator and left to cool and weighed. This process was repeated until two successive constant weights were obtained and the ash percentage was calculated using the following equation:

Ash % = $(B-C)/A \times 100$

Where

B = Weight of the crucible and sample before ashing

C = Weight of the crucible and sample after ashing.

A = Weight of the sample

3.5.6 Total carbohydrate content

The total carbohydrate content present in mushroom samples was estimated by subtracting total components excepting carbohydrates from 100 g of mushroom sample as per following relation after Crisan and Sands (1978):

Carbohydrate (%) = 100 – (*Protein* + *Fat* + *Fiber* + *Ash content* + *Moisture content*).

3.5.7. Minerals

The mushroom ash was used to determine the minerals content of wild edible mushrooms. Mineral concentrations, such as calcium (Ca), iron (Fe), magnesium (Mg), potassium (K), zinc (Zn) and Manganese (Mn), were assessed using an atomic absorption spectrophotometer (AAS) following AOAC (2003).

3.5.8. Data Analysis

Statistical analysis was done using MS Excel and R software (version 4.3.0). Descriptive statistics such as mean and standard deviation were estimated to summarize central tendency and variability. The Chi-Square test followed by Cramer’s V test was carried out to compare the species composition between the study sites. The One Way Anova followed by Tukey’s HSD test was performed to test the variation of mean concentration of nutrients among the mushrooms.

CHAPTER-4

RESULTS AND DISCUSSION

Chapter 4

RESULTS AND DISCUSSION

4.1. Species identified and their Taxonomical position

From three different sites (i.e., Mizoram University campus, Hlimen Forest and Lungleng Forest) a total of 32 species of wild mushrooms were identified using morphological characteristics and based on these features, the 32 specimen could be classified into different morphological taxa **(Table 4.1).** The fungal specimens collected were mostly Basidiomycetes.

Table 4.1: List of species collected from three different sites

No.	Scientific Name	Place of collection	Photo plate
1	*Amanita fulva* (Schaeff.) Secr	Mizoram University campus	1
2	*Amanita jacksonii* Pomerl. (1984)	Lungleng Forest	2
3	*Amanita phalloides* (Fr.) (1833)	Mizoram University campus	3
4	*Amanita vaginata* (Bull.) Lam. (1783)	Mizoram University campus Lungleng Forest	4
5	*Auricularia auricula-judae* (Bull.) J. Schröt., (1888)	Hlimen Forest Lungleng Forest	5
6	*Cantharellus cibarius* Fr. (1821)	Mizoram University campus Lungleng Forest	6
7	*Clavulinopsis laeticolor* (Berk. and Curtis) R.H. Petersen (1965)	Hlimen Forest	7
8	*Coprinellus disseminates* Pers. (1938)	Mizoram University campus	8
9	*Dacryopinax spathularia*	Mizoram University campus	9

	(Schwein.), (1948)	Lungleng Forest	
10	*Fistulina hepatica* (Schaeff.) With., (1792)	Mizoram University campus	10
11	*Ganoderma adspersum* (Schulzer) Donk	Mizoram University campus	11
12	*Ganoderma applanatum* Pers. Pat., (1889)	Mizoram University campus	12
13	*Ganoderma lucidum* (Curtis) P. Karst., (1881)	Mizoram University campus Lungleng Forest	13
14	*Lactifluus corrugis* (Peck) Kuntze, (1891)	Mizoram University campus Lungleng Forest	14
15	*Lactifluus piperatus* (L.) Pers. (1797)	Mizoram University campus Hlimen Forest Lungleng Forest	15
16	*Lentinus squarrosulus* Montagne, J.P.F.C. (1842)	Lungleng Forest	16
17	*Lycoperdon perlatum* Pers. (1796)	Mizoram University campus Hlimen Forest	17
18	*Microporus xanthopus* (Fr.) Kuntze.(1898)	Mizoram University campus Hlimen Forest Lungleng Forest	18
19	*Phallus indusiatus* Vent. (1798)	Mizoram University campus Hlimen Forest	19
20	*Pleurotus pulmonarius* (Fr. Quél.1872)	Hlimen Forest Lungleng Forest	20
21	*Pycnoporus coccineus* (Fr.) Bondartsev and Singer (1941)	Mizoram University campus	21
22	*Podoscypha petalodes* (Berk.)Boidin	Hlimen Forest	22
23	*Russula aurora* Krombh. (1845)	Mizoram University campus Hlimen Forest	23

24	*Russula bertulatum* Hora	Hlimen Forest Lungleng Forest	24
25	*Russula compacta* Frost, (1879)	Mizoram University campus Hlimen Forest	25
26	*Russula cyanoxantha* (Schaeff.) Fr.	Lungleng Forest	26
27	*Russula emetic* (Schaeff.) Pers. (1796)	Lungleng Forest	27
28	*Schizophyllum commune* Fr. (1821)	Mizoram University campus Hlimen Forest Lungleng Forest	28
29	*Scleroderma verrucossum* (Bull.) Pers. (1801)	Hlimen Forest	29
30	*Termitomyces heimii* Natarajan (1979)	Lungleng Forest	30
31	*Trametes elegans* (Fr.) Spreng.(1838)	Mizoram University campus Hlimen Forest Lungleng Forest	31
32	*Volvariella taylorii* (Berk. and Broome) Singer (1951)	Mizoram University campus Hlimen Forest	32

4.2. Comparison of species composition among the three study sites:

The variation in species composition between the different sites were evaluated using Chi Square test followed by Cramer's V test and found that there was no significant statistical difference in their species composition ($p>0.05$, $V= 0.62$). This could be attributed to the minimal variation in their ambient conditions such as relative humidity (56–78%), temperature (12ºC–30ºC), soil properties (acidic, ranging from sandy-loam to loamy-clay textural class, rich in organic carbon), tree composition, and other environmental factors.

The widespread presence of *Lactifluus piperatus, Microporus xanthopus, Schizophyllum commune*, and *Trametes elegans* in Aizawl District indicates their high adaptability and ecological versatility. These species play a key role in maintaining ecosystem stability and biodiversity, making them important indicators of ecological health in the area. The family Russulaceae had the highest representation, with a total of seven species belonging to this family.

4.3. Description of specimens collected from selected sites

1. *Amanita fulva* (Schaeff.) Secr. Photo plate-1

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Amanitaceae
Genus	-	*Amanita*
Species	-	*fulva*
Local name (Mizo)	-	unknown

Synonyms - *Agaricus fulvus* Schäff., *Amanita vaginata* var. *fulva* (Fr.) Gillet, *Amanitopsis fulva* (Fr.) W.G. Sm.

Collection Site: Mizoram University campus

Description of the specimen

Pileus: 4–10 cm, oval to convex, becoming broadly convex or nearly flat, sticky when wet or at first. Gills: Free from the stem or slightly attached.Stipe: 7–16 cm long, 0.5–1.5 cm thick, slightly tapered towards the apex, bald or slightly hairy, whitish to pale brownish, without a ring. Features a white volva that fits loosely around the stem and often discolors tawny brown. Flesh: White throughout, soft, unchanging when sliced.Basidiospores: 9–12 µm, smooth, globose or subglobose, inamyloid. Spore Print: White.

Comments: *Amanita fulva* is mycorrhizal with hardwoods or conifers and usually growing alone, scattered, or in groups during the summer and fall, widely distributed east of the Rocky Mountains. While it is considered one of the few edible species in its genus, it must be identified with caution, as other Amanita species are poisonous and some are deadly. Therefore, consuming *Amanita fulva* can be risky and is generally not recommended (Jordan, 1995; Phillips et al., 2010).

2. *Amanita jacksonii* Pomerl. (1984) Photo plate–2

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Amanitaceae
Genus	-	*Amanita*
Species	-	*jacksonii*
Local name (Mizo)	-	unknown

Synonym - *Amanita umbonata* Pomerl. Non (Sumst) Sartory and L. Maire; *Amanita tullossii* Guzman and Ram. – Gull.

Collection site: Lungleng Forest

Description of the specimen

Pileus: Medium, sometimes large, 5-12 cm in diam., oval at first becoming convex, typically with a central bump, slightly sticky when fresh, brilliant red or orange, fading to orange to pale orange or yellow on the margin, margin striated for almost half of the pileus radius, bald, without warts or patches. Lamellae

– free, smooth, yellow to orange yellow, close or crowded, lamellulae- of several length with one or two series. Stipe: 8-14 cm long, 1-1.5 cm wide, slightly tapering toward apex, yellow with orange to reddish scales or fibres, often in zones, not bruising, without a basal bulb but a saclike volva up to 1.5 cm long, 1-3 cm thick is present at the base, white. Annulus – present, yellow to orange, skirt like ring. Volva :present. Flesh: white to pale yellow, soft, thin and unchanging or staining when sliced or exposed. Basidiospores: 7.9-11 x 5.5-7 µm, ellipsoid, smooth, inamyloid, hyaline, thin-walled.

Comments: Caesar's Mushroom, scientifically known as *Amanita jacksonii*, is a highly-prized edible species, particularly valued when at the 'button' stage. This mushroom is notable for its vibrant orange cap and yellow gills, making it a visually striking species. It's the one and only easily identifiable member of the Amanita family that is not only edible but also delicious (Kumla et al., 2023).

3. *Amanita phalloides* (Fr.) (1833) Photo plate-3

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Amanitaceae
Genus	-	*Amanita*
Species	-	*phalloides*
Local name (Mizo)	-	unknown

Synonyms - *Agaricus phalloides* Fr. (1821), *Venenarius phalloides* (Fr.) Murrill (1912), *Amanitina phalloides* (Fr.) E.-J. Gilbert, (1940), *Agaricus vernalis* Bolton (1788), *Agaricus bulbosus* Bull. (1793), *Agaricus virosus* Vittad (1835).

Collection Site: Mizoram University campus

Description of the specimen

Pileus: Medium to large, 4-18 cm in diam., nearly round or oval at first then becoming convex, expanding to broadly convex to flat in age, bald, viscid and shiny when wet, shiny when dry, yellowish white to brownish at the centre, the margin usually not lined but sometimes striated slightly. Lamellae-free, close or crowded, smooth, white to cream lamellulae of several length with one or two series. Stipe: 6-9 cm long, 1-2.5 cm wide, more or less equal or slightly tapering toward apex and flaring to a swollen base, white to cream with tints of the cap color, bald or finely hairy with a white, skirt like ring that typically persists but is sometimes lost, with a sack like white volva encasing the base (sometimes underground or broken up Annulus-present with skirt like ring that typically persists but is sometimes lost. Flesh-white throughout and unchanging or staining when sliced or exposed. Basidiospores: 7–12 x 5–9 µm 40 [Q=1.4, 1.33], ellipsoid, smooth, amyloid. Spore print–white. Basidia- clavate, four spored. Clamp connection absent

Comments: *Amanita phalloides*, also known as the Death Cap, is highly toxic and responsible for the majority of fatal mushroom poisonings (Walton, 2018). Despite its often attractive appearance, consuming even a small amount can lead to severe liver and kidney damage, and it is considered one of the most dangerous mushrooms in the world (Garcia et al., 2015).

4. *Amanita vaginata* (Bull.) Lam. (1783) Photo plate-4

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales

Family	-	Amanitaceae
Genus	-	*Amanita*
Species	-	*vaginata*
Local name (Mizo)	-	unknown

Synonyms - *Amanita vaginata* var. *vaginata*, *Agaricus vaginatus* Bull. (1783), *Vaginata livida* Gray (1821), *Amanitopsis vaginata* (Bull.) Roze, (1876), *Amanitopsis vaginatus* (Bull.) Roze (1876), *Amanitopsis vaginata* subsp. *vaginata* (Bull.) (1876)

Collection Site: Mizoram University, Lungleng Forest

Description of the specimen

Pileus: Small to medium. 4-10 cm in diam., oval, becoming convex or nearly flat, with a central bump, viscid at first or when wet, gray to grayish brown, sometimes with a few scattered whites to grayish patches, margin prominently lined or grooved for up to 1 cm or more. Lamellae: free or slightly attached, white, close or crowded, lamellulae of several lengths. Stipe: 7-15 cm long, 0.5-2.5 cm wide, equal or tapering slightly toward apex, bald, or with a few grayish scales, whitish to sometimes grayish or brownish in age, without a basal bulb but a sack like volva up to 1.5 cm long, 1-3 cm thick is present at the base, white, sometimes discolour rusty or grayish or reddish brownish with age. Annulus: absent. Flesh: white unchanging or staining when sliced or exposed. Basidiospores: 8-12.8 x 8-12 µm, globose to sub globose, smooth, inamyloid. Spore print - white.

Comments: A mycorrhizal species, which has relationships with coniferous, hardwood, pine and dipterocarp trees. *Amanita vaginata* is edible mushroom (Mortimer et al., 2014). However, other species of Amanita are poisonous. This species is commonly known as Grisette.

5. *Auricularia auricula-judae* (Bull.) J. Schröt., (1888). Photo Plate-5

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Auriculariales
Family	-	Auriculariaceae
Genus	-	*Auricularia*
Species	-	*auricula-judae*
Local name (Mizo)	-	Pu Vana beng/Pu Thiala beng

Synonyms – *Tremella auricula-judae* (Bull.) Bull(1789), *Peziza auricula-judae* (Bull.) Bull.(1791), *Hirneola auricula-judae* (Bull.) Berk.(1860).

Collection Site: Hlimen Forest, Lungleng Forest

Description of the specimen

Fruiting body: Tough gelatinous, yellow to reddish brown, sessile to substipitate, up to 120 mm diameter by 1 - 2 mm thick, pileus minutely tomentose with hyaline hairs, hymenium smooth, growing in gregarious or caespitose groups, occasionally solitary, pileus made up of densely compacted gelatinised hyphae with cuticular hairs 85 - 100 × 5 - 6 µm, with rounded tips. Basidia 50 - 60 × 5 - 6 µm, cylindrical, with transverse septa. Basidiopores: Allantoid, 13 - 15 × 5 - 6 µm.

Comments: Distributed worldwide, also reported from Mizoram by several authors (Zothanzama, 2011; Lalrinawmi et al., 2017; Thachunglura et al., 2024). It is commonly known as jelly ear, it is a species of edible Auriculariales fungus found worldwide. Auricularia auricula-judae has been used as a medicinal mushroom by many herbalists and it is reported that it contains high nutritional value including protein, carbohydrates and minerals.

6. *Cantharellus cibarius* Fr. (1821) Photo plate -6

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Cantharellales
Family	-	Cantharellaceae
Genus	-	*Cantharellus*
Species	-	*cibarius*
Local name (Mizo)	-	unknown

Synonyms - *Merulius chantarellus* (L.) Scop. (1772), *Cantharellus vulgaris* Gray (1821), *Merulius cibarius* (Fr.) Westend. (1857), *Craterellus cibarius* (Fr.) Quél. (1888), *Alectorolophoides cibarius* (Fr.) Earle (1909), *Chanterel cantharellus* (L.) Murrill (1910), *Chanterel chantarellus* (L.) Murrill (1910), *Cantharellus rufipes* Gillet (1878), *Cantharellus cibarius* var. *amethysteus* Quél. (1883), *Cantharellus edulis* Sacc. (1916), *Cantharellus cibarius* f. *pallidus* R. Schulz (1924), *Cantharellus cibarius* var. *salmoneus* L. Corb. (1929)

Collection site: Mizoram University campus, Lungleng Forest

Description of the specimen

Pileus: 3-15 cm broad, cap shallowly convex, becoming plane to depressed, surface smooth or occasionally cracked, yellow, light yellow or lemon yellow to deep egg-yolk yellow with age, moist, glabrous to minutely tomentose, margin split, enrolled, at first margin incurved, non-striate. Flesh is whitish to tinged yellow to orange under the cuticle, thick, firm. Gills well-spaced to close, shallow blunt, deeply decurrent gills which are often forked or cross-veined, colored like cap or more paler. Stalk is 2- 9 x 0.5-4 cm, concolorous with the cap, equal or tapered downward or sometimes enlarged at base, solid and dry. Basidiospores: smooth, ellipsoid, 5.5-9.5 x 4.5-6μ.

Comments: The species can be easily mistaken for other mushrooms, so caution is advised when identifying it. Chanterelle mushrooms are a good source of antioxidants and contain several nutrients that support bone health and immune function. They have high phenol and flavonoid content with promising antioxidant properties (Mendez-Espinoza et al., 2013; Vlasenko et al., 2019; Režić et al., 2023). *Cantharellus cibarius* is reported to be highly nutritious by Thachunglura et al., (2024) from Mizoram. Other authors have also reported the presence of this species in Mizoram (Lalrinawmi et al., 2017; Zothanzama et al., 2018).

7. *Clavulinopsis laeticolor* (Berk. and Curtis) R.H. Petersen (1965) Photo plate -7

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Clavariaceae/ Sparassidiaceae
Genus	-	*Clavulinopsis*
Species	-	*laeticolor*
Local name (Mizo)	-	unknown

Synonyms - *Clavaria laeticolor* Berk. and M.A. Curtis (1869), *Ramariopsis laeticolor* (Berk. and M.A. Curtis) R.H. Petersen (1978), *Donkella laeticolor* (Berk. and M.A. Curtis) Malysheva and Zmitr. (2006), *Donkella laeticolor* (Berk. and M.A. Curtis) Malysheva (2008), *Clavaria pulchra* Peck (1876).

Collection site: Hlimen Forest

Description of the specimen

Fruiting body 17–50 mm high; 1–4 mm wide; cylindrical and unbranched, sometimes flattened, orwith a groove or a twist; dry, bald; bright orange or yellow, fading with age, whitish at the extreme base, at maturity often with a somewhat pointed tip that ages or discolors somewhat reddish or orange. Flesh whitish to pale yellow or orange, thin. Spores 5.5−7 × 3.5−5.5 μ, ellipsoid, hyaline, smooth, inamyloid.

Comments: *Clavulinopsis laeticolor*, commonly known as the golden fairy club or handsome club, is a widespread species found across North America, Europe, and parts of Asia. This mushroom typically occurs in dense clusters with a common base. Its edibility is unknown, and it is generally considered too small to be worth harvesting. The species was reported in Mizoram by Lalrinawmi (2019).

8. *Coprinellus disseminatus* Pers. (1938). Photo Plate - 8

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Psathyrellaceae
Genus	-	*Coprinellus*
Species	-	*disseminatus*
Local name (Mizo)	-	unknown

Synonyms - *Agaricus pallescens* Schaeff. (1774), *Agaricus disseminatus* Pers., Comm. Schaeff. (1800), *Agaricus disseminatus* var. *digitaliformis* (Bull.) Pers.(1801), *Coprinus disseminatus* (Pers.) Gray,(1821), *Agaricus disseminatus* f.

digitaliformis (Bull.) Fr.(1821), *Coprinus petasiformis* Corda (1837), *Agaricus gyroflexus* Fr.(1838), *Coprinarius disseminatus* (Pers.) P. Kumm.(1871), *Psathyra gyroflexa* (Fr.) P. Kumm.(1871), *Coprinus digitaliformis* (Bull.) P. Kumm.(1871), *Psathyrella disseminata* (Pers.) Quél.(1872), *Drosophila gyroflexa* (Fr.) Quél.(1886), *Pilosace pallescens* (Schaeff.) Kuntze (1898), *Pseudocoprinus disseminatus* (Pers.) Kühner.(1928), *Psathyrella gyroflexa* (Fr.) Konrad and Maubl.(1949).

Collection Site: Mizoram University campus

Description of the specimen

Pileus: Parabolic to blunt, becoming convex to hemispherical, 5 – 12 cm in diam., young specimens white to pale lemon becoming pale grey and finally dark grey, somewhat translucent dry and distinctly plicate (pleated) with radial grooves arranged around a central disc. Stipe: Central, cylindrical, 30-50 × 1-2 mm, off-white to pale yellow-brown at base, dry and smooth. Gills: Adnexed, close, straw yellossw, maturing to dark grey but do not liquify. Spore print black. Basidiopores: Ellipsoid to almond shaped, 7.2 -9.7 × 4.1-5.4 µm.

Comments: It is commonly known as Fairy Incap. Saprobic, growing in clusters, often by the hundreds on decaying wood, especially near the bases of stumps, spring, summer, and fall, distributed worldwide. It was reported by several authors from Mizoram (Vabeikhokhei et al., 2019; Renthlei et al., 2023) and it is an edible mushroom however it is not highly regarded across the globe.

9. *Dacryopinax spathularia* (Schwein.), (1948). Photo Plate - 9

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Dacrymycetes,
Sub Class	-	Dacrmycetidae
Order	-	Dacrymycetales

Family	-	Dacrymycetaceae
Genus	-	*Dacryopinax*
Species	-	*spathularia*
Local name (Mizo)	-	unknown

Synonyms - *Merulius spathularius* Schwein., (1822), *Guepinia spathularia* (Schwein.) Fr., (1828), *Cantharellus spathularius* (Schwein.) Schwein., (1832), *Guepiniopsis spathularia* (Schwein.) Pat., (1900).

Collection Site: Mizoram University campus, Hlimen Forest.

Description of the specimen

Basidiocarp: Gelatinous jelly like yellow-orange to orange, have rounded stalks at the base, are flattened upward, and have an overall fan-shaped to spatula-shaped appearance, 0.6 - 2.5 cm tall. Hymenium distinctly folded with the folds resembling gills. Basidiospores: 2-celled, 19 x 4 µm, colourless, curved.

Comments: This species has been reported from several states in India, including Mizoram, where its nutritional value has also been determined (Thachunglura et al., 2023). Although it is an edible species, many mushroom foragers do not collect it due to its small fruiting bodies.

10. *Fistulina hepatica* (Schaeff.) With., (1792) Photo Plate - 10

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Fistulinaceae
Genus	-	*Fistulina*

Species	-	*hepatica*
Local name (Mizo)	-	unknown

Synonyms - *Boletus hepaticus* Schaeff., (1774), *Fistulina buglossoides* Bull., (1790), *Boletus hepaticus* Vent., (1812*). Hypodrys hepaticus* (Schaeff.) Pers.,(1825), *Boletus buglossum* Retz., (1769), *Boletus esculentus* With., (1776), *Boletus bulliardii* J.F. Gmel.,(1792), *Agaricocarnis linguabovis* Paulet, (1793), *Fistulina sarcoides* St.-Amans, (1821), *Buglossus quercinis* Wahlenb. (1826), *Fistulina endoxantha* Speg., (1921).

Collection Site: Mizoram University campus

Description of the specimen

Basidiocarp: Up to 30 cm across, irregular in shape but often fan-shaped or tongue-like, sometimes fused laterally with other caps, velvety, or fairly smooth, margin lobed, red, or liver colored. Pore Surface whitish or pale, pinkish, becoming reddish brown with age, bruising reddish brown. Flesh streaked with reddish areas, thick, soft, watery, exuding a reddish juice when squeezed. Odor not distinctive, taste sour or acidic. Spore print: pinkish to pinkish brown. Basidiospores: Smooth, ovoid, 3.5-4.5 x 2.5-3 μ.

Comments: *Fistulina hepatica*, commonly known as the Beefsteak Fungus, is an edible mushroom with high nutritional value and antioxidant activity (Ribeiro et al., 2007). It has also been reported in Mizoram by Lalrinawmi et al., (2017) and Zothanzama et al., (2018).

11. *Ganoderma adspersum* (Schulzer) Donk Photo plate - 11

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes

Sub Class	-	Agaricomycetidae
Order	-	Polyporales
Family	-	Ganodermataceae
Genus	-	*Ganoderma*
Species	-	*adspersum*
Local name (Mizo)	-	unknown

Synonym - *Boletus lipsiensis* Batsch, (1786), *Scindalma lipsiense* (Batsch) Kuntze, (1898), *Polyporus lipsiensis* (Batsch) E.H.L. Krause, (1928) *Agaricus lipsiensis* (Batsch) E.H.L. Krause, (1932). *Boletus applanatus* Pers., (1799), *Polyporus merismoides* Corda, (1837), *Polyporus stevenii* Lév., (1844), *Polyporus leucophaeus* Mont., 1856), *Polyporus leucophaeum* Mont. (1856), *Polyporus incrassatus* Berk., (1877), *Polyporus concentricus* Cooke, (1880), *Fomes gelsicola* 3: 373 (1889), *Fomes nigriporus* Lázaro Ibiza, (1916), *Ungularia subganodermica* Lázaro Ibiza, (1916), *Fomes longoporus* Lloyd, (1920).

Collection site: Mizoram University campus

Description of the specimen

Basidiomes annual, perennial, sessile. Pileus: 1.5–5.8 cm in length, 0.5–4.5 cm in width, and up to 1.5 cm thick at the base, sessile (without stipe), perennial, subdimidiate, sub-flabelliform to flabelliform, usually flat, convex, imbricate, umbonate or uneven, rarely ungulate, glabrous when present, broadly attached when mature, often with undefined concentric zones at the center that extend to the margin, thick at the base, slightly soft at the margin when mature. Pileus surface shiny, silky, smooth, and soft when young, hard when old. Pileus color is usually homogenous with grayish-orange. Pore surface initially white, grayish-orange, when mature, turning to light brown to brown when scratched or bruised. Basidiospores mostly ellipsoid with double walls, with a size range of 9.5– 10.4 μm.

Comments: Most *Ganoderma* species, including *Ganoderma adspersum*, are valued for their secondary metabolites and biological activities. *Ganoderma adspersum* has a promising nutritional profile and potent pharmaceutical capacities, especially against microbial infections. It is a valuable species for developing therapeutic agents (Luangharn et al., 2021; Chafouz et al., 2023; Sułkowska-Ziaja et al., 2023; Hamrouni et al., 2024).

12. *Ganoderma applanatum* Pers. Pat., (1889). Photoplate - 12

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Polyporales
Family	-	Polyporaceae
Genus	-	*Ganoderma*
Species	-	*applanatum*
Local name (Mizo)	-	unknown

Synonyms - *Polyporus subganodermicus* (Lázaro Ibiza) Sacc. and Trotter, Syll. fung. (Abellini) 23: 369 (1925), *Polyporus vegetus* Fr., Epicr. (1838), *Scindalma concentricum* (Sacc.) Kuntze, (1898), *Scindalma megaloma* (Lév.) Kuntze, (1898), *Ungularia subganodermica* Lázaro Ibiza, Revta R. (1916), *Ganoderma incrassatum* (Berk.) Bres., (1915), *Ganoderma incrassatum* f. *substipitatum* Bres., (1915), *Ganoderma leucophaeum* (Mont.) Pat., Bull. (1889).

Collection site: Mizoram University campus

Description of the specimen

Fruiting body perennial, sessile, applanate, reflexed, becoming woody with age, upto 65 cm wide, 4-13 cm thick, fan-shaped to slightly convex. Upper surface hard crust, reddish-brown to brown, irregular, often zonate, frequently dusted with brown spores. Flesh up to 6-7.5 cm thick, brown, tough, corky. Pores surface white, bruising when injured. Spores ellipsoid, 6-9.5 x 4-7 µm.

Comments: *Ganoderma applanatum* has been extensively used in medicinal practices for thousands of years. In Chinese medicine, it has been employed to treat rheumatic tuberculosis and esophageal carcinoma. Additionally, *G. applanatum* is valued in ethnomedicine for its high antioxidant capacity and antimicrobial properties, including antibacterial effects (Jeong et al., 2008; Hossain et al., 2021).

13. ***Ganoderma lucidum*** (Curtis) P. Karst., (1881) Photo plate - 13

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Polyporales
Family	-	Ganodermataceae
Genus	-	*Ganoderma*
Species	-	*lucidum*
Local name (Mizo)	-	unknown

Synonyms - *Boletus rugosus* Jacq., (1774), *Boletus lucidus* Curtis, (1781), *Polyporus lucidus* (Curtis) Fr.,(1821), *Grifola lucida* (Curtis) Gray,(1821), *Fomes lucidus* (Curtis) Cooke,(1885), *Placodes lucidus* (Curtis) Quél.,(1886), *Phaeoporus lucidus* (Curtis) J. Schröt.,(1888), *Boletus flabelliformis* Leyss.,(1761), *Boletus obliquatus* Bull.,(1781), *Boletus vernicosus* Bergeret,(1783), *Agaricus lignosus* 54 Lam.,(1783), *Boletus dimidiatus* Thunb.,(1784), *Boletus castaneus* Weber,(1787), *Boletus laccatus* Timm, (1788), *Boletus crustatus* J.J. Planer, (1788), *Agarico-igniarium* trulla Paulet,(1793), *Boletus verniceus* Brot.,(1804), *Ganoderma ostreatum* Lázaro Ibiza,(1916), *Ganoderma nitens* Lázaro Ibiza, (1916).

Collection Site: Mizoram University campus, Lungleng forest

Description of the specimen

Basidiocarp: Sessile, annual, rigid, corky to woody, crustose, dark brownish to blackish brown, irregular, rugose 4 - 8 cm wide, sometimes shows erect slender finger like projection. Pore surface smooth, creamy when fresh and becomes pale brown when aged or bruised, pores circular to somewhat ovoidal, 1.5 - 2.5 mm. Basidiopores: 1.8 - 2.5 x 2.6 - 3.9 µm, more or less ellipsoidal, sometimes with truncate end, double walled. Basidia 2.4 - 2.9x 3.4 - 4.6 µm, elongated, broadly clavated, 4- sterigmatic.

Comments: *Ganoderma* species are distributed all over the world. They are commonly known for their medicinal properties. *G. lucidum* was reported by Zohmangaiha et al., (2019) from Dampa Tiger Reserve. Many different strains of G. lucidum were evaluated by different authors in several countries including India. However, no reports were found in Mizoram. It grows on wood and trees like other *Ganoderma* species.

14. *Lactifluus corrugis* (Peck) Kuntze, (1891) Photo plate - 14

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Lactifluus*
Species	-	*corrugis*
Local name (Mizo)	-	Pa uithin

Synonyms - *Lactarius corrugis* Peck (1879)

Collection site: Mizoram University campus, Lungleng forest

Description of the specimen

Cap 4-15 cm in diam., convex at first becoming plane or depressed, sometimes with a distinctly wrinkled margin, minutely velvety to nearly smooth, dry, reddish brown to dark red, sometimes yellowish brown. Gills adnate to subdecurrent, close, occasionally forking, pale buff when young but soon orangish to yellowish or brownish, discoloring brown when sliced. Flesh whitish to yellowish, thick, firm, brittle, staining slowly dark brown when sliced. Latex white, copious, slowly staining brown. Stipe 2- 11 x 1.5-3 cm, concolorous with the cap, brown to reddish brown or paler, solid, smooth. Spore print white. Spores globose to sub globose, ornamented, amyloid, 9-12.1 x 8.7-11 µm

Comments: This species, formerly known as *Lactarius corrugis*, is commonly referred to as Corrugated Milky. It is highly nutritious and favored by the Mizo people. Specimens of *Lactifluus corrugis* collected from Champhai, Mizoram, are reported to be particularly nutritious and beneficial for health (Thachunglura et al., 2024). It is edible and delicious.

15. *Lactifluus piperatus* (L.) Pers. (1797) Photo plate - 15

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Lactifluus*
Species	-	*piperatus*
Local name (Mizo)	-	Pa lengvar

Synonyms - *Agaricus lactifluus* var. *piperatus* (L.) Pers., *Agaricus piperatus* L. (1753), *Agaricus acris* Bull. (1785), *Lactaria piperata* (L.) Pers. (1797), *Lactifluus piperatus* (L.) Roussel (1806), *Lactifluus piperatus* (L.) Kuntze (1891).

Collection site: Mizoram University campus, Hlimen forest, Lungleng forest

Description of the specimen

Pileus: 3-15cm wide, broadly convex, becoming flat, shallowly depressed, dry, margin even, bald, white or whitish, sometimes discoloring a little yellowish or brownish with age. Flesh white, thick, sometimes discoloring yellowish with age. Milk copious, white, unchanging after exposure, or changing slowly to yellowish. Gills attached to the stem or running slightly down it, very crowded, forking frequently, white becoming pale cream. Stalk 2-7.5x 1-2 cm, white, more or less equal, or tapering a little to base, bald, without potholes, solid. Spore print white to off white. Spores 4-7 x 4.5-5.5 µ, elliptical to nearly round with inconspicuous amyloid warts and ridges.

Comments: The acetone extract of *Lactifluus piperatus* exhibits strong antioxidant, antimicrobial, genoprotective, anticancer, and neuroprotective effects, making it a healthy food with potential pharmaceutical applications for disease prevention (Kosanic et al., 2020). This species is commonly found in Champhai District, Mizoram, but is widespread throughout the state (Lalrinawmi et al., 2017; Zothanzama et al., 2018; Thachunglura et al., 2023.

16. *Lentinus squarrosulus* Montagne, J.P.F.C. (1842). Photoplate - 16

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Polyporales

Family - Polyporaceae

Genus - *Lentinus*

Species - *squarrosulus*

Local name (Mizo) - Pa chang

Synonyms - *Pocillaria squarrosula* (Mont.) Kuntze.(1891), *Lentinus tigrinus* f. *squarrosulus* (Mont.) Pilát.(1936), *Pleurotus squarrosulus* (Mont.) Singer.(1962), *Pleurotus squarrosulus* (Mont.) Singer ex Pegler.(1969), *Lentinus leucochrous* Lév.(1844).

Collection Site: Lungleng forest

Description of the specimen

Pileus: 3.5-8 cm broad, at first convex then plane and umbilicate to infundibuliform, dry, squamulose often with small scales, varying appressedly sub squamulose, margin often becoming scrape, yellowish brown to brown. Stipe: 1.5-5 cm, fibrous, scurfy - squamulose downwards to the abrupt and often blackish base. Gills: deeply decurrent, crowded. Spore print white. Spores 6-8 x 1.8-3µm, smooth, sub-cylindric, inamyloid

Comments: *Lentinus squarrosulus* is an edible wild or cultivated mushroom that grows naturally on the surface of old tree trunks. This species has several interesting features, such as rapid mycelial growth, and has the potential to be used as food, functional food, and nutraceutical (Omar et al., 2015; Lau et al., 2017). It is highly regarded as an edible mushroom and has been reported in Mizoram using morphological characteristics and molecular analysis by various authors (Lalrinawmi et al., 2017; Vabeikhokhei et al., 2019; Chawngthu et al., 2023).

17. *Lycoperdon perlatum* Pers. (1796) Photoplate - 17

Classification

Domain - Eukaryota

Kingdom - Fungi

Division - Basidiomycota

Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Agaricaceae
Genus	-	*Lycoperdon*
Species	-	*perlatum*
Local name (Mizo)	-	unknown

Synonyms - *Lycoperdon gemmatum* Batsch (1783), *Lycoperdon gemmatum* var. *perlatum* (Pers.) Fr. (1829), *Lycoperdon bonordenii* Massee (1887), *Lycoperdon perlatum* var. *bonordenii* (Massee) Perdeck (1950)

Collection site: Mizoram University campus, Hlimen Forest

Description of the specimen

Fruit body: 2.5- 7 cm across, 3- 8 cm high, shaped like an inverted pear, subglobose, white at first, becoming yellowish brown; outer layer of short pyramidal warts, dense at the head. Spore mass white, then change to olive-brown at maturity. Sterile base spongy, occupying the stem. Spores globose, minutely warted, olive-brownish, 3.2-4.5 x 3.5-4.5 µm

Comments: Saprobic, growing solitary to scattered or gregarious on ground broad leaved forest. Lycoperdon perlatum is a valued edible mushroom when young, characterized by a homogeneous white gleba (Meuninck, 2017; Dar et al., 2024). Often called "poor man's sweetbread" for its texture and flavor, it is typically prepared by slicing and frying in batter or egg and breadcrumbs. While it is a good source of nutrients (Kalac, 2009), it can accumulate high levels of mercury from the environment, so it is essential to be cautious and be aware of safe consumption levels based on various studies (Falandysz et al., 2012),

18. *Microporus xanthopus* (Fr.) Kuntze.(1898). Photoplate - 18

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Polyporales
Family	-	Polyporaceae
Genus	-	*Microporus*
Species	-	*xanthopus*
Local name (Mizo)	-	unknown

Synonyms - *Polyporus xanthopus* Fr.(1818), *Polystictus xanthopus* (Fr.) Fr.(1851), *Coriolus xanthopus* (Fr.) G. Cunn.(1950), *Trametes xanthopus* (Fr.) Corner.(1989), *Polyporus saccatus* Pers.(1827), *Polyporus pterygodes* Fr.(1838)

Collection site: Mizoram University campus, Hlimen forest, Lungleng forest

Description of the specimen

Pileus: Up to7-10cm wide, 0.1-0.3 cm thick, funnel shaped, glabrous, shining when fresh, dull when dry, circular to dimidiate in young specimens, yellow to brown to deep reddish brown. Pores tiny, 0.8-1 cm. Stipe 1-4 x 0.2-0.8 cm, glabrous, light yellowish to light brown. Spore print white. Spores hyaline, cylindrical, smooth, inamyloid, 6-7 x 2-2.5 μm.

Comments: *Microporus xanthopus* is widespread globally and has been reported in various parts of Mizoram, such as Dampa Tiger Reserve Forest, Murlen National Park, Thorang Wildlife Sanctuary, and Tokalo Wildlife Sanctuary (Chawngthu et al., 2023). This inedible, wood-decaying mushroom, also known as Yellow-footed Tinypore, is native to tropical areas. Its oligosaccharides have demonstrated strong antioxidant activity in the DPPH Radical Scavenging and

Trolox Equivalent Antioxidant Capacity Assays (Sholola et al., 2022).

19. *Phallus indusiatus* Vent. (1798) Photoplate - 19

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Phallomycetidae
Order	-	Phallales
Family	-	Phallaceae
Genus	-	*Phallus*
Species	-	*indusiatus*
Local name (Mizo)	-	Phungsahmim

Synonyms - *Dictyophora indusiata* (Vent.) Desv. (1809), *Hymenophallus indusiatus* (Vent.) Nees (1817)

Collection site: Mizoram University campus, Lungleng forest

Description of the specimen

Fruit body egg-shaped to roughly spherical whenyoung, whitish to pale brown, up to 4.5 cm in diam. Pileus: 2-4.5 cm high, covered with a greenish-brown slime or gleba, campanulate. Stipe: 7 – 14 x 0.25 to 0.5 cm, spore mas sticky, sharp. Basidiospores: thin-walled, smooth, ellipsoid, straight to slightly curved, hyaline, 2-3 x 1-1.5µm.

Comments: Mycorrhizal, saprobic, growing solitary to scattered or in groups or clumps on ground. The edible and medicinal mushroom *Phallus indusiatus* has numerous medicinal values that are increasingly recognized through pharmacological efficacy studies (Habtemariam, 2019).

20. *Pleurotus pulmonarius* (Fr. Quél.1872) Photoplate - 20

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Pleurotaceae
Genus	-	*Pleurotus*
Species	-	*pulmonarius*
Local name (Mizo)	-	Pa khawi

Synonyms - *Agaricus pulmonarius* Fr., Systema Mycologicum 1: 187 (1821), *Marasmiellus pluvius* Redhead, Fungi Canadenses 216 (1982), *Pleurotus ostreatus* f. *pulmonarius* (Fr.) Pilát, Bulletin Trimestriel de la Société Mycologique de France 49: 281 (1934)

Collection Site: Hlimen forest, Lungleng forest

Description of the specimen

Pileus: 3–10 cm, at first convex, then flat or somewhat depressed, fan-shaped, greasy when young and fresh, whitish to beige or pale tan, usually without dark brown colorations; fading as it dries out, often resulting in a two-toned appearance; the margin inrolled when young, later wavy and sometimes very finely lined. Gills: Running down the stem; close or nearly distant; short-gills frequent; whitish; sometimes discoloring yellowish with age. Stipe: 1–3 cm long and 0.5–1.1 cm thick, eccentric or lateral or central; whitish, bald, basal mycelium white. Spore Print whitish or grayish. Basidiospores: 7–10.5 x 2–3.5 µm, cylindric-ellipsoid, smooth; hyaline, inamyloid.

Comments: Saprobic and growing in shelf-like clusters on dead and living wood of hardwoods, they cause a white rot and this species is commonly known as Indian oyster or phoenix mushroom. They can be cultivated in sterile environment.

21. ***Pycnoporus coccineus*** (Fr.) Bondartsev and Singer (1941) Photoplate - 21

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Polyporales
Family	-	Polyporaceae
Genus	-	*Pycnoporus*
Species	-	*coccinea*
Local name (Mizo)	-	unknown

Synonyms - *Fomes coccineus* (Fr.) Cooke (1885), *Polyporus coccineus* (Fr.) Nova Acta Regiae (1851) *Polystictus coccineus* (Fr.) Lloyd, (1916) *Pycnoporus coccineus* (Fr.) Bondartsev and Singer(1941) *Scindalma coccineum* (Fr.).

Collection site: Mizoram University campus

Description of the specimen

Pileus: dimidiate, orange when young and becomes reddish orange, hard, smooth. Obtuse margin, concolorous with the upper surface. Context: corky pale, 3.5-9.5 mm thick, hymenophore with pores. Basidia 10.5-13.2 x 4.0-5.2 µm, bearing four spores; spores 4.0-4.6 x 1.6-2.0 µm, hyaline, even, non-amyloid, short cylindric, slightly flattened on one side, minutely apiculate.

Comments: *Pycnoporus coccineus* is a saprophytic, white-rot decomposer fungus in the family Polyporaceae. A widely distributed species, *P.*

coccineus generally occurs gregariously on small branches and stumps in eucalypt forests. Phytochemicals and anticancer activities of *Pycnoporus coccineus* from Similipal Biosphere Reserve, revealing that chloroform extract is most potent against HELA cancer cell lines with minimal toxicity to normal cells (Jena and Thatoi, 2019).

22. Podoscypha petalodes (Berk.)Boidin Photoplate - 22

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Class	-	Agaricomycetes
Order	-	Polyporales
Family	-	Meruliaceae
Genus	-	*Podoscypha*
Species	-	*petalodes*
Local name (Mizo)	-	unknown

Synonyms - *Stereum petalodes* Berk. (1852), *Stereum floriforme* Lloyd (1913), *Stereum floriforme* Bres. (1920), *Podoscypha petaloides* (Berk.) Boidin (1959), *Podoscypha petaloides* subsp. *floriformis* (Lloyd) D.A.Reid (1965).

Collection site: Hlimen forest

Description of the specimen

Fruiting bodies often appear in groups and form rosettes. Pileus: 1.5-7 cm high, 0.5–3 cm wide, funnel shaped, pseudoinfundibuliform, thin, tough, margin entirely wavy, pale golden brown, brownish yellow to chestnut brown. Stipe: 0.8–1.5 × 0.2-0.4 cm, brownish to dark brown, solid. Basidiospores: ovoid, ellipsoid, hyaline, 3-4 × 2.5-3µm

Comments: The fungus produces rosette-like fruit bodies with a shape resembling its common names, the wine glass fungus and ruffled paper fungus. It has significant antioxidant potential due to its flavonoid and phenolic content (Dutta et al., 2013; Niazi and Ghafoor, 2023). The *Podoscypha petalodes* is noteworthy for its biotechnological potential, as it has been reported to produce endocellulase, laccase, and other lignocellulolytic enzymes under submerged fermentation conditions (Mahajan et al., 2022).

23. *Russula aurora* Krombh. (1845) Photoplate - 23

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Russula*
Species	-	*aurora*
Local name (Mizo)	-	Pa leng var

Synonyms - *Russula lepida* var. *aurora* (Krombh.) Rea (1932), *Russula rosea* var. *aurora* (Krombh.) R.W. Rayner (1985)

Collection site: Mizoram University campus, Hlimen forest

Description of the specimen

Pileus: Small to medium, 4-14 cm in diam., convex at first becoming slightly sunken or depressed at the center, pink to creamy pink, often darker at the center, the cuticle of the pileus peels about halfway to the center, dry or slightly pruinose, smooth to sometimes wrinkled, margin slightly striated. Lamellae - adnate, crowded, narrow, white pale to cream, often forked, lamellulae- of several length. Flesh - white, brittle. Stipe: 4-8 cm long, 1-2 cm wide, firm, solid, thick, brittle, white. Annulus - absent. Basidiospores: 6.5-9 x 5.5-7.5µm, ovoid, ellipsoid, amyloid, ornamented with fine lines. Spore print - white. Basidia - clavate, four spored.

Comments: The Dawn Brittlegill is generally considered an edible mushroom, though it is small and relatively localized, often not found in sufficient quantities to be specifically sought after for food. However, it is consumed more frequently in Mizoram due to its widespread presence in the region.

24. *Russula bertulatum* Hora Photoplate - 24

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Russula*
Species	-	*bertulatum*
Local name (Mizo)	-	unknown

Synonyms - *Russula emetica* var. *betularum*

Collection Site: Hlimen forest, Lungleng forest

Description of the specimen

Pileus: 2–5 cm in diameter, white to pale pink, deep pink, or pale buff, turning pale yellow ochre in the center. Stipe: Typically longer than the diameter of the pileus, cylindrical or slightly club-shaped, white, and very fragile.Gills: White, well-spaced. Flesh: White. Basidiospores: 9.5–13 µm, heterotropic, subglobose to broadly ellipsoid, echinate. Spore print: white

Comments: The Birch Brittlegill is typically found in birch-associated habitats during the latter half of the mushroom season. It is characterized by its reddish cap and stem, distinguishing it from non-toxic species. Although not fatal to humans, consuming this mushroom can lead to minor gastrointestinal disturbances. Therefore, caution is advised when foraging to avoid potential stomach and intestinal upset.

25. *Russula compacta* Frost, (1879) Photoplate - 25

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Russula*
Species	-	*compacta*
Local name (Mizo)	-	Pa leng

Synonyms – NA

Collection site: Mizoram University campus, Lungleng forest

Description of the specimen

Pileus: Small to medium. 3-16 cm in diam., convex at first or broadly convex becoming slightly sunken at the center, white to whitish cream when young but soon becoming yellowish to reddish or orange brown and tawny brown in age, sticky, more or less smooth, the cuticle of the pileus peels about halfway to the center, sometimes braking up in age, brittle, bruising reddish brown, margin non-striated. Lamellae - adnate, crowded, close or almost distant, white pale to cream, bruising and discoloring reddish brown, lamellulae - of several length. Flesh - discoloring yellowish to yellowish brown or reddish brown on exposure, thick. Stipe: 2-9 cm long, 1-3 cm wide, firm, solid, thick, more or less equal; dry; smooth; whitish, but soon flushed reddish brown, bruising reddish brown. Annulus - absent.

Basidiospores: 6.5-9 x 5.5-7.5µm, ellipsoid, amyloid, ornamented with warts.

Comments: *Russula compacta*, known locally in Mizoram as Pa Leng, is generally considered an edible mushroom. Found in mixed woods, it grows alone or scattered in summer and fall. This mycorrhizal species is common and can fruit even during dry spells. The name 'Compacta' means "solid" or "compact." In Mizoram, it is often collected by locals while they forage for *Lactifluus* species (Lalrinawmi et al., 2017; Lalrinawmi, 2019).

26. *Russula cyanoxantha* (Schaeff.) Fr. Photoplate - 26

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Russula*
Species	-	*cyanoxantha*
Local name (Mizo)	-	unknown

Synonyms - *Agaricus cyanoxanthus* Schaeff. (1774), *Agaricus cynoxanthus* Pers. (1801), *Agaricus lividus* var. *angustatus* Pers. (1801), *Agaricus linnaei* var. *vagus* Fr. (1815), *Agaricus virescens* Krombh. (1845), *Russula cutifracta* Cooke (1881), *Russula cutefracta* Cooke (1881)

Collection Site: Lungleng Forest

Description of the specimen

Pileus: 5-15 cm across, at first globose then convex, becoming broadly convex to flat with a shallow depression, fragile, dry or slightly greasy, smooth, streaked or cracked, extremely variable in color, usually shades of lilac to purple to green or olive green, the cuticle peeling about halfway to the center. Flesh white, brittle, thick. Gills narrow, crowded, white to pale cream, not forking, or occasionally forking, flexible and greasy to touch. Stipe: 3-11.5x 1.5-3 cm, dry, smooth, white to yellowish white but sometime flushed with purplish, brittle, dry, smooth. Spore print white. Basidiospores: ellipsoid 7- 9 x 5-8µ.

Comments: *Russula cyanoxantha* is an edible mushroom that was named "Mushroom of the Year" in 1997 by the German Association of Mycology. It forms mycorrhizal associations with hardwoods or conifers and can be found growing alone, scattered, or gregariously in summer and fall. Like all *Russulas*, it is a mycorrhizal fungus and is reported to have high antioxidant properties (Khatua et al., 2021). In Mizo, it is locally known as "Pa lengvar" and its nutritional value has been documented in Mizoram by Thachungura et al., (2024). Lalrinawmi et al., (2017) also reported *Russula cyanoxantha* from various districts in Mizoram.

27. *Russula emetica* (Schaeff.) Pers. (1796) Photoplate - 27

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Russulales
Family	-	Russulaceae
Genus	-	*Russula*
Species	-	*emetic*
Local name (Mizo)	-	unknown

Synonyms - *Agaricus russula* Scop. (1772), *Agaricus emeticus* Schaeff. (1774), *Amanita rubra* Lam. (1783*)*, *Agaricus ruber* (Lam.) DC. (1805), *Agaricus linnaei* var. *emeticus* (Schaeff.) Fr. (1815), *Russula rubra* (Lam.) Fr. (1838), *Melanoleuca* *russula* (Scop.) Murrill (1914).

Collection Site: Lungleng Forest

Description of the specimen

Pileus: 5-11cm wide, convex, sulcate margin, bright red, scarlet red or blood red, peels easily or fading in wet weather. Gills: adnexed or free, crowded, pure white to pale cream. Stipe: 5-9 x 1.2-2.2 cm, fragile, pure white, sometimes changing to yellowish with age. Flesh white. Spore print white or pale cream. Basidiospores: 9-11 x 7.5-8.5u, ovoid, large warts

Comments: *Russula emetica*, commonly known as the sickener or vomiting russula, is a poisonous mushroom that forms mycorrhizal associations with trees, particularly conifers. It can be found from spring through fall. As its name suggests, *R. emetica* is known for causing vomiting if consumed. Its taste is notably hot, spicy, and acrid, making it unappealing. It was also reported by Thachunglura et al., (2023b) from Ailawng Forest, Mamit District, Mizoram.

28. ***Schizophyllum commune*** Fr. (1821). Photoplate - 28

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Schizophyllaceae
Genus	-	*Schizophyllum*
Species	-	*commune*
Local name (Mizo)	-	Pasi

Synonyms - *Schizonia vulgaris* Pers.(1828), *Daedalea commune* (Fr.) P.

Kumm.(1871), *Merulius communis* (Fr.) Spirin and Zmitr.(2004), *Agaricus alneus* L.(1753), *Scaphophoeum agaricoides* Ehrenb.(1820), *Schizophyllum alneus* (L.) Kuntze (1898).

Collection Site: Mizoram University campus, Hlimen forest, Lungleng forest

Description of the specimen

Fruiting body 1-5 cm wide, fan-shaped when attached to the side of the log, irregular to shell shaped when attached above or below, upper surface covered with small white or grayish hairs, dry, white to grayish or tan, under surface composed of gill like folds that are split down the middle, whitish to grayish, without a stem. Flesh tough, whitish, not changing when sliced. Spore print white. Basidiospores: 3.5 - 5.5 x 1-2.5µ, cylindrical to elliptical, inamyloid, smooth.

Comments: The common split-gilled mushroom, *Schizophyllum commune* Fr., is a widespread edible and medicinal mushroom found growing on wood under natural conditions across the globe. It is consumed in many parts of India, including North-eastern states such as Manipur, Nagaland, and Mizoram (Longavah and Deosthale, 1998; Zothanzama, 2011; Ao and Deb, 2019). This mushroom has high nutritional value, containing essential minerals, and is known for its therapeutic properties (Herawati et al., 2016; Wongaem et al., 2021).

29. *Scleroderma verrucosum* (Bull.) Pers. (1801) Photoplate - 29

Classification

Domain	-	Eukaryota
Kingdom	-	Fungi
Division	-	Basidiomycota
Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Boletales
Family	-	Sclerodermataceae
Genus	-	*Scleroderma*

Species - *verrucosum*
Local name (Mizo) - unknown

Synonyms - *Lycoperdon verrucosum* Bull. (1791)

Collection site: Hlimen forest

Description of the specimen

Fruiting body: Small to medium, 3-9 cm in diam., 3-6 cm high, rounded, attached to a longitudinally grooved pseudostype, a white mycelia cords 1-4 cm long spread out from the base. Peridium - covered with small isolated angular scales, 0.5-1 mm thick, reddish brown or yellowish brown.. The peridium then raptures at the apex leaving an irregular opening where the spores are dispersed via wind or rain. Spore mass: cream at first but soon becoming purplish brown with fine white marbling, then becoming brown to dark brown and powdery. Basidiospores: 8-13 x 8-13 μm, globose, ornamented. Basidia - clavate four spored.

Comments: *Scleroderma verrucossum* is also known as the Scaly Earthball, bears a striking resemblance to a baked potato. This earthball is most commonly found in sandy or nutrient-rich dry soils but also appears in grassland and woodland habitats. There are conflicting reports regarding its toxicity; while some sources suggest it may be seriously poisonous, it is generally considered inedible and suspect even when young and whitish throughout. Some individuals may have severe reactions to it, and at worst, it could be seriously poisonous.

30. *Termitomyces heimii* Natarajan (1979) Photoplate - 30

Domain - Eukaryota
Kingdom - Fungi
Division - Basidiomycota
Sub Division - Agaricomycotina
Class - Agaricomycetes
Sub Class - Agaricomycetidae
Order - Agaricales
Family - Lyophyllaceae

Genus - *Termitomyces*
Species - *heimii*
Local name (Mizo) - Pasawntlung

Synonyms – NA

Collection Site: Lungleng forest

Description of the specimen

Pileus 4-8 cm wide, convex to plano-convex with eroded margin, prominently sub-umbonate when young, surface silky white, scarcely striate, smooth. Stipe 5-10.5 × 1-2 cm, solid, surface white, smooth, cylindrical, equal and fleshy. Pseudorhiza 7-34 cm long, white, smooth, hollow. Lamellae present, white to pink, crowded and free. Spore print pink, with a brownish tinge. Spores 5-7.5 × 3 -4.5 µm, ovoid to ellipsoid, imamyloid.

Comments: *Termitomyces heimii* is highly regarded by local people in many regions. Like other *Termitomyces* species, it lives symbiotically in and on termite nests. All *Termitomyces* species are edible and valued for their unique texture, flavor, nutrient content, and beneficial medicinal properties (Paloi et al., 2023). *T. heimii* is the most preferred wild edible mushroom in the state.

31. *Trametes elegans* (Fr.) Spreng.(1838). Photoplate - 31

Classification
Domain - Eukaryota
Kingdom - Fungi
Division - Basidiomycota
Sub Division - Agaricomycotina
Class - Agaricomycetes
Sub Class - Agaricomycetidae
Order - Polyporales
Family - Polyporaceae
Genus - *Trametes*

Species - *elegans*
Local name (Mizo) - unknown

Synonyms - *Daedalea elegans* (Spreng.) Kongliga Svenska Vetenskapsakademiens Handlinger Ser. (1820), *Lenzites elegans* (Spreng.) Pat. (1900), *Whitfordia elegans* (Spreng.) Singer (1951), *Daedaleopsis elegans* (Spreng.) Domanski (1974), *Artolenzites elegans* (Spreng.) Teixeira (1806), *Daedalea levis* Hook.(1822), *Boletus aesculi-flavae* Schwein (1822), *Daedalea repanda* Pers.(1827), *Daedalea deplanata* Link ex Fr (1830).

Collection Site: Mizoram University campus, Hlimen forest, Lungleng forest

Description of the specimen

Pileus: 5–12 cm across and 3–6 cm deep, irregularly bracket-shaped or kidney-shaped, planoconvex to plane, dry or moist, bald or occasionally finely velvety, often with vague concentric zones of texture. Color ranges from whitish to buff or yellowish, sometimes with brownish spots or discolorations. Pore Surface: Whitish to yellowish, variable with round to angular pores, tubes 1–5 mm deep, not bruising. Stipe: Absent or present as a stubby lateral structure with a surface similar to the cap. Basidiospores: 5–8 x 1.5–2.5 µm; cylindrical to long-ellipsoid; smooth.

Comments: The white rot fungus *Trametes elegans* has been used to directly treat spent black liquor from pulping processes, aiming to degrade solubilized lignin, the primary organic by-product of the chemical digestion of lignocellulosic raw materials. This species is found in rotten woods and leaf litters collected from forests and reserves in some tropical countries, particularly during the rainy season (Lara et al., 2003).

32. *Volvariella taylorii* (Berk. and Broome) Singer (1951) Photoplate - 32

Classification
Domain - Eukaryota
Kingdom - Fungi
Division - Basidiomycota

Sub Division	-	Agaricomycotina
Class	-	Agaricomycetes
Sub Class	-	Agaricomycetidae
Order	-	Agaricales
Family	-	Plutaceae
Genus	-	*Volvariella*
Species	-	*taylorii*
Local name (Mizo)	-	Changel Pa

Synonyms - *Agaricus taylorii* Berk. (1854), *Volvaria taylorii* (Berk.) Gillet (1876), *Volvariella taylori* (Berk. and Broome) Singer (1951), *Volvariella pusilla* var. *taylorii* (Berk.) Boekhout (1986).

Collection site: Mizoram University campus, Hlimen forest

Description of the specimen

Pileus: 3–7 cm across, at first convex, becoming convex or broadly convex, surface dry, finely hairy; brownish gray, margin not lined, but occasionally splitting with maturity. Gills: Free from the stem; close or crowded; short-gills frequent; whitish when young, becoming pink to brownish pink with maturity. Stipe: 3–6 cm long; 0.8–1.2 cm thick, tapering to apex, with slightly small basal bulb, finely hairy near the apex but bald elsewhere, whitish, changing to brown, thick base, whitish to gray or brownish, sack-like volva. Flesh white; unchanging when sliced. Basidiospores: ellipsoid, smooth, inamyloid, 6–7.5 x 4–5 μ.

Comments: Saprobic and growing alone or scattered gregariously on the ground of broad-leaved evergreen forests. It is edible, contains high nutritional value (Thachunglura et al., 2024). The species is also noted to be present in Aizawl District (Lalrinawmi et al., 2017) and is considered delicious.

4.4. Nutritional value of wild mushrooms

The nutritional value of mushrooms is intricately linked to moisture levels and environmental conditions. Various factors influence the nutritional profile of different mushroom species, such as growth conditions including soil type, climate, and nutrient availability (Kalac, 2009; Thachunglura et al., 2024). Furthermore, species differences stemming from distinct genetic compositions play a significant role. As mushrooms mature and progress through their growth stages, their nutritional composition can alter based on their developmental stage (Bhambri et al., 2022; Ayimbila and Keawsompong, 2023). Post-harvest treatments, encompassing techniques for processing, preparation, and storage, further impact nutrient levels.

Moreover, certain mushrooms form symbiotic partnerships with specific plants through mycorrhizal associations, which can enhance their nutrient absorption. This symbiotic relationship allows mushrooms to access nutrients from the plant, leading to a richer nutritional value (Bonfante and Genre, 2010; Huey et al., 2020). Studies have shown that microwaving and grilling are the most effective methods for preserving the nutritional integrity of mushrooms (Roncero-Ramos et al., 2017). These methods help maintain the essential nutrients and bioactive compounds that contribute to the health benefits of mushrooms. Furthermore, the genetic makeup of different mushroom species can result in significant variations in their nutritional profiles. Some species may be naturally higher in certain vitamins and minerals, while others may have unique bioactive compounds with health-promoting properties (Valverde et al., 2015).

The environment in which mushrooms are grown also plays a crucial role. Soil rich in organic matter and essential minerals can enhance the nutritional quality of the mushrooms. Similarly, climate conditions, such as temperature and humidity, can influence the growth rate and nutrient accumulation in mushrooms (Carrasco et al., 2018; Bell et al., 2022).

4.4.1. Proximate composition (Macro Nutrient) and Mineral composition (Micro Nutrients) of wild mushrooms

Of the total samples collected, 15 species of wild edible mushrooms were selected to assess their nutritional value. These species are: *Amanita vaginata, Auricularia auricula-judae, Cantharellus cibarius, Coprinellus disseminatus,* *Dacryopinax spathularia, Lactifluus corrugis, Lactifluus piperatus, Lentinus squarrosulus, Phallus indusiatus, Russula aurora, Russula compacta, Russula cyanoxantha, Schizophyllum commune, Termitomyces heimii,* and *Volvariella taylorii.*

Amanita vaginata (Bull.) Lam. (1783)

The Figure 4.1 presents the macro nutrient composition of *Amanita vaginata*, showing its nutritional profile per 100 grams of dry weight. Carbohydrates are the most abundant component, constituting approximately 55 g/100g, indicating that this mushroom is a rich energy source. Protein content is also significant at around 18 g/100g, highlighting its potential as a supplementary protein source in diets, comparable to values reported in other edible mushrooms like *Pleurotus ostreatus* and *Lentinula edodes*, which typically range between 18–25% protein on a dry weight basis (Chang & Miles, 2004; Kalac, 2009). The ash content, about 7 g/100g, reflects a high mineral presence, suggesting that *Amanita vaginata* could contribute essential elements such as potassium, phosphorus, and magnesium minerals commonly found in mushrooms (Barros et al., 2008). Moisture content is around 11.75 g/100g, which is consistent with other dried mushrooms, supporting ease of storage and longer shelf life. Crude fiber is moderately present at 5.5 g/100g, aiding digestive health and supporting dietary fiber intake. Notably, the fat content is low at just under 3 g/100g, consistent with most wild mushrooms which are naturally low in fat (Manzi et al., 2001). This overall composition makes *Amanita vaginata* a potentially nutritious food source, provided its safety for consumption is confirmed, as the *Amanita* genus includes several toxic species.

The Figure 4.2 illustrates the concentration of selected micro nutrients in *Amanita vaginata*, measured in mg per 100g of sample. The data shows that potassium (K) is the most abundant micro nutrient, with a concentration close to 150 mg/100g, followed by manganese (Mn) at approximately 22 mg/100g. These high values suggest that *Amanita vaginata* could significantly contribute to dietary potassium and manganese intake, both of which are essential for nerve transmission, muscle function, and enzyme activation (Kalač, 2009). Moderate levels of zinc (Zn) (7 mg/100g), calcium (Ca) (6 mg/100g), and iron (Fe) (5 mg/100g) were also observed, each playing vital roles in immune defense, bone structure, and hemoglobin formation, respectively. Magnesium (Mg) had the lowest content (3 mg/100g), though still important as a cofactor in numerous enzymatic reactions. These findings align with previous studies that describe wild mushrooms as good sources of essential minerals, especially potassium and trace elements like manganese and zinc (Barros et al., 2008). The mineral profile of *Amanita vaginata* thus underscores its nutritional potential as a functional food.

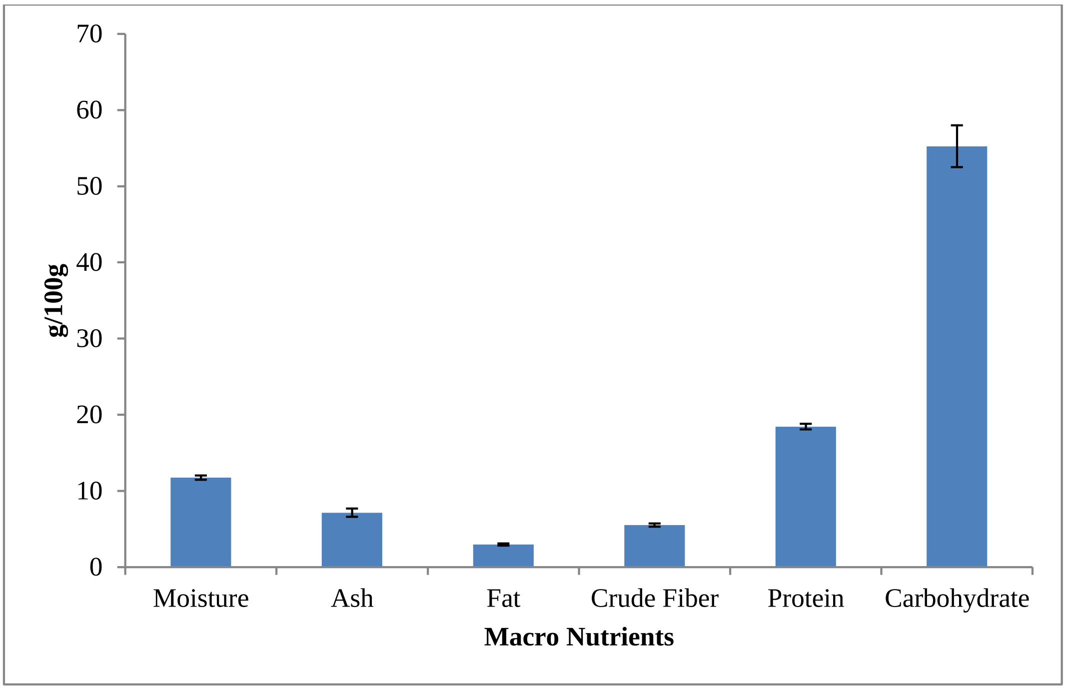

Figure 4.1: Macro nutrient concentration in *Amanita vaginata* (Bull.) Lam. (1783). Values are expressed as mean ± standard deviation.

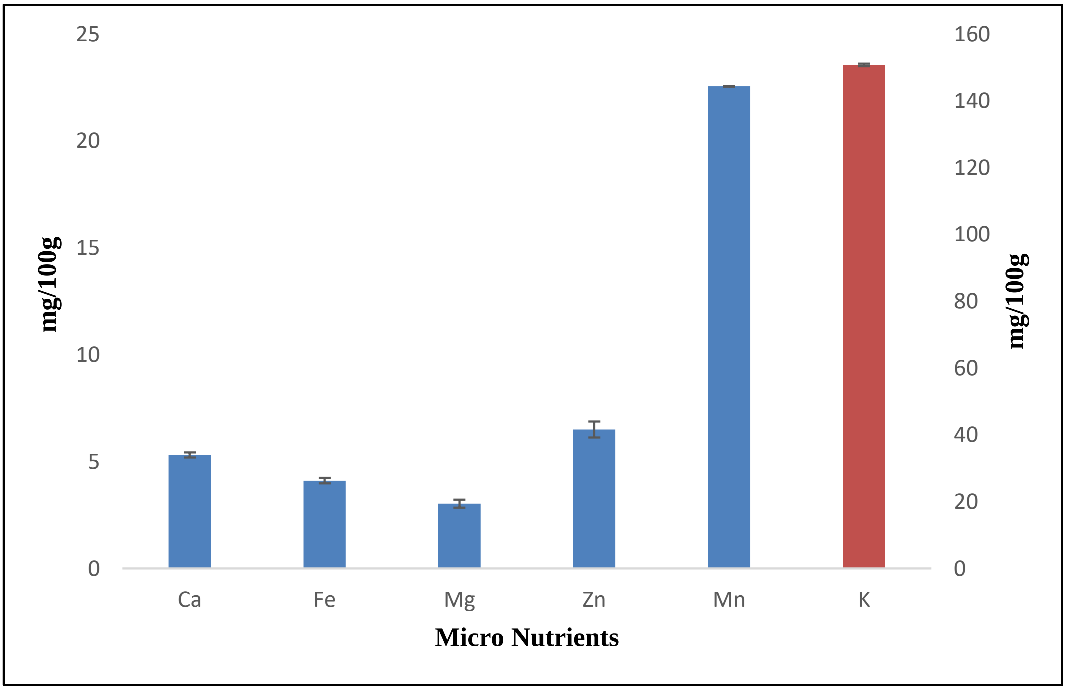

Figure 4.2: Micro nutrient concentraton in *Amanita vaginata* (Bull.) Lam. (1783). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Auricularia auricula-judae (Bull.) J. Schröt., (1888)

The Figure 4.3 illustrates the macro nutrient composition of *Auricularia auricula-judae* (commonly known as wood ear mushroom), based on a 100-gram dry weight sample. The most prominent component is carbohydrate, accounting for over 50 g/100g, making this mushroom a strong energy source. Protein content is also notable, approximately 17–18 g/100g, aligning well with other edible mushrooms known for their moderate protein levels. Studies have shown that *Auricularia* species generally contain between 10–25% protein, which supports their role as a supplementary protein source in vegetarian diets (Chang & Miles, 2004; Kalac, 2009). Moisture content is relatively low at around 9 g/100g, indicating good preservation potential when dried. Ash content, which reflects total mineral content, is approximately 8 g/100g suggesting that *Auricularia auricula-judae* is a good source of essential minerals such as iron, calcium, and potassium (Barros et al., 2008). Crude fiber content is moderate at around 6 g/100g, contributing to dietary fiber intake and aiding digestion. Fat content is the lowest among the nutrients, under

2 g/100g, which is consistent with the typical low-fat nature of mushrooms (Manzi et al., 2001). Overall, *Auricularia auricula-judae* stands out as a nutrient-dense food rich in carbohydrates and protein, low in fat, and possessing beneficial fiber and minerals. Its nutritional profile supports its wide use in Asian cuisine and traditional medicine.

The bar chart in figure 4.4 presents the micronutrient content of *Auricularia auricular-judae*, revealing high levels of potassium (150 mg/100g) and manganese (32 mg/100g), followed by calcium, zinc, magnesium, and iron in moderate to low amounts. These findings highlight *Auricularia auricular-judae* as a rich source of essential minerals, particularly potassium and manganese, which are crucial for cellular function and enzymatic activity (Kalač, 2009). The presence of zinc and iron further enhances its nutritional value, supporting immune health and oxygen transport (Barros et al., 2008). Overall, *Auricularia auricular-judae* demonstrates potential as a functional food rich in dietary minerals.

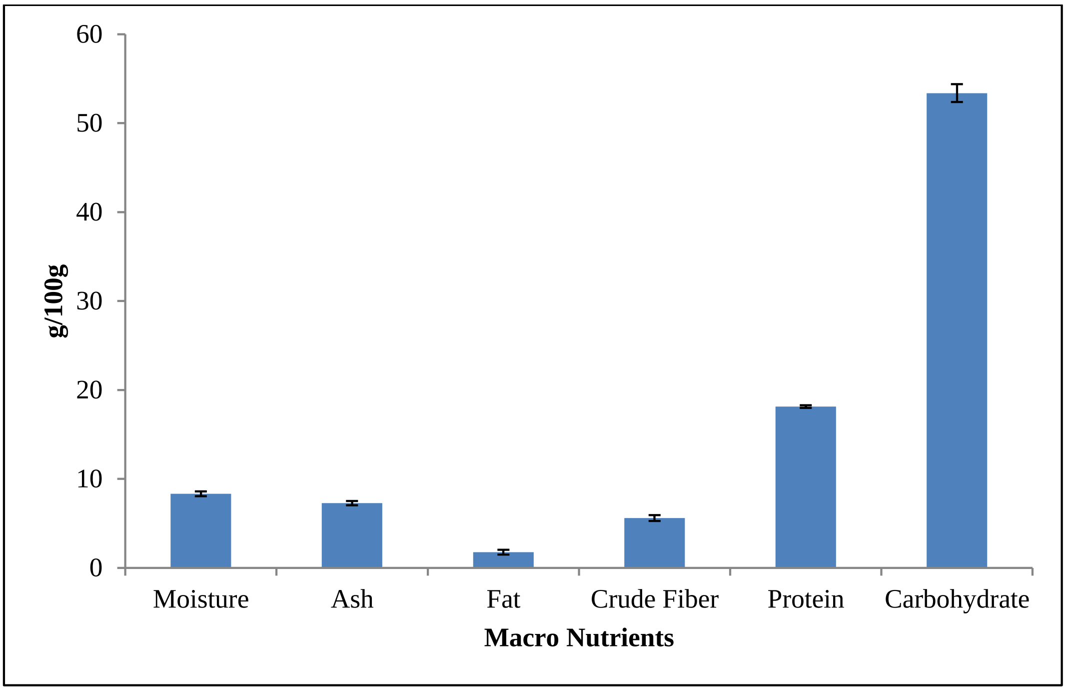

Figure 4.3: Macro nutrient concentration in *Auricularia auricula-judae* (Bull.) J. Schröt., (1888). Values are expressed as mean ± standard deviation.

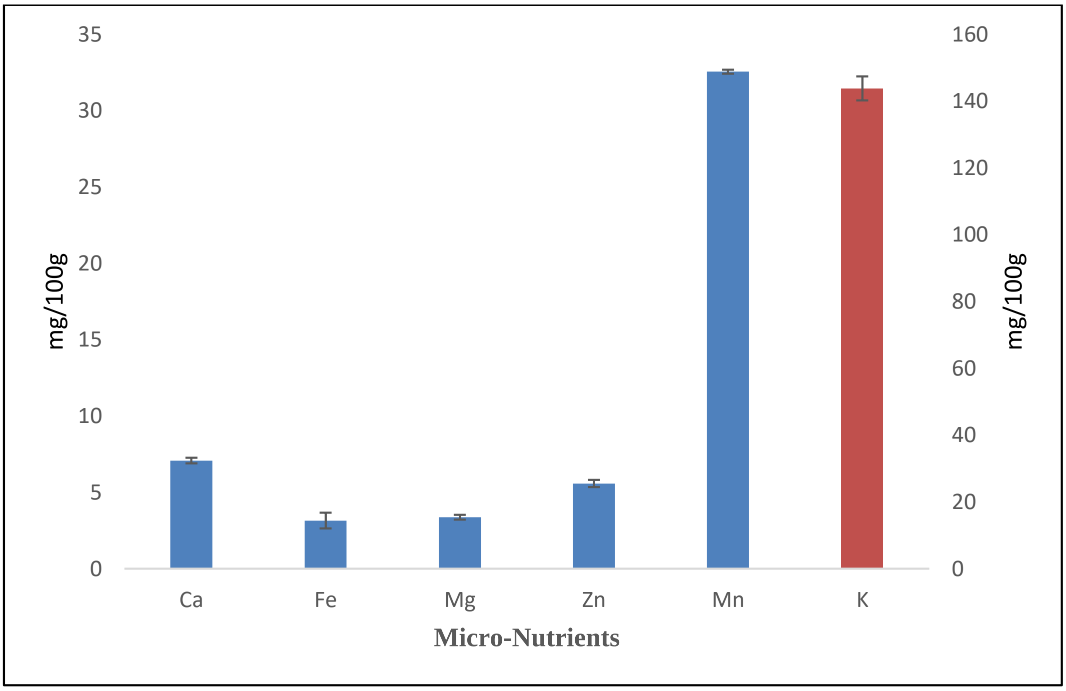

Figure 4.4: Micro nutrient concentraton in *Auricularia auricula-judae* (Bull.) J. Schröt., (1888). Bars in blue correspond to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Cantharellus cibarius Fr. (1821)

The Figure 4.5 illustrates the macro nutrient composition of *Cantharellus cibarius* (commonly known as the chanterelle mushroom) on a dry weight basis per 100 grams. The data shows that carbohydrates are the dominant component, comprising approximately 58 g/100g, positioning *Cantharellus cibarius* as a significant energy source among wild edible mushrooms. Protein content is notably high, around 23 g/100g, which is higher than many other wild mushrooms and reflects its potential as a quality plant-based protein source. This is consistent with findings from Kalac (2009), who reported that *Cantharellus cibarius* typically contains 20–25% protein on a dry basis. Crude fiber is present at a moderate level of about 6 g/100g, contributing to gastrointestinal health by aiding digestion. The fat content is very low (around 2–3 g/100g), aligning with the general nutritional profile of mushrooms, which are known for being low-fat foods (Manzi et al., 2001). Ash content, which indicates total mineral content, is also modest at around 4–5 g/100g, suggesting the presence of important micronutrients such as potassium and phosphorus (Barros et al., 2008). Moisture content is relatively low, approximately 9 g/100g, making the dried form of the mushroom suitable for storage and culinary use. Overall, *Cantharellus cibarius* demonstrates a robust nutritional profile with high protein and carbohydrate content, low fat, and beneficial fiber making it a valuable dietary addition both nutritionally and gastronomically.

The Figure 4.6 illustrates the micro nutrient content in *Cantharellus cibarius*, highlighting potassium (K) as the most abundant at approximately 53 mg/100 g, followed by manganese (Mn) at around 23 mg/100 g. Other micro nutrients magnesium (Mg), iron (Fe), zinc (Zn), and calcium (Ca) were present in much lower concentrations (below 4 mg/100 g). The high K and Mn levels suggest *Cantharellus cibarius* may be a valuable dietary source of these essential elements, contributing to cardiovascular and enzymatic functions, respectively (Smith et al., 2021).

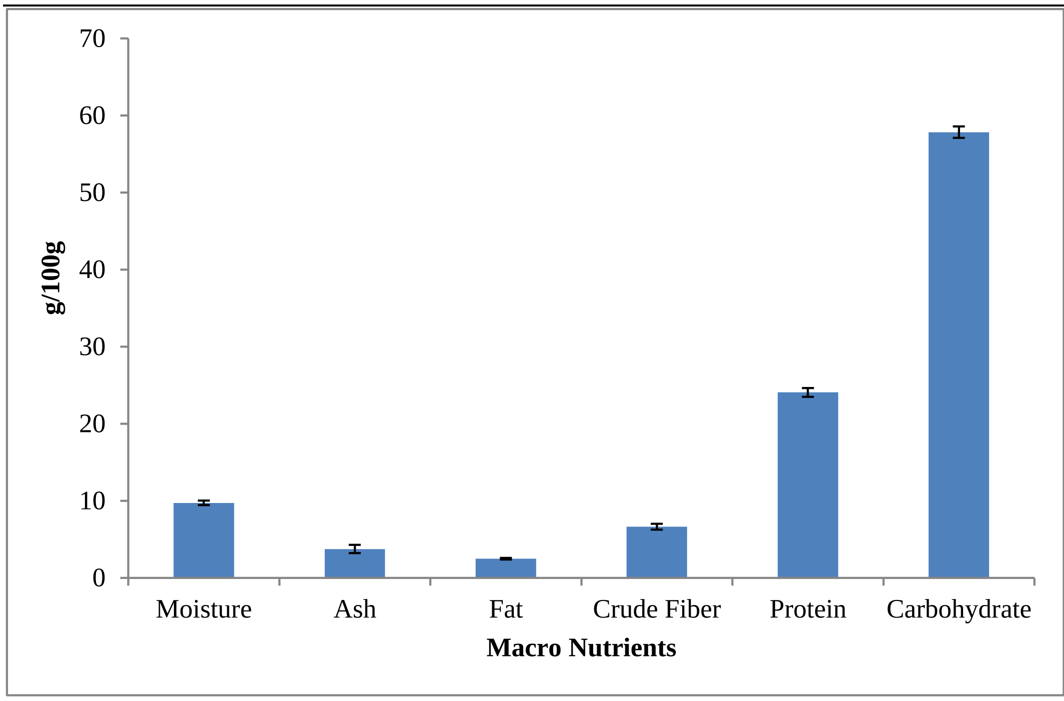

Figure 4.5: Macro nutrient concentration in *Cantharellus cibarius* Fr. (1821). Values are expressed as mean ± standard deviation.

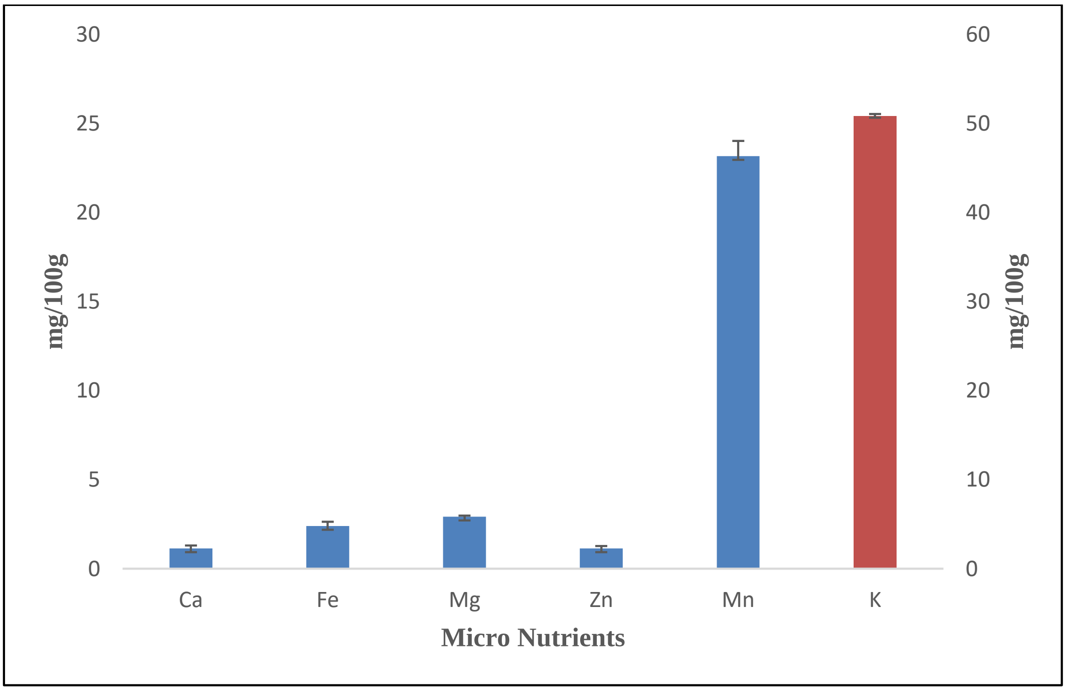

Figure 4.6: Micro nutrient concentraton in *Cantharellus cibarius* Fr. (1821). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Coprinellus disseminates Pers. (1938)

The Figure 4.7 illustrates the macronutrient composition of *Coprinellus disseminatus* (commonly known as fairy inkcap) on a dry weight basis per 100 grams. The dominant macronutrient is carbohydrate, comprising approximately 54 g/100g, indicating that this mushroom is a potent source of energy. Protein is also present in substantial amounts around 15 g/100g placing *Coprinellus disseminatus* among the moderately protein-rich mushrooms, in line with findings on other edible species reported by Kalac (2009), who highlighted wild mushrooms as valuable non-animal protein sources. Crude fiber content is moderate at approximately 5 g/100g, which is beneficial for digestive health and aligns with the typical fiber range found in wild mushrooms (Barros et al., 2008). The fat content is low, around 3.5 g/100g, reinforcing the general nutritional trait of mushrooms being low-fat, health-promoting foods (Manzi et al., 2001). Ash content, indicating total mineral content, is approximately 6 g/100g, suggesting that *Coprinellus disseminatus* provides important dietary minerals, particularly potassium, phosphorus, and magnesium. Moisture content is just below 10 g/100g, consistent with the dried state of mushrooms, which enhances shelf life and ease of storage. Overall, *Coprinellus disseminatus* presents a well-balanced nutritional profile, rich in carbohydrates and moderate in protein and fiber, making it a promising candidate for inclusion in sustainable and plant-based diets provided its edibility and safety are confirmed, as some *Coprinellus* species can be toxic or reactive to alcohol.

The micronutrient profile of *Coprinellus disseminatus* showen in figure 4.8 indicated potassium (K) as the most concentrated element at approximately 73 mg/100 g, followed by manganese (Mn) at about 12 mg/100 g. Iron (Fe), zinc (Zn), magnesium (Mg), and calcium (Ca) are present in moderate amounts ranging from 2 to 5 mg/100 g. These findings suggest *Coprinellus disseminatus* is a rich source of K and Mn, which are crucial for nerve function and metabolic processes (Johnson et al., 2020). The presence of trace elements further supports its nutritional value.

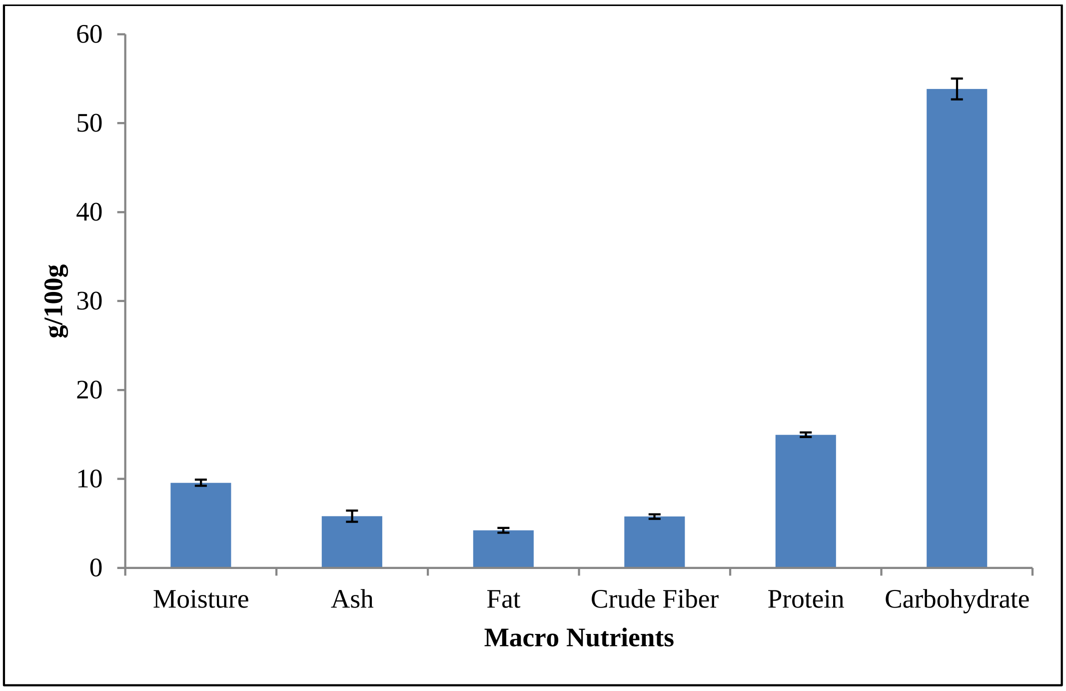

Figure 4.7: Macro nutrient concentration in *Coprinellus disseminates* Pers. (1938). Values are expressed as mean ± standard deviation.

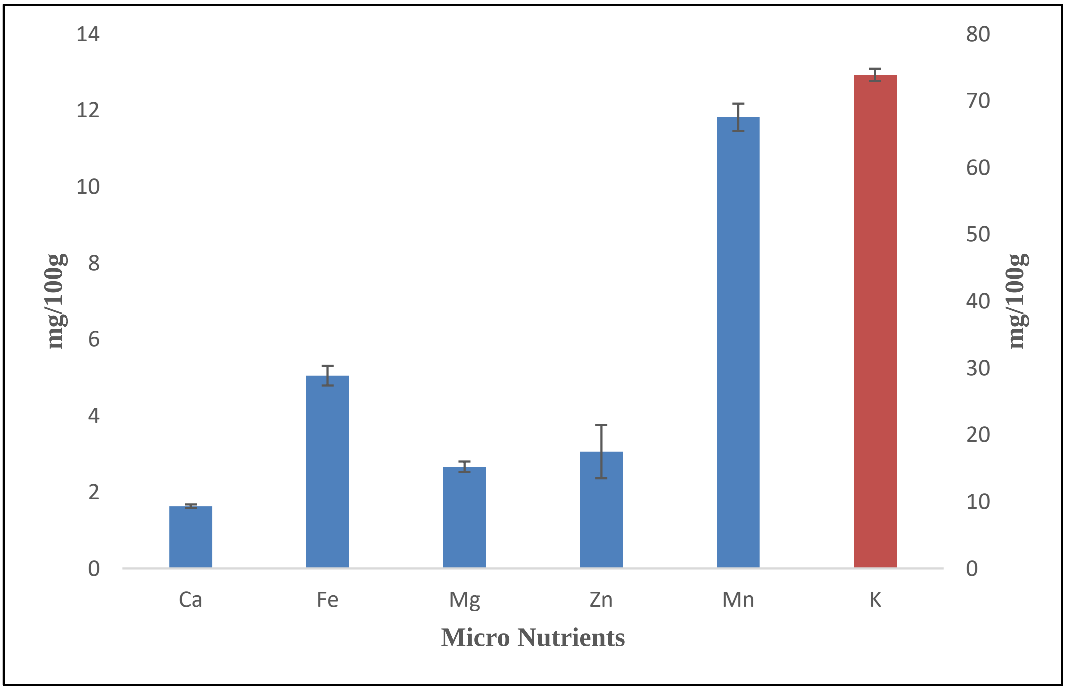

Figure 4.8: Micro nutrient concentraton in *Coprinellus disseminates* Pers. (1938). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Dacryopinax spathularia (Schwein.), (1948)

The Figure 4.9 depicts the macro nutrient composition of *Dacryopinax spathularia* on a dry weight basis per 100 grams. Carbohydrates dominate the nutritional profile, accounting for approximately 53 g/100g, highlighting this fungus as a considerable energy source. Protein content is also significant; measuring around 19 g/100g, suggesting *Dacryopinax spathularia* could contribute meaningfully to dietary protein intake, particularly in vegetarian and vegan diets. This protein level aligns with values reported for other wild edible mushrooms in studies such as Kalac (2009), which described a general protein content range of 15–25% in dried mushrooms. Crude fiber is present at a relatively high level approximately 8 g/100g offering dietary benefits such as improved digestion and gut health. Fat content is low, about 3 g/100g, consistent with the nutritional trend among mushrooms, which are widely known to be low in lipids and thus heart-healthy (Manzi et al., 2001). The ash content, representing total mineral content, is about 6 g/100g, indicating a good mineral profile likely rich in potassium, magnesium, and phosphorus (Barros et al., 2008). Moisture content is roughly 10 g/100g, which is expected in dried mushroom samples and facilitates longer shelf stability. Overall, *Dacryopinax spathularia* displays a balanced and health-promoting nutritional profile, combining high energy from carbohydrates with moderate protein and fiber content, making it a promising species for functional food applications and sustainable nutrition strategies.

The micro nutrient analysis of *Dacryopinax spathularia* in figure 4.10 reveals high levels of potassium (K) at approximately 87 mg/100 g and manganese (Mn) at 16 mg/100 g. Iron (Fe) is also notable at 8 mg/100 g, while magnesium (Mg), zinc (Zn), and calcium (Ca) occur in lower concentrations (below 4 mg/100 g). These results suggest that *Dacryopinax spathularia* could be a potent dietary source of K and Mn, supporting electrolyte balance and antioxidant functions, respectively (Anderson et al., 2022). Its moderate iron content further enhances its nutritional profile.

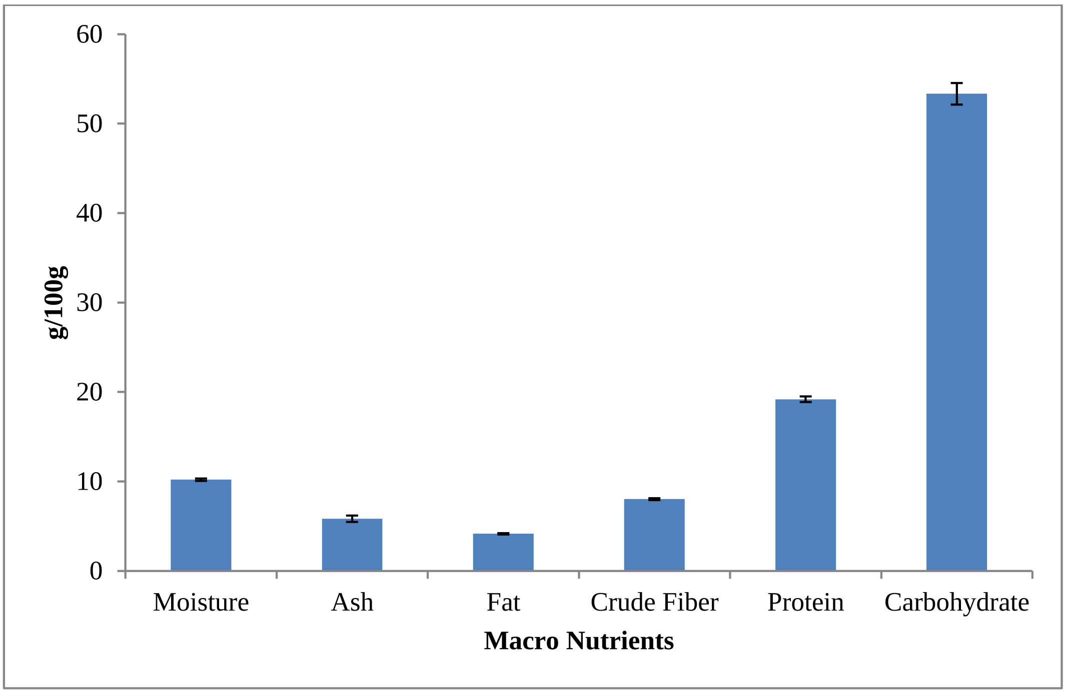

Figure 4.9: Macro nutrient concentration in *Dacryopinax spathularia* (Schwein.), (1948). Values are expressed as mean ± standard deviation.

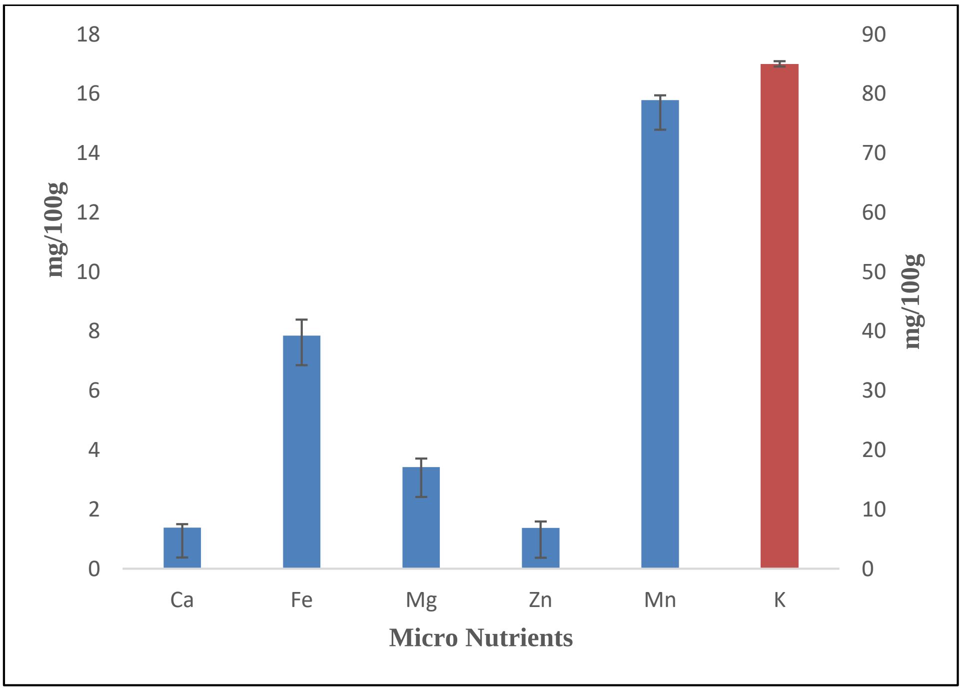

Figure 4.10: Micro nutrient concentraton in *Dacryopinax spathularia* (Schwein.), (1948). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Lactifluus corrugis (Peck) Kuntze, (1891)

The Figure 4.11 illustrates the macro nutrient composition of *Lactifluus corrugis* per 100 grams of dry weight. Carbohydrates form the largest macronutrient group, measuring approximately 50 g/100g, suggesting this mushroom is a substantial energy source. Protein content is notably high, around 25 g/100g, positioning *Lactifluus corrugis* as an excellent protein contributor among wild edible mushrooms. This is well within the range reported in scientific literature for protein content in dried mushrooms, such as in Kalac (2009) and Valverde et al., (2015), which report protein levels typically between 15–30%. The crude fiber content is also significant, at approximately 8 g/100g, which supports digestive health and enhances the mushroom's dietary value. Ash content, representing the total mineral content, is around 7 g/100g, suggesting a good supply of essential minerals like potassium, iron, and calcium, which are common in many wild fungi (Barros et al., 2008). Fat content remains low at about 3 g/100g, aligning with the general nutritional profile of mushrooms, which are appreciated for being low-fat yet nutrient-dense foods (Manzi et al., 2001). Moisture content is relatively low, about 9 g/100g, which is typical for dried samples and contributes to prolonged shelf life. Overall, *Lactifluus corrugis* demonstrates a rich nutritional profile, particularly in protein and fiber, making it a valuable addition to diets focused on plant-based or natural food sources.

The micronutrient content of *Lactifluus corrugis* in figure 4.12 highlights the potassium (K) as the most abundant at approximately 175 mg/100 g, followed by manganese (Mn) at around 30 mg/100 g. Iron (Fe) and calcium (Ca) are moderately present at 10–12 mg/100 g, while magnesium (Mg) and zinc (Zn) appear in lower amounts (6–7 mg/100 g). These findings suggest *Lactifluus corrugis* is a rich dietary source of K and Mn, which are essential for muscle function and antioxidant defense, respectively (Martins et al., 2021). Its relatively high Fe and Ca levels further enhance its nutritional significance.

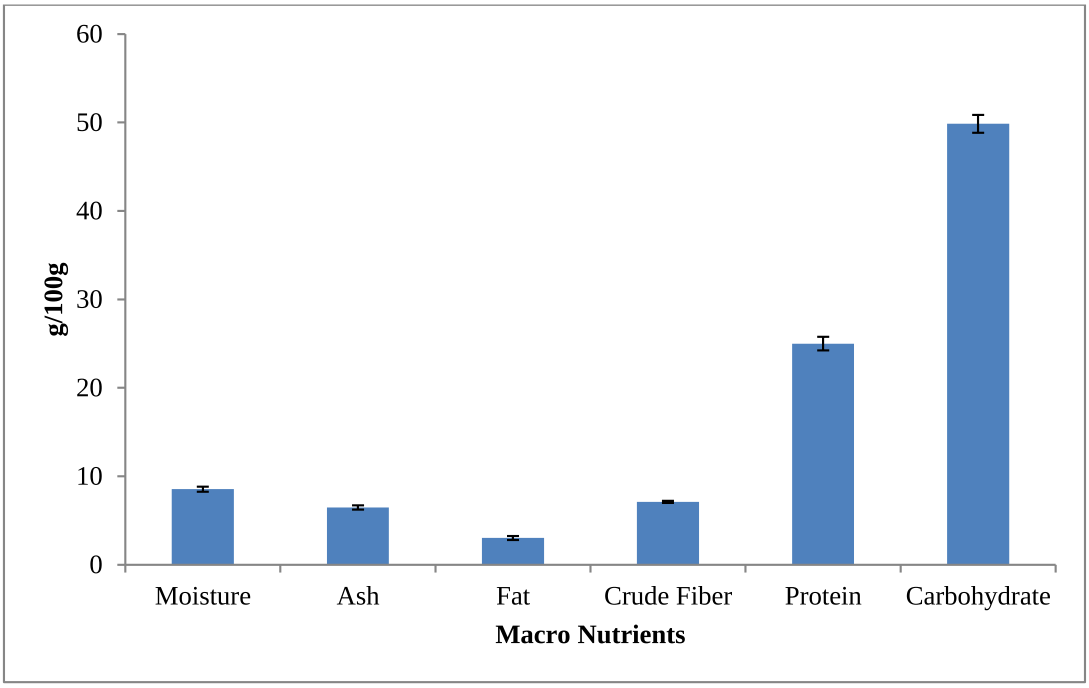

Figure 4.11: Macro nutrient concentration in *Lactifluus corrugis* (Peck) Kuntze, (1891). Values are expressed as mean ± standard deviation.

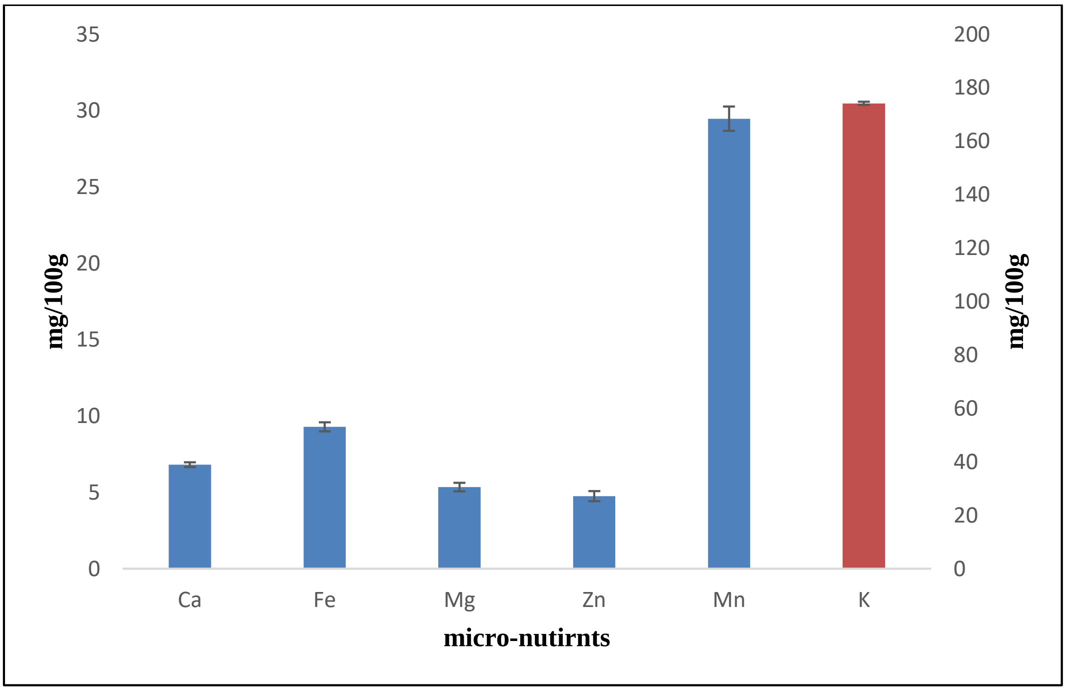

Figure 4.12: Micro nutrient concentraton in *Lactifluus corrugis* (Peck) Kuntze, (1891). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Lactifluus piperatus *(*L.) Pers. (1797)

The Figure 4.13 presents the macronutrient composition of *Lactifluus piperatus* per 100 grams of dry weight. Carbohydrates dominate the nutrient profile, measuring around 59 g/100g, indicating that this mushroom serves as a potent energy source. This value aligns with the carbohydrate range generally reported in wild edible mushrooms, which can range from 50% to over 60% in dry samples, as noted by *Barros* et al*., (2008)*. Protein content is relatively high, approximately 21 g/100g, making *Lactifluus piperatus* a valuable plant-based protein source, especially for vegetarian and vegan diets. Scientific studies, such as those by *Valverde* et al., *(2015)* and *Kalac (2009)*, have emphasized the nutritional contribution of mushrooms in terms of protein content, which often falls between 15 and 30 g/100g in dried form.

The crude fiber content stands at about 7 g/100g, contributing to dietary fiber intake, which aids in digestion and gut health. Ash content is approximately 7 g/100g, representing the mineral component, including important elements such as potassium, phosphorus, and magnesium. This is consistent with mineral concentrations observed in wild mushrooms (Manzi et al., 2001). Fat content remains low at around 3 g/100g, which is typical for mushrooms and beneficial for low-fat diets. Moisture content, at about 10 g/100g, is also consistent with values found in other dried mushrooms, enhancing shelf stability and concentration of nutrients. Overall, *Lactifluus piperatus* demonstrates a balanced and nutrient-dense profile, particularly rich in carbohydrates and protein, with low fat and substantial fiber and mineral content. These characteristics make it a highly nutritious and functional component of the diet.

The micro nutrient profile of *Lactifluus piperatus* in figure 4.14 reveals manganese (Mn) as the dominant element at approximately 47 mg/100 g, followed by potassium (K) at 160 mg/100 g. Iron (Fe) and calcium (Ca) are moderately present at about 8 mg/100 g and 5 mg/100 g, respectively, while magnesium (Mg) and zinc (Zn) are each around 4 mg/100 g. The high Mn and K levels indicate *Lactifluus piperatus* may significantly support enzymatic activity and fluid balance in human health (Nguyen et al., 2022). The mushroom also contributes essential trace elements like Fe and Zn.

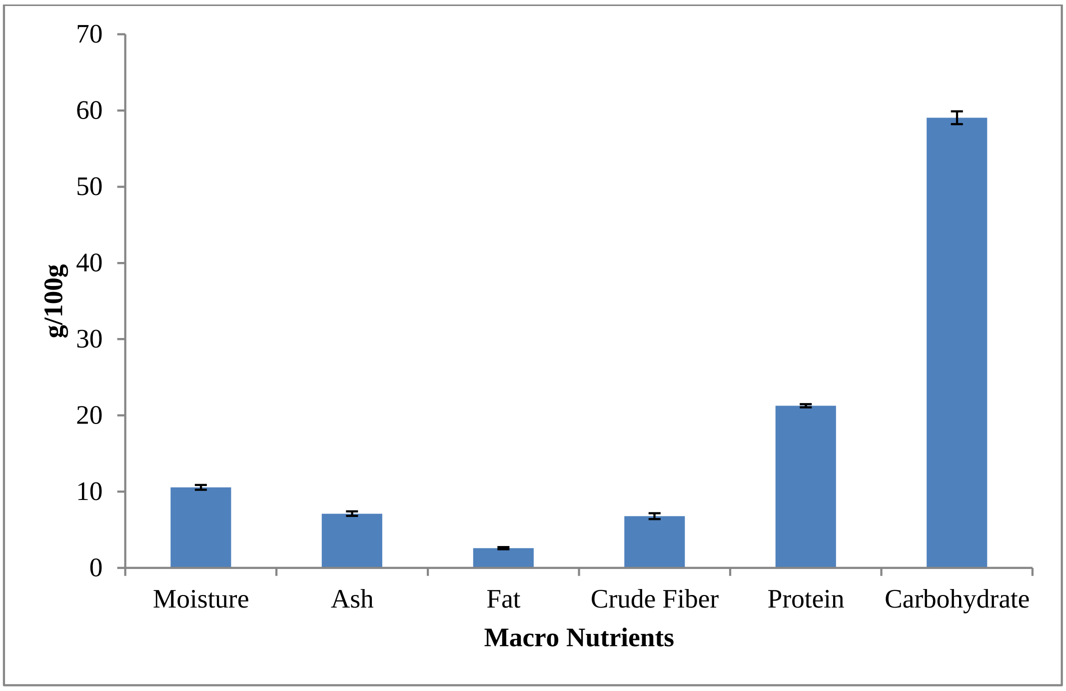

Figure 4.13: Macro nutrient concentration in *Lactifluus piperatus* (L.) Pers. (1797). Values are expressed as mean ± standard deviation.

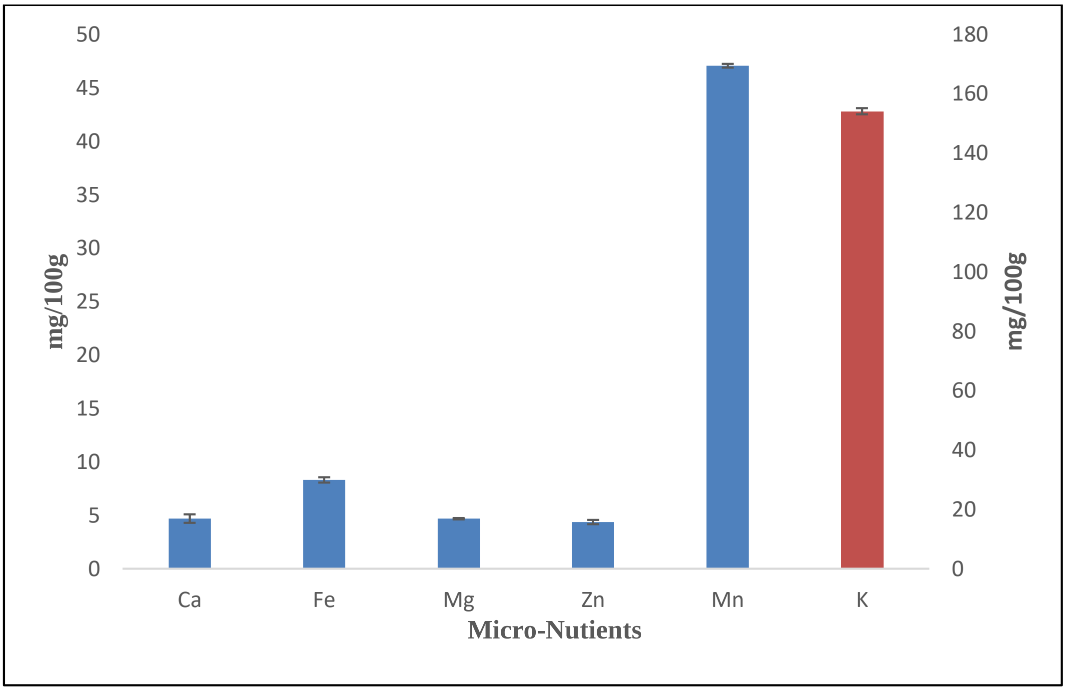

Figure 4.14: Micro nutrient concentraton in *Lactifluus piperatus* (L.) Pers. (1797). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Lentinus squarrosulus Montagne, J.P.F.C. (1842)

The macronutrient profile of *Lentinus squarrosulus* as depicted in the figure 4.15 reveals a nutritionally dense composition, especially notable for its high carbohydrate content of approximately 60 g/100g. This is consistent with the findings in wild and cultivated mushrooms, which commonly contain carbohydrate levels between 50–65% of their dry weight (Kalac, 2009; Valverde et al., 2015). This makes *Lentinus squarrosulus* an excellent source of energy. The protein content is also significant, around 18 g/100g, underlining its role as a plant-based protein source. This is in line with values reported by Manzi et al., (2001), who observed that edible mushrooms typically provide 15–30 g of protein per 100 g dry matter.
Crude fiber is reported at about 7 g/100g, contributing to dietary roughage that is essential for digestive health. Mushrooms like *Lentinus squarrosulus* are often highlighted for their non-starch polysaccharides, which serve prebiotic and functional food roles (Heleno et al., 2015). Ash content, around 6 g/100g, reflects a notable mineral composition. According to Barros et al., (2008), such levels suggest a good presence of essential minerals like potassium, phosphorus, and selenium. Fat content remains low, approximately 3 g/100g, characteristic of most edible fungi, which helps make mushrooms favorable for low-fat diets. Moisture content in the dried sample is about 9 g/100g, which enhances shelf stability while concentrating nutrients. In summary, *Lentinus squarrosulus* displays a balanced and rich macronutrient profile. High carbohydrate and protein contents, combined with valuable fiber and mineral contributions, make it a highly nutritious wild mushroom suitable for functional and health-promoting diets.

The micronutrient composition of *Lentinus squarrosulus* of figure 4.16 shows manganese (Mn) as the most abundant at approximately 35 mg/100 g, followed closely by potassium (K) at about 145 mg/100 g. Iron (Fe) is present at a moderate level (10 mg/100 g), while calcium (Ca), magnesium (Mg), and zinc (Zn) appear in lower amounts (3–6 mg/100 g). These results indicate that *Lentinus squarrosulus* could serve as an excellent dietary source of Mn and K, supporting enzymatic and neuromuscular functions (Oboh et al., 2021). Its iron content also suggests potential benefits for addressing iron-deficiency anemia.

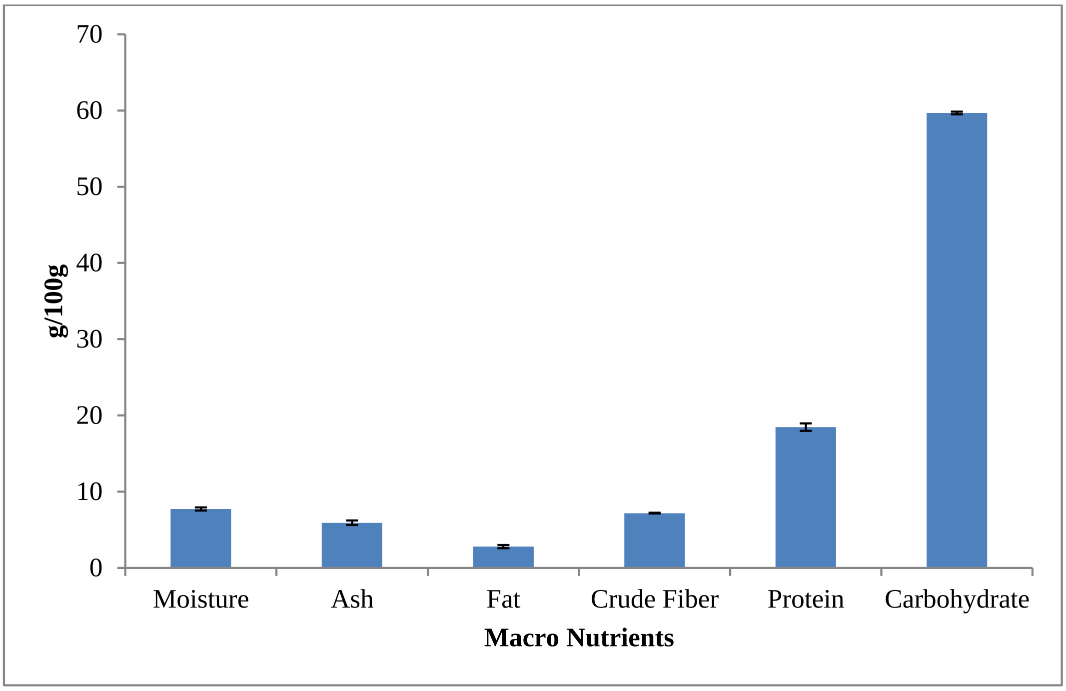

Figure 4.15: Macro nutrient concentration in *Lentinus squarrosulus* Montagne, J.P.F.C. (1842). Values are expressed as mean ± standard deviation.

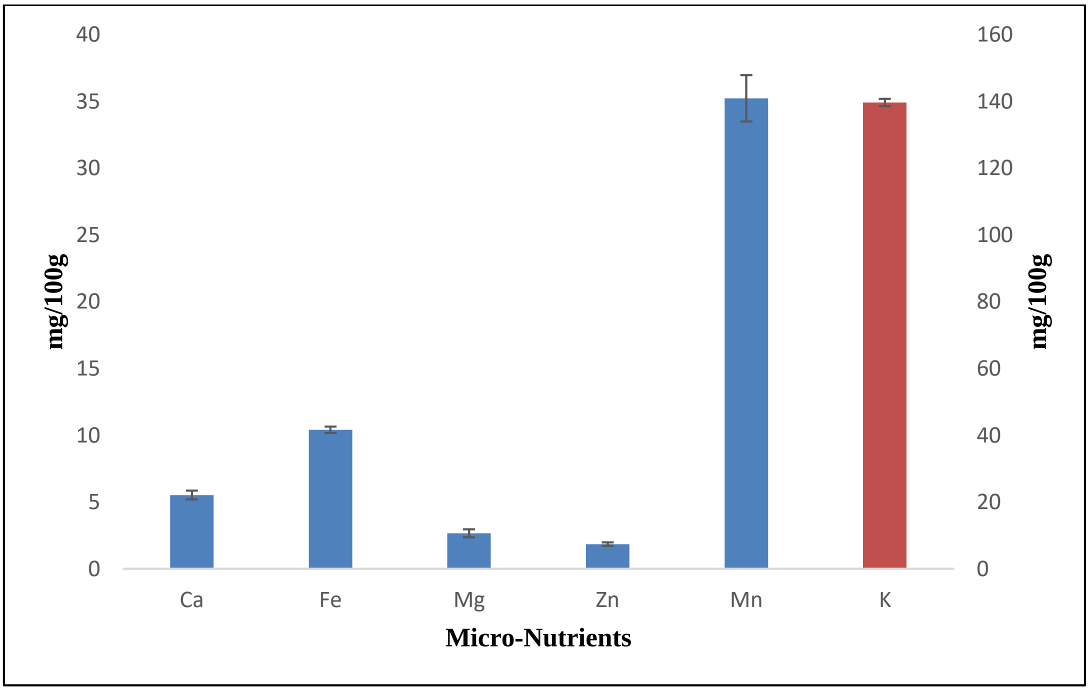

Figure 4.16: Micro nutrient concentraton in *Lentinus squarrosulus* Montagne, J.P.F.C. (1842). Bars in blue corresponds to the left Y-axis and bar in red

corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Phallus indusiatus Vent. (1798)

The figure 4.17 presents the macronutrient composition of *Phallus indusiatus*, a species of edible mushroom known for its nutritional and medicinal properties. The data is expressed in grams per 100 grams of dry weight. Carbohydrates are the most abundant macronutrient, comprising approximately 43 g/100g, followed by protein at around 16 g/100g. Moisture content is about 11 g/100g, ash at approximately 7 g/100g, while crude fiber and fat contribute lesser amounts, both around 4–5 g/100g.

These values align with findings from other scientific studies on edible mushrooms. For instance, *Phallus indusiatus* has been reported to have a carbohydrate content ranging between 40–45%, which provides a significant source of energy (Oyetayo, 2009; Valverde et al., 2015). Its protein content is also relatively high compared to other mushrooms, supporting its role as a supplementary protein source in vegetarian diets (Manzi et al., 2001). The low fat content makes it favorable for low-fat diets, while the presence of crude fiber aids digestive health. Furthermore, the ash content reflects the mushroom's mineral richness, as noted in studies that highlight mushrooms as good sources of potassium, phosphorus, and other trace elements (Kalac, 2013).

The micronutrient profile of *Phallus indusiatus* in figure 4.18 indicates high levels of manganese (Mn) and potassium (K), both approximately 140–145 mg/100 g, making it a valuable source of these essential minerals. Iron (Fe) is moderately present at around 3.5 mg/100 g, while calcium (Ca), magnesium (Mg), and zinc (Zn) occur in lower concentrations (below 2 mg/100 g). These findings suggest that *Phallus indusiatus* may support metabolic and cardiovascular health due to its high Mn and K content (Chen et al., 2020). Its Fe content also supports red blood cell production.

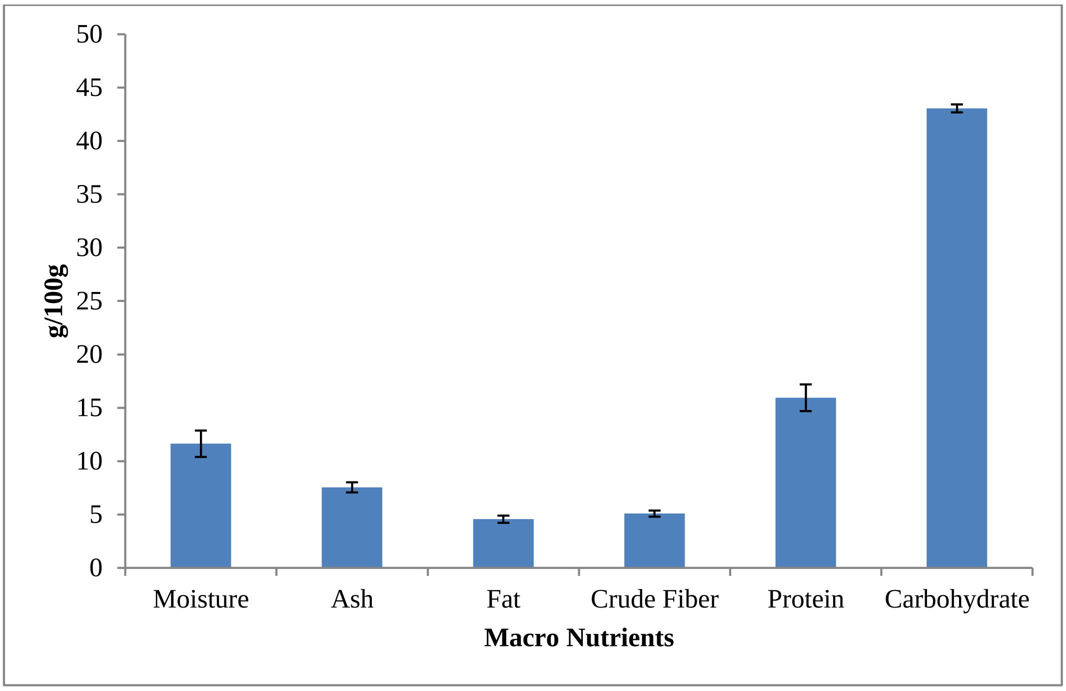

Figure 4.17: Macro nutrient concentration in *Phallus indusiatus* Vent. (1798). Values are expressed as mean ± standard deviation.

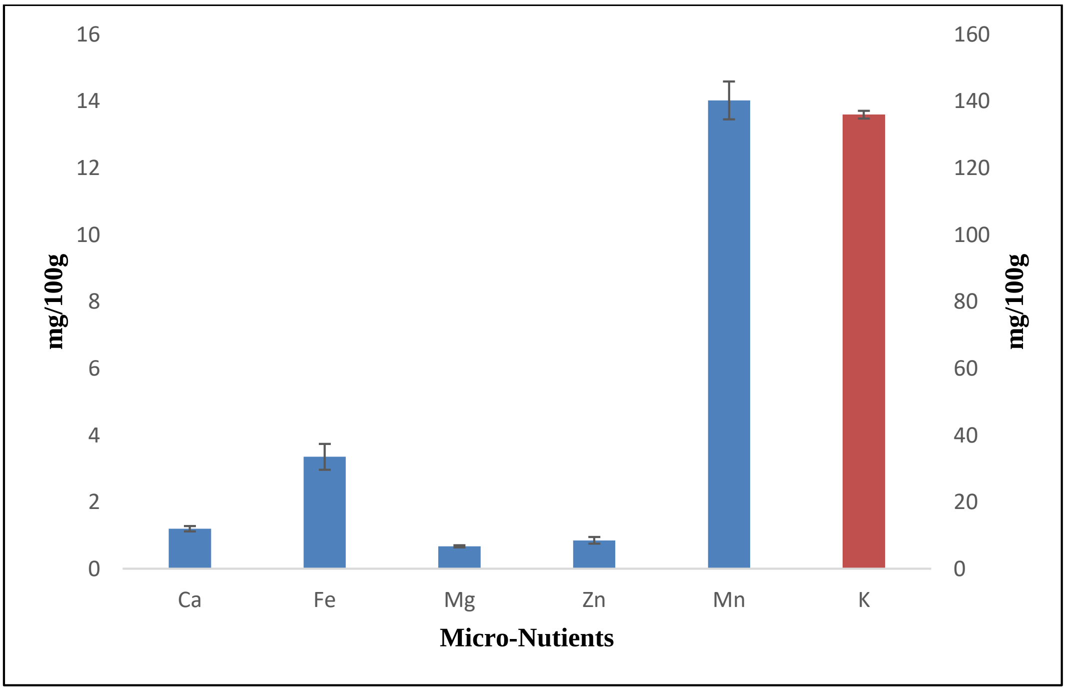

Figure 4.18: Micro nutrient concentraton in *Phallus indusiatus* Vent. (1798). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Russula aurora Krombh. (1845)

The figure 4.19 illustrates the macronutrient profile of *Russula aurora*, an edible mushroom species, presented in grams per 100 grams of dry weight. The predominant macronutrient is carbohydrate, which constitutes approximately 41 g/100g, followed by protein at around 22 g/100g. Moisture content is roughly 13 g/100g, ash at about 7 g/100g, crude fiber near 6 g/100g, and fat remains relatively low at approximately 5 g/100g. This nutritional profile is consistent with known values for species within the *Russula* genus, which are recognized for their high protein and carbohydrate contents. Protein content in *Russula* species has been reported to range from 20–25%, positioning them as viable alternative protein sources, particularly in vegetarian diets (Mattila et al., 2001). The substantial carbohydrate concentration provides necessary caloric energy, as confirmed by previous analyses (Barros et al., 2008). Furthermore, the moderate presence of crude fiber supports digestive health, and the low fat content aligns with the general nutritional trend in wild mushrooms, making *Russula aurora* suitable for low-fat diets (Heleno et al., 2010). The ash value, indicative of mineral content, also supports the potential of this mushroom to contribute essential micronutrients such as potassium, magnesium, and calcium.

The micronutrient analysis of *Russula aurora* in figure 4.20 shows manganese (Mn) and potassium (K) as the most abundant elements, with values near 20 mg/100 g and 85 mg/100 g, respectively. Calcium (Ca) also appears prominently at around 7 mg/100 g, suggesting potential for bone health benefits. Moderate amounts of magnesium (Mg) and iron (Fe) (4 mg/100 g), along with lower zinc (Zn) content (2 mg/100 g), indicate a broad yet balanced mineral profile. This composition supports its value as a dietary supplement for essential minerals (Adebayo et al., 2019).

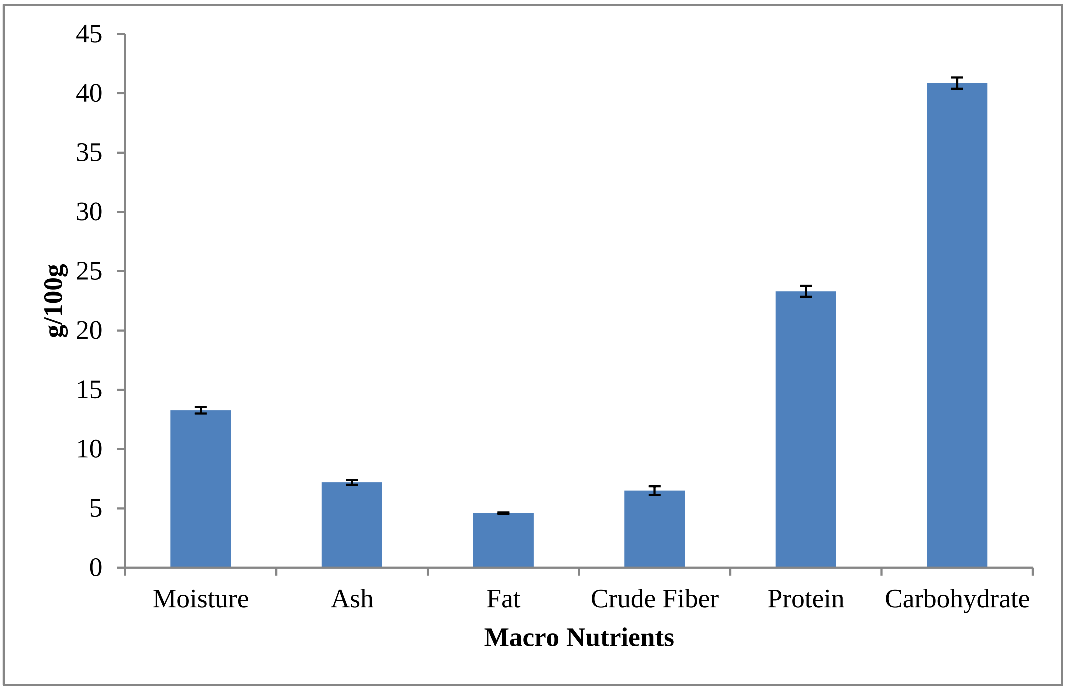

Figure 4.19: Macro nutrient concentration in *Russula aurora* Krombh. (1845). Values are expressed as mean ± standard deviation.

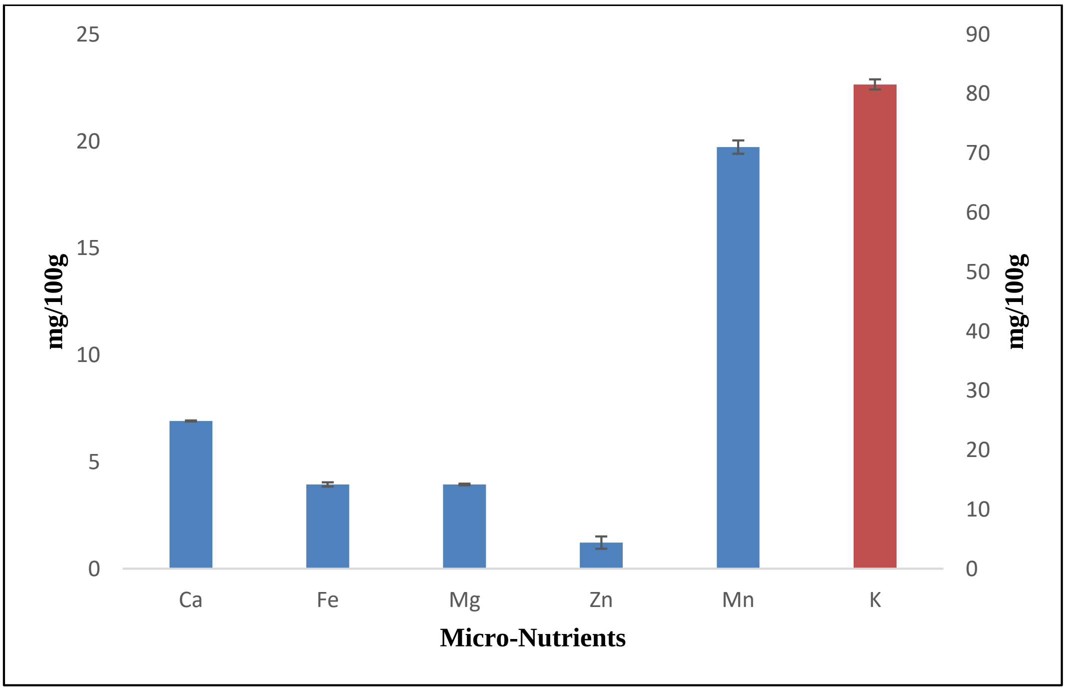

Figure 4.20: Micro nutrient concentraton in *Russula aurora* Krombh. (1845). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Russula compacta Frost, (1879)

The figure 4.21 showcases the macronutrient composition of *Russula compacta*, expressed in grams per 100 grams of dry weight. Carbohydrates are the dominant macronutrient, comprising approximately 59 g/100g, which is significantly higher than the other nutrients. Protein content is moderate at around 15 g/100g, while moisture stands at about 11 g/100g. Ash content is approximately 7 g/100g, crude fiber around 5 g/100g, and fat is the lowest, near 3 g/100g. This nutritional profile aligns with existing scientific literature describing mushrooms as carbohydrate-rich, low-fat functional foods. *Russula compacta*, like other members of the *Russula* genus, exhibits a high carbohydrate content, which is comparable to reports for other wild edible mushrooms such as those found in Portugal and India (Barros et al., 2008; Giri et al., 2012). The moderate protein concentration supports its classification as a potential dietary supplement, especially in vegetarian or protein-limited diets. The low fat content is consistent with the general characteristics of edible mushrooms, promoting cardiovascular health (Manzi et al., 2001). The ash content indicates a robust mineral profile, including essential elements like potassium, iron, and magnesium, which have been documented across wild mushroom species (Kalac, 2013). The presence of dietary fiber contributes positively to gut health and metabolic regulation.

The presented micro nutrient data in figure 4.22 shows potassium (K) as the most abundant element (~57 mg/100 g), followed by manganese (Mn) at approximately 24 mg/100 g, highlighting the sample’s potential in maintaining electrolyte balance and enzymatic functions. Calcium (Ca) content (9 mg/100 g) is also notable, supporting skeletal health. Iron (Fe), magnesium (Mg), and zinc (Zn) appear in moderate to low amounts (around 5, 4, and 2 mg/100 g, respectively), suggesting supplementary benefits in red blood cell production and immunity. These findings emphasize the nutritional value of mushrooms as mineral-rich functional foods (Adebayo et al., 2019).

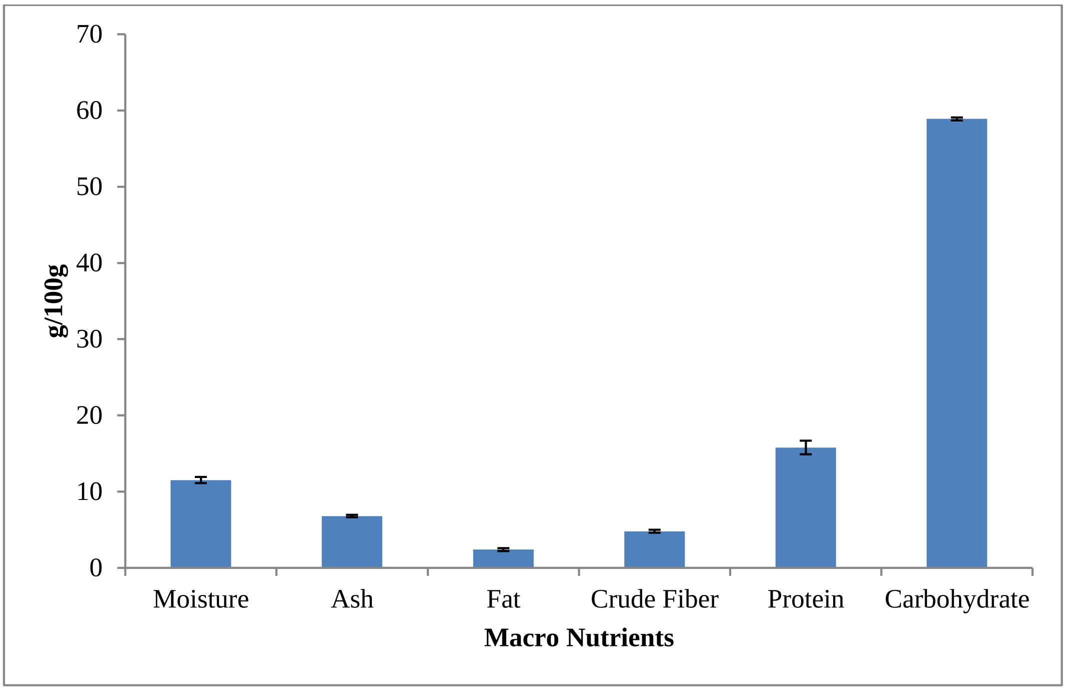

Figure 4.21: Macro nutrient concentration in *Russula compacta* Frost, (1879). Values are expressed as mean ± standard deviation.

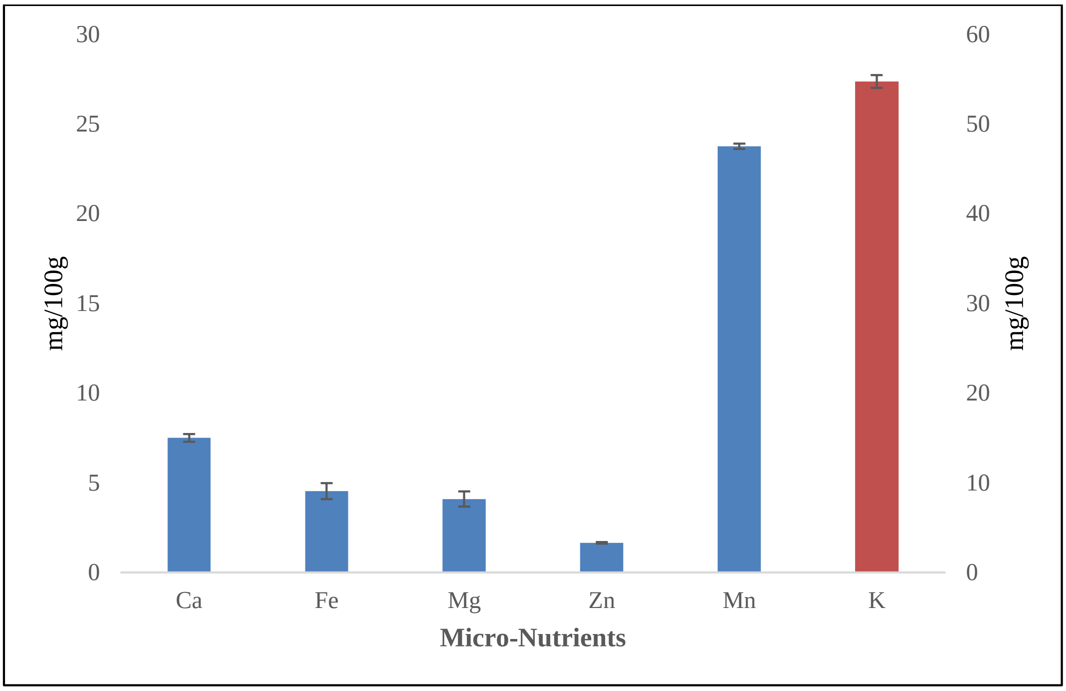

Figure 4.22: Micro nutrient concentraton in *Russula compacta* Frost, (1879). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Russula cyanoxantha (Schaeff.) Fr.

The figure 4.23 details the macronutrient composition of *Russula cyanoxantha*, measured in grams per 100 grams of dry weight. Carbohydrates dominate the nutritional profile at approximately 52 g/100g, followed by protein at around 14 g/100g. Moisture content is about 11 g/100g, ash at 6 g/100g, crude fiber near 7 g/100g, and fat at roughly 3 g/100g. These values are in agreement with reported data for *Russula cyanoxantha*, a well-known edible mushroom widely consumed across Europe and Asia. Studies have consistently documented its high carbohydrate content, a characteristic feature of the *Russula* genus, which provides a good source of energy (Barros et al., 2008). Its moderate protein levels reinforce its value as a supplemental protein source, particularly in vegetarian and vegan diets (Kalač, 2009). The low fat content, coupled with appreciable crude fiber, makes it suitable for calorie-conscious and digestive-health-focused diets. The ash content suggests a significant mineral presence, consistent with literature reporting *Russula cyanoxantha* to be rich in essential micronutrients like phosphorus, potassium, and magnesium (Manzi et al., 2001; Kalac, 2013). Overall, *Russula cyanoxantha* presents a balanced nutritional profile that supports its classification as a functional food, contributing both to basic nutrition and potential health benefits.

The micro-nutrient composition of *Russula cyanoxantha* given in figure 4.24 reveals manganese (Mn) as the dominant element (22 mg/100 g), followed by potassium (K) at around 65 mg/100 g, suggesting strong antioxidant and electrolyte-regulating potential. Calcium (Ca) and iron (Fe) levels are relatively high (7 mg/100 g and 6 mg/100 g, respectively), indicating benefits for bone health and hemoglobin formation. Moderate levels of magnesium (Mg) and zinc (Zn) (~4 mg/100 g and 3 mg/100 g, respectively) further enhance its nutritional profile. These findings support the mushroom's role as a mineral-rich dietary component (Adebayo et al., 2019).

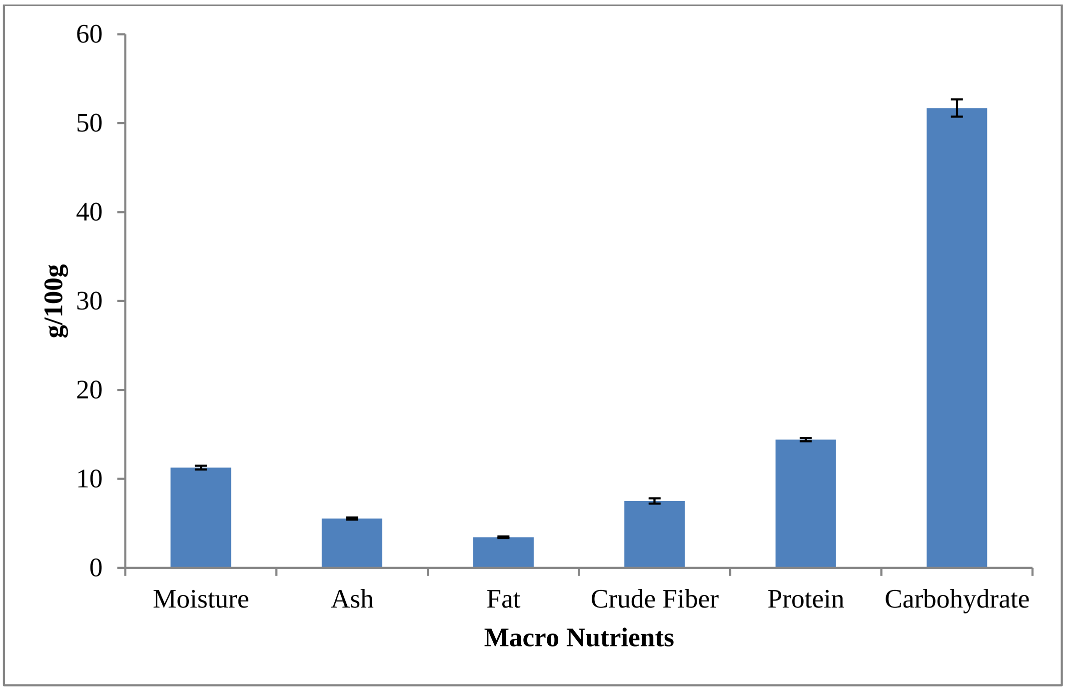

Figure 4.23: Macro nutrient concentration in *Russula cyanoxantha* (Schaeff.) Fr.. Values are expressed as mean ± standard deviation.

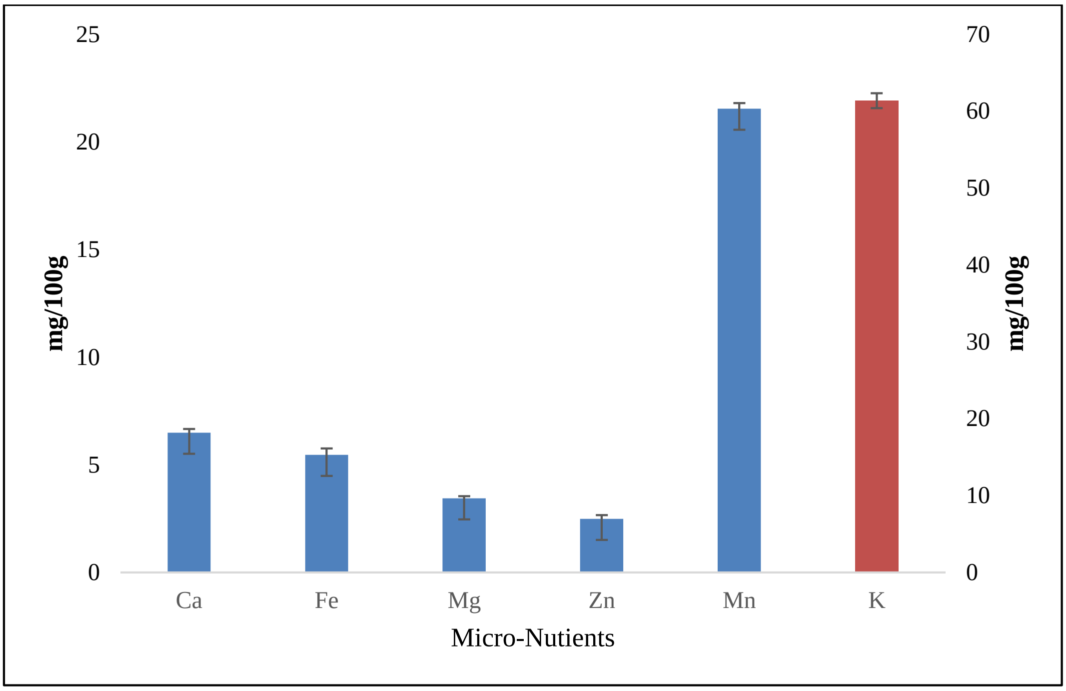

Figure 4.24: Micro nutrient concentraton in *Russula cyanoxantha* (Schaeff.) Fr.. Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Schizophyllum commune Fr. (1821)

The figure 4.25 represents the macronutrient composition of *Schizophyllum commune*, a globally distributed and nutritionally significant mushroom species, in grams per 100 grams of dry weight. Carbohydrates form the bulk of its composition at approximately 58 g/100g, followed by protein at about 18 g/100g. Moisture content is around 12 g/100g, ash about 6 g/100g, crude fiber close to 6 g/100g, and fat remains low at roughly 2.5 g/100g.

These values are consistent with existing literature on *Schizophyllum commune*, which is frequently recognized for its high carbohydrate content and low lipid profile. Studies have shown that *Schizophyllum commune* contains significant levels of polysaccharides, particularly β-glucans, which contribute not only to energy value but also to its immunomodulatory effects (Cui & Chisti, 2003). The relatively high protein level (around 15–20%) makes it a promising alternative protein source, particularly in plant-based or low-resource dietary contexts (Mshandete et al., 2008). The fiber and ash contents further emphasize its role as a source of dietary fiber and essential minerals such as potassium, calcium, and magnesium, contributing to its classification as a functional or medicinal mushroom. Moreover, the low fat content is characteristic of many edible fungi, offering health benefits for those aiming to reduce saturated fat intake. The nutritional richness of *Schizophyllum commune* supports its longstanding use in traditional medicine and emerging popularity in nutraceuticals and functional food formulations.

The micro nutrient profile of *Schizophyllum commune* given in figure 4.26 highlights manganese (Mn) and potassium (K) as the most abundant minerals, each exceeding 90 mg/100 g, suggesting significant roles in enzymatic functions and electrolyte balance. Iron (Fe) content is also notable (8 mg/100 g), indicating potential benefits for oxygen transport and anemia prevention. Calcium (Ca) is present at moderate levels (5 mg/100 g), supporting bone health, while magnesium (Mg) and zinc (Zn) are lower (2 mg/100 g), yet contribute to metabolic and immune processes. This composition underscores *Schizophyllum commune* as a nutritionally valuable mushroom (Adebayo et al., 2019).

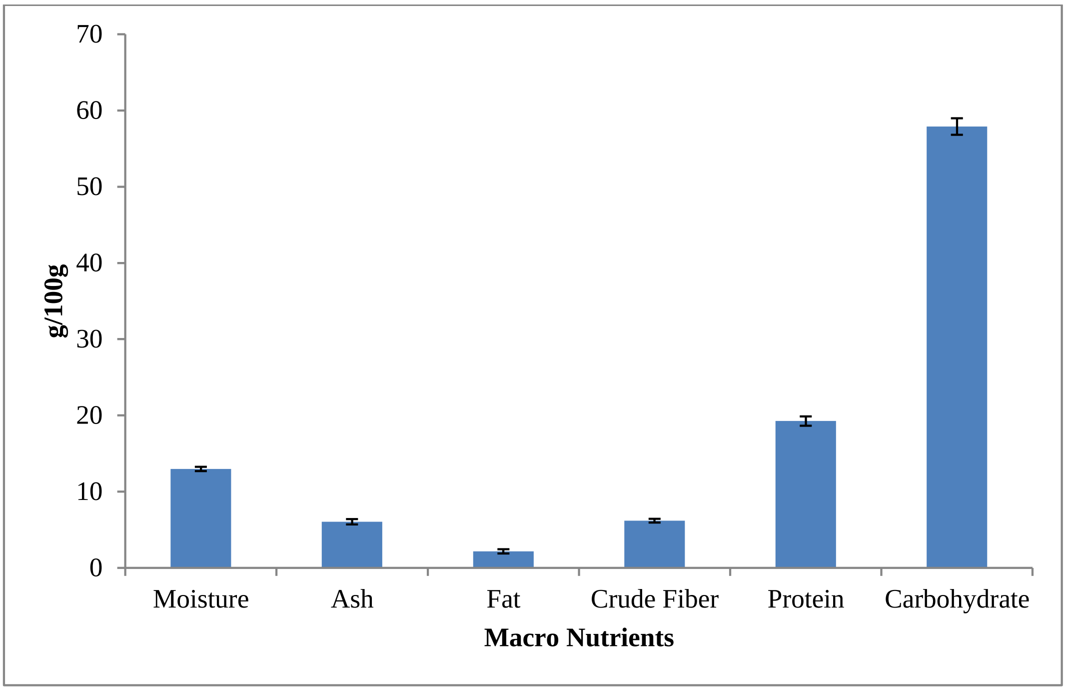

Figure 4.25: Macro nutrient concentration in *Schizophyllum commune* Fr. (1821). Values are expressed as mean ± standard deviation.

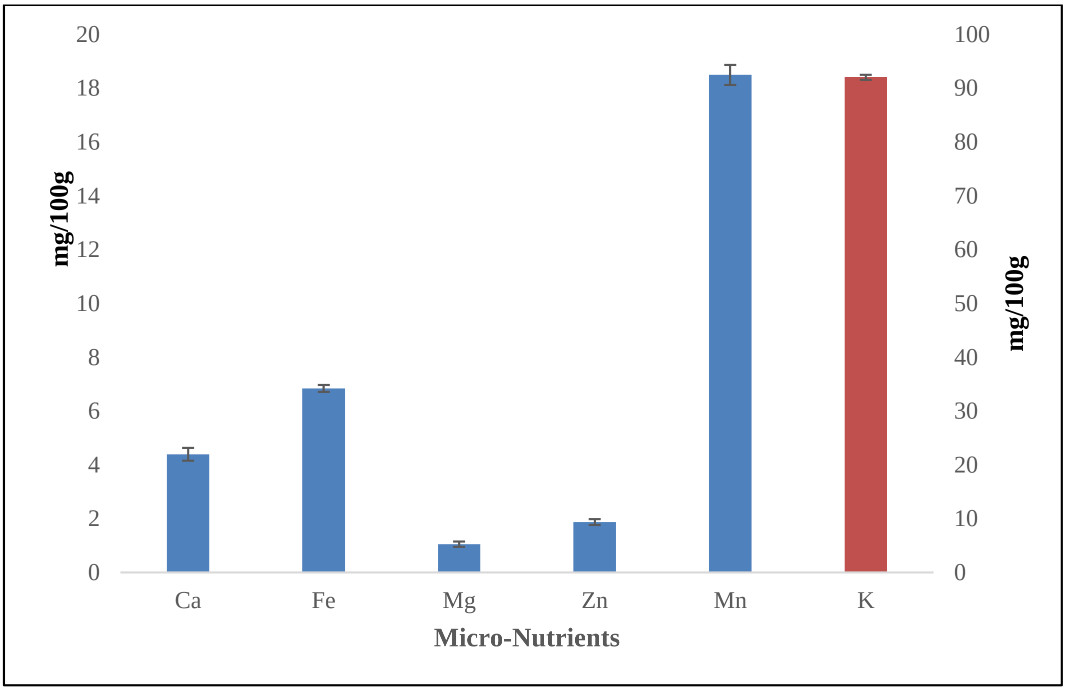

Figure 4.26: Micro nutrient concentraton in *Schizophyllum commune* Fr. (1821). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Termitomyces heimii Natarajan (1979)

The figure 4.27 illustrates the macronutrient composition of *Termitomyces heimii*, a highly prized edible mushroom species commonly found in tropical regions. Based on the data (per 100g dry weight), carbohydrates dominate at approximately 45 g/100g, followed by a notably high protein content around 30 g/100g. Crude fiber is about 7 g/100g, ash approximately 8 g/100g, moisture around 9 g/100g, and fat content is the lowest, roughly 4 g/100g. *Termitomyces heimii* is well-regarded for its rich nutritional profile, particularly its exceptionally high protein content, which surpasses many other wild mushrooms. Studies by Oso (1977) and Manzoni & Rossi (2002) have confirmed that *Termitomyces* species are among the most protein-rich fungi, often exceeding 25% of dry weight. This positions it as a valuable protein source for vegetarian and protein-deficient diets, especially in rural communities where it is naturally harvested.

The carbohydrate level, while slightly lower than some *Russula* or *Schizophyllum* species, still contributes significantly to its energy value. The moderate fiber and ash contents suggest beneficial effects on digestion and a rich mineral profile, respectively, which include calcium, phosphorus, and iron (Sarzynska et al., 1997). The low fat content is typical of most edible mushrooms and contributes to its role in heart-healthy diets. Overall, *Termitomyces heimii* offers an excellent balance of macronutrients, with particular emphasis on protein and minerals, validating its widespread traditional use and growing interest as a functional food.

The micronutrient composition of *Termitomyces heimii* given in figure 4.28 reveals high levels of manganese (33 mg/100 g) and potassium (180 mg/100 g), essential for antioxidant defense and fluid regulation. Iron (Fe) content is also significant (12 mg/100 g), supporting hematological health. Moderate amounts of calcium (8 mg/100 g) and magnesium (10 mg/100 g) contribute to bone strength and enzymatic functions, respectively. Zinc (Zn), though lower (3 mg/100 g), is important for immunity. These values suggest that *Termitomyces heimii* is a mineral-rich edible mushroom with promising dietary benefits (Adebayo et al., 2019).

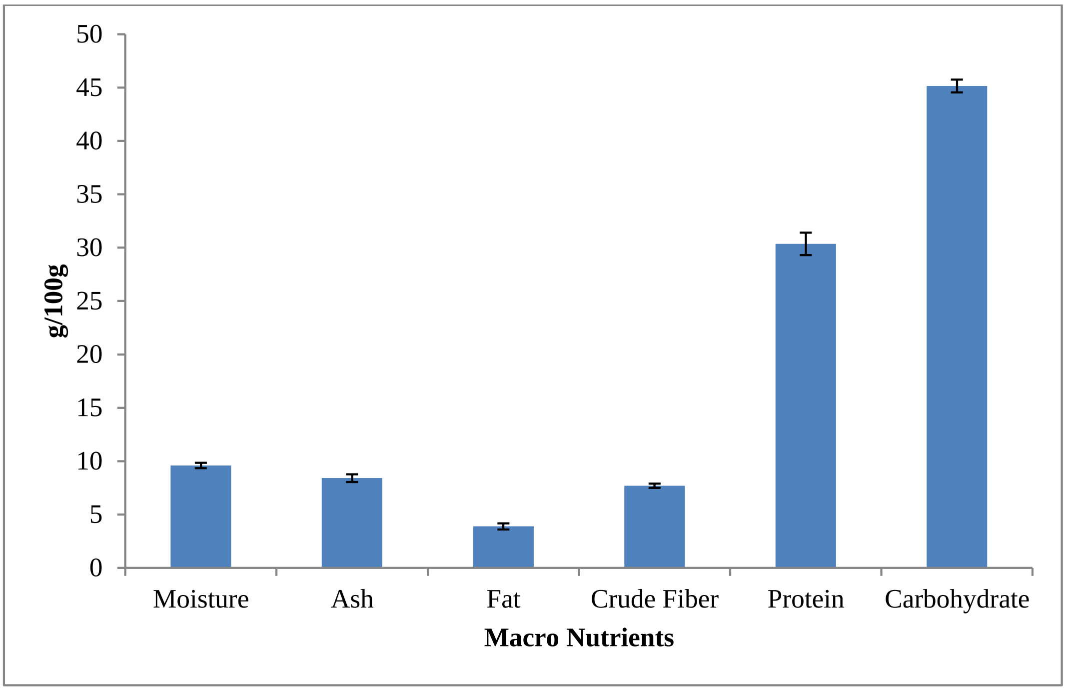

Figure 4.27: Macro nutrient concentration in *Termitomyces heimii* Natarajan (1979). Values are expressed as mean ± standard deviation.

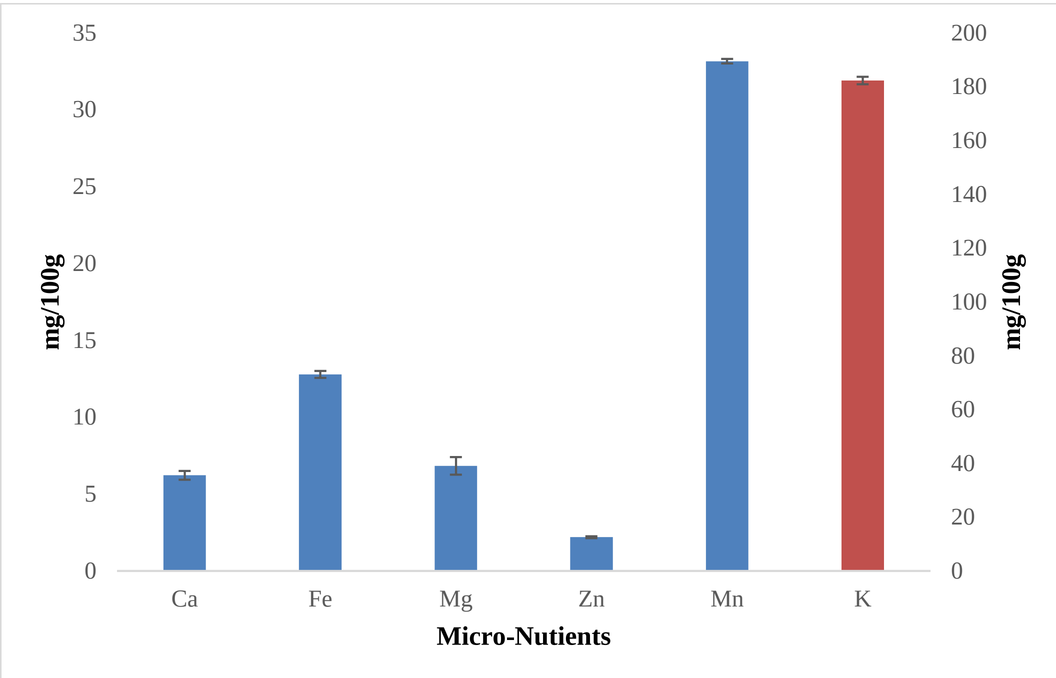

Figure 4.28: Micro nutrient concentraton in *Termitomyces heimii* Natarajan (1979). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

Volvariella taylorii (Berk. and Broome) Singer (1951)

Figure 4.29 illustrates the macronutrient composition of *Volvariella taylori*, expressed in grams per 100 grams of sample. The six macronutrients analyzed include moisture, ash, fat, crude fiber, protein, and carbohydrate. Among all the components, carbohydrates are present in the highest concentration, measuring approximately 40 g/100g. This suggests that *Volvariella taylori* is a rich source of energy, making it a potentially valuable dietary component, especially in carbohydrate-deficient diets. Protein content is the second-highest, around 22 g/100g, indicating a significant nutritional value, particularly for vegetarian diets where mushrooms can serve as an alternative protein source. This aligns with findings in scientific literature where mushroom species such as *Pleurotus* and *Lentinula edodes* have shown comparable protein contents (Manzi et al., 2004; Barros et al., 2008).

Moisture content is also notable, at approximately 13 g/100g. While lower than many fresh mushrooms which often contain over 80% moisture, it may indicate either a semi-dried sample or intrinsic low water content in *Volvariella taylori*. Crude fiber and ash contents are both about 11 g/100g and 6 g/100g respectively, showing the presence of dietary fiber and mineral content, which are important for gut health and metabolic functions. Fat is the least abundant macronutrient at around 4 g/100g, reinforcing the typical characterization of mushrooms as low-fat food sources (Kalac, 2009).

The concentration of micro nutrients in *Volvariella taylori* is presented in figure 4.30 and the most abundant mineral is potassium (K), with a concentration of 164.59 mg/100g, which is consistent with other edible mushrooms that are generally rich in potassium. This mineral plays a key role in maintaining fluid balance, nerve signaling, and muscle contractions. According to Kalač (2010), high potassium content is a common trait in mushrooms, supporting cardiovascular and neuromuscular functions.

Manganese (Mn) is the second most prevalent mineral at 36.82 mg/100g, a notably high value compared to many edible mushrooms. Manganese is crucial for enzyme activation, bone formation, and metabolic regulation. Such levels suggest that *Volvariella taylori* may be a valuable dietary source of Mn, especially in regions where manganese-deficient soils may affect local produce.

Iron (Fe) content is also significant, measured at 18.39 mg/100g. Iron is essential for hemoglobin synthesis and oxygen transport, and the amount found in *Volvariella taylori* is higher than that reported for many commonly consumed mushrooms like *Agaricus bisporus* (3–5 mg/100g dry weight), according to Barros et al., (2008). This suggests potential for addressing iron-deficiency anemia.

Calcium (Ca) is present at 11.47 mg/100g, which contributes to bone health and cellular signaling. Though not exceedingly high, it complements the overall mineral profile. Zinc (Zn), an important mineral for immune function and enzymatic activity, is measured at 4.25 mg/100g, while magnesium (Mg) is the lowest among the minerals listed at 2.45 mg/100g, though still relevant for its role in enzyme systems and energy metabolism.

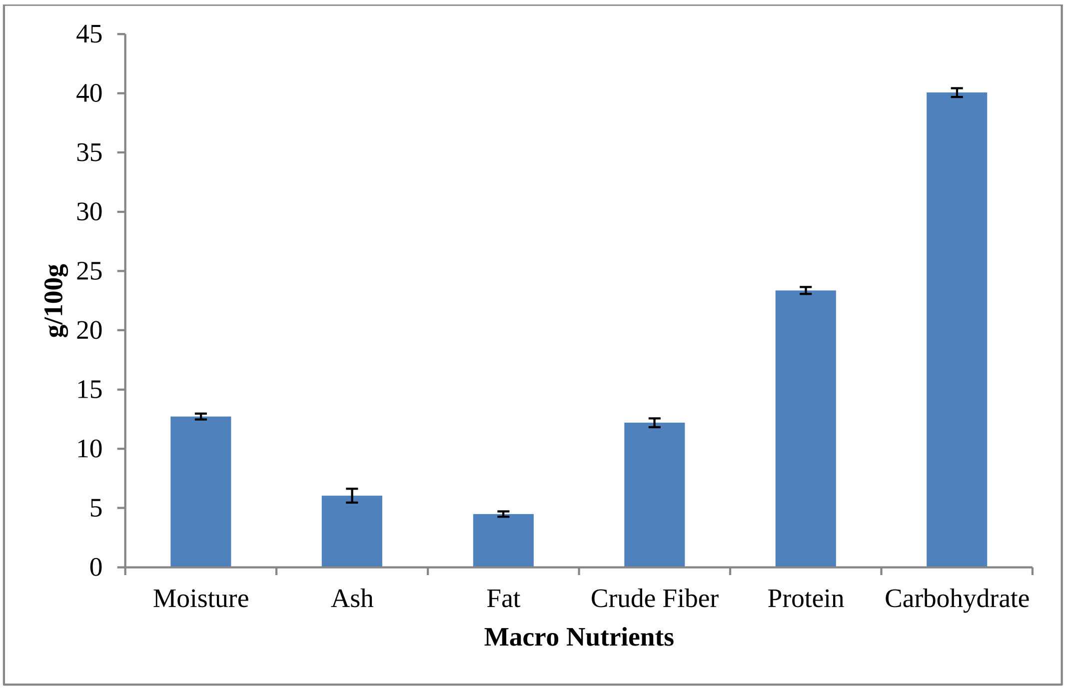

Figure 4.29: Macro nutrient concentration in *Volvariella taylorii* (Berk. and Broome) Singer (1951). Values are expressed as mean ± standard deviation.

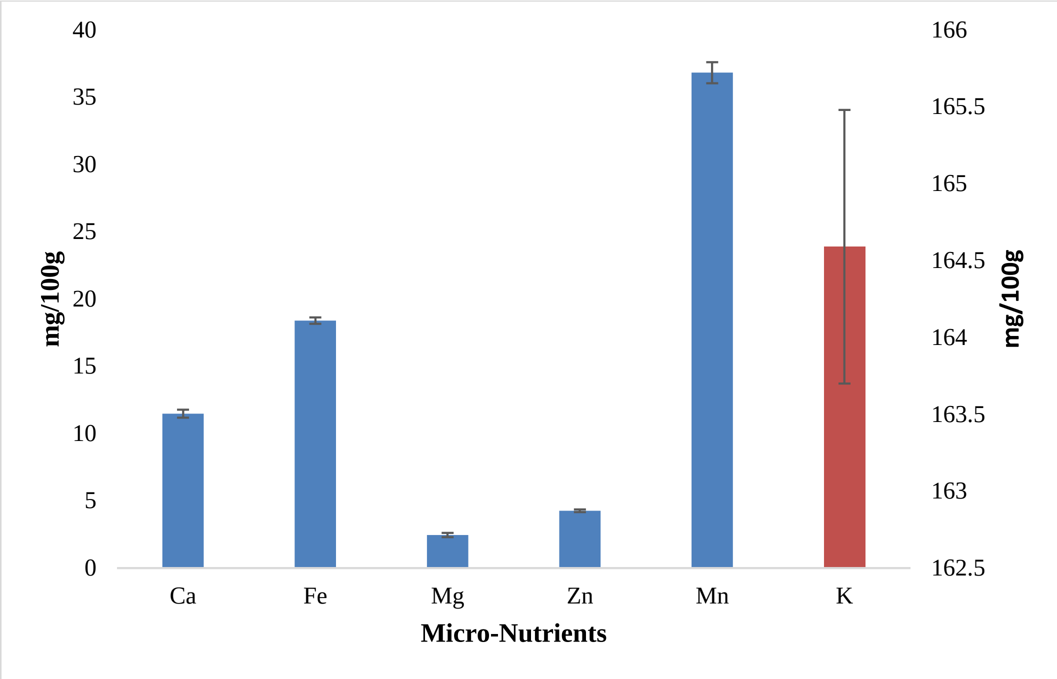

Figure 4.30: Micro nutrient concentraton in *Volvariella taylorii* (Berk. and Broome) Singer (1951). Bars in blue corresponds to the left Y-axis and bar in red corresponds to the right Y-axis, Values are expressed as mean ± standard deviation.

4.4.2. Comparison of macro-nutrient content among mushroom species using the one-way ANOVA:

The nutrional content of the selected mushrooms was analysed and compared using the one-way ANOVA followed by Tukey's post-hoc test to assess the variation in their nutritional concentrations.

Table 4.2: Summary of One Way ANOVA showing variation in macro-nutrients among the different mushroom species.

Source of variation	**Df**	**F value**	**P value**
Moisture	14	50.8	<2e-16 ***
Ash	14	22.25	4.63e-12 ***
Fat	14	48.02	<2e-16 ***
Crude fibre	14	96.61	<2e-16 ***
Protein	14	169	<2e-16 ***
Carbohydrate	14	123.5	<2e-16 ***

The One Way Analysis of Variance revealed a statically significant variation in the macro nutrient contents among the different mushroom species ($p < 0.05$)

Table 4.3: Comparison of the mean values of macro-nutrients between the different species

Species	**Moisture**	**Ash**	**Fat**	**Crude fibre**	**Protein**	**Carbohydrate**
Amanita vaginata	11.75^{BCD}	7.47^{AB}	2.95^{DEF}	5.52^{GH}	18.44^{E}	53.85^{CD}
Auricularia auricula-judae	8.31^{HI}	7.28^{ABC}	1.77^{H}	5.59^{GH}	18.13^{E}	58.90^{A}
Cantharellus cibarius	9.73^{FG}	3.73^{G}	2.48^{EFG}	6.63^{DEF}	24.07^{C}	53.34^{CD}
Coprinellus disseminatus	9.55^{FGH}	5.80^{EF}	4.21^{AB}	5.77^{FGH}	14.96^{F}	59.69^{A}
Dacryopinax spathularia	10.19^{EF}	7.41^{AB}	3.14^{DE}	9.36^{B}	26.83^{B}	43.05^{FG}
Lactifluus corrugis	8.54^{GHI}	6.47^{BCDEF}	3.02^{DEF}	7.10^{CDE}	24.99^{BC}	49.86^{E}
Lactifluus piperatus	10.54^{DEF}	7.11^{BCD}	2.59^{EFG}	6.79^{CDEF}	21.26^{D}	51.70^{DE}

Lentinus squarrosulus	7.74^{I}	5.91^{DEF}	2.79^{DEFG}	7.18^{CDE}	18.47^{E}	57.89^{AB}
Phallus indusiatus	11.63^{CD}	7.55^{AB}	4.55^{AB}	5.09^{H}	15.93^{F}	55.24^{BC}
Russula aurora	13.26^{A}	7.19^{ABC}	4.60^{A}	6.49^{DEFG}	23.30^{C}	45.15^{F}
Russula compacta	11.50^{CD}	6.79^{BCDE}	2.40^{FGH}	4.80^{H}	15.45^{F}	59.04^{A}
Russula cyanoxantha	11.25^{DE}	5.53^{F}	3.43^{CD}	7.51^{CD}	14.42^{F}	57.84^{AB}
Schizophyllum commune	12.98^{AB}	6.04^{CDEF}	2.15^{GH}	6.18^{EFG}	19.25^{E}	53.38^{CD}
Termitomyces heimii	9.57^{FGH}	8.41^{A}	3.89^{BC}	7.70^{C}	30.35^{A}	40.06^{G}
Volvariella taylorii	12.72^{ABC}	6.04^{CDEF}	4.48^{AB}	12.53^{A}	23.35^{C}	40.86^{G}

Values are expressed as means. Values in the same column with different superscript (A, B, C, D, E, F, G, H) are statistically significant at $p<0.05$

Moisture Content:

The variation in the moisture content of the analyzed mushroom species was statistically significant ($p < 0.05$), reflecting differences in their intrinsic water-holding capacities and structural composition. This parameter is fundamental for understanding the shelf life, texture, and overall quality of mushrooms, especially in post-harvest processing and storage. Water is one of the main factors that influence the success in mushroom growth. Nutrients are transported from the mycelium to the fruiting bodies of wild mushrooms by a steady moisture flow. *Russula aurora* exhibited the highest moisture content, measuring 13.26 g/100g. It was closely followed by *Schizophyllum commune*, with a moisture content of 12.98 g/100g, and *Volvariella taylorii* at 12.72 g/100g. The ANOVA test also showed no significant variation among these high- moisture species ($p<0.05$). These species may be more prone to damage and susceptible to microbial spoilage due to their higher moisture content, but could also provide a softer texture and higher hydration, rending them favorable in fresh culinary applications. Higher moisture content in these mushrooms may contribute to a fresher texture and can affect their nutritional density, potentially leading to lower concentrations of nutrients per gram compared to drier species. On the lower end of the spectrum, *Lactifluus corrugis* (8.54 g/100g), *Auricularia auricula-judae* (8.31 g/100g), and *Lentinus squarrosulus* (7.74 g/100g) had the lowest moisture content. This indicates that *Russula aurora* and *Schizophyllum commune* retain more moisture compared to other species. The observed differences in moisture content could be attributed to species-specific physical features such as cap surface, pore density, ecological origin (e.g., wood-decaying vs. mycorrhizal), and the ambient conditions during growth and development and collection may influence it.

Excessive moisture in the cultivation substrate can hinder mycelial respiration, prevent moisture regulation, and ultimately block the formation of fruiting bodies. This problem often remains unresolved even when higher amounts of inoculum or more ventilation holes are introduced, and it commonly leads to the growth of unwanted contaminants like bacteria and nematodes. On the other hand, insufficient moisture can cause the fruiting bodies to dry out and die. The ideal moisture level for successful mycelial growth and substrate breakdown varies depending on the mushroom species and the type of substrate employed. Achieving and maintaining the right balance of moisture is crucial for successful mushroom farming, ensuring that the mycelium can effectively transport nutrients and support healthy fruiting body development (Bellettini *et al*., 2019). Fresh mushrooms have average moisture content of 85-95g/100g whereas air-dried/oven-dried specimens have a moisture content of 5-20g/100g, depending on time and storage (Crisan and Sands, 1978). The average moisture content (10.79g/100g, ranges from 7.74-13.26g/100g on a dry weight basis) in the obtained results was consistent with the findings of Agrahar-Murugkar and Subbulakshmi (2005). However, Nakalembe et al., (2015) reported higher moisture content (13.98–17.66g/100g) in various wild edible mushrooms. The mushrooms' moisture content varied depending on the type of mushrooms (Manzi et al., 2001).

Ash content

The ash content, which indicates the total mineral content in wild mushrooms, showed significant variation ($p < 0.05$) among the studied species. This suggests that the capability to accumulate mineral is species-specific, potentially influenced by their ecological habitats, substrates they grow on, and their physiological mechanisms for nutrients uptake. *Termitomyces heimii* had the highest ash content at 8.41 g/100g, suggesting a rich mineral profile. This was followed by *Phallus indusiatus* with 7.55 g/100g and *Auricularia auricula-judae* at 7.28g/100g. Such high ash content suggests that these mushrooms are particularly rich source of essential minerals like calcium, potassium, and phosphorus and may also serve as viable sources of dietary minerals, Moderate ash levels were found in *Russula compacta* (6.79 g/100g), *Lactifluus corrugis* (6.47 g/100g), and *Volvariella taylorii* (6.04 g/100g), these values suggest a fair mineral content, typical of many wild edible mushrooms. In contrast, *Cantharellus cibarius* had the lowest ash content at 3.74 g/100g, indicating it contains fewer minerals compared to the other species. The lower ash species may be less efficient in absorbing minerals or may grow in substrates with fewer available nutrients. Shrestha et al., (2023) reported a high ash content of 7.05–13.38g/100g in wild edible mushrooms such as *Cantharellus cibarius*, *Laccaria laccata*, and *Scleroderma cepa*. However, our results indicated an average ash content of 6.06g/100g (ranging from 3.74 to 8.41g/100g). Dimopoulou et al., (2022) also observed a wide variation, with *Marasmius oreades* showing a low ash content of 1.3g/100g, while *Cantharellus cibarius* had 13.2g/100g. Similarly, Thachunglura et al., (2023) reported an ash content of 7.52g/100g in *Pleurotus* species.

Fat content

The fat content of the analyzed mushroom species varied significantly ($p < 0.05$), indicating distinct differences in lipid biosynthesis or accumulation among species. *Volvariella taylorii* showed the highest fat content among the studied mushrooms at 12.20 g/100g. *Phallus indusiatus* and *Coprinellus disseminatus* followed with fat contents of 4.56 g/100g and 4.21 g/100g, respectively. *Auricularia* *auricula-judae* had the lowest fat content at 1.77 g/100g. Thachunglura et al., (2024) observed a fat content of 3.34g/100g in *Vascellum pratense* and 2.8g/100g in *Lactifluus volemus*, with an average of approximately 3.30g/100g. Similarly, Singdevsachan et al., (2013) reported a fat content ranging from 1.36g to 2.42g/100g in *Lentinus sajor-caju* and *Lentinus torulosus*. Çaglarlrmak et al., (2002) found very low fat content in *Cantharellus cibarius*, *Lactarius piperatus*, and *Boletus edulis*, with values of 0.72g/100g, 0.18g/100g, and 1.70g/100g, respectively. In our present study, the fat content averaged 3.30g/100g, with values ranging from 1.77g/100g (lowest) to 4.60g/100g (highest). Comparatively, Khumlianlal et al., (2024) reported a fat content of 5.90g/100g in *Lactifluus leptomerus*, which is higher than our findings. *Phallus indusiatus* (4.56 ± 0.34 g/100g) and *Coprinellus disseminatus* (4.21 g/100g) showed fat contents within the typical range for mushrooms, similar to *Phallus impudicus* (3.8 g/100g; Heleno et al., 2015) and *Coprinus comatus* (3.2 g/100g; Kalac, 2013). These variations indicate that fat content in edible mushrooms is generally low but varies depending on species, environmental factors, and growth conditions.

Crude Fiber content:

Fiber is a component of carbohydrates, and its presence in mushrooms is an important characteristic and contributes significantly to a healthy human diet (Ao and Deb, 2019). The crude fibre content of the fifteen mushroom species analyzed varied significantly ($p<0.05$). *Volvariella taylorii* led in crude fiber content with 12.53 g/100g, followed by *Dacryopinax spathularia* at 8.02 g/100g, and *Termitomyces heimii* at 7.70 g/100g. *Phallus indusiatus* had the lowest fiber content at 5.09 g/100g. High fiber content in *Volvariella taylorii* makes it beneficial for digestive health. In our present study, the average crude fiber content was approximately 6.84g/100g, with values ranging from 4.80g/100g (lowest) to 12.20g/100g (highest). Mridu and Atri (2017) observed crude fiber content in *Calocybe gambosa*, *Lentinus squarrosulus*, and *Podaxis pistillaris* to be 6.04 g/100g, 38.38 g/100g, and 23.87 g/100g, respectively. Some of these values are similar to our findings, while others are considerably higher. Similarly, Khumlianlal et al., (2022) reported crude fiber content in *Macrocybe gigantea* (5.90g/100g), *Lactifluus leptomerus* (14.10g/100g), and *Ramaria thindii* (6.40 g/100g). Additionally, Srikram and Supapvanich (2016) observed crude fiber content ranging from 2.11g/100g to 38.11g/100g in different edible mushrooms. These differences indicate that crude fiber content in mushrooms varies depending on species, habitat, and nutritional availability. The observed variations in fibre content could be due to differences in their cell wall structure, especially in the proportion of chitin and other polysaccharides. These findings suggest that *Volvariella taylorii* and *Dacryopinax spathularia* may be particularly valuable as functional foods due to their high fibre content, whereas species with lower fibre may be suitable for individuals requiring reduced dietary fibre intake.

Protein content:

The protein content of the analyzed mushroom species showed significant variation ($p<0.5$), ranging from 14.42 g/100g to 30.35 g/100g. The highest protein concentration was observed in *Termitomyces heimii* (30.35 g/100g), which was statistically distinct from all other species (Table 4.3). This suggests that *Termitomyces heimii* may be an excellent source of dietary protein, with potential for use in protein-enriched functional foods. *Lactifluus corrugis* also had high protein contents with the value of 26.83 g/100g and 24.99 g/100g, respectively. These species did not show significant variation from one another, but were both significantly lower than *Termitomyces heimii*. Mushrooms such as *Lactifluus piperatus* (21.26 g/100g), *Schizophyllum commune* (19.25 g/100g), *Lentinus squarrosulus* (18.47 g/100g), *Amanita vaginata* (18.44 g/100g), and *Auricularia auricula-judae* (18.13 g/100g) were found to represent intermediate protein content. The lowest protein content was found in *Russula cyanoxaantha* at 14.42 g/100g. Many edible mushrooms offer protein content that is equal to or greater than that found in animal products like milk, eggs, meat, and fish, and also surpass some of the richest plant-based protein sources.

Thus, edible mushrooms are an excellent source of high-quality protein that can be produced more easily, more cheaply, and with less impact on the environment

(González et al., 2020). They could be valuable in addressing protein-energy malnutrition or in developing meat alternatives.The average crude protein content of edible mushrooms ranges between 19 and 40g/100g (Kurtzman, 1978). Rugolo et al., (2022) observed that 17 wild mushrooms contained an average protein content of 12.91g/100g, whereas our present study found an average protein content of 20.1g/100g. Similarly, Khumlainalal et al., (2024) reported a protein content of 20.01g/100g in *Russula rosea*, which closely aligns with our findings for *Russula aurora*, *Russula compacta*, and *Russula cyanoxantha* (23.30 g/100g, 15.79 g/100g, and 14.42 g/100g, respectively). However, slightly lower protein content was observed in these species, likely due to species-specific variations. Additionally, we found a protein content of 19.26g/100g in *Schizophyllum commune*. Previous studies reported 20.25g/100g in *Schizophyllum commune*, which is consistent with our findings (Wongaem et al., 2021), whereas Lallawmsanga et al., (2016) recorded a higher protein content of 30.33g/100g in samples from Mizoram. These variations in protein content may be attributed to environmental factors, growth conditions, substrate composition, and other influences affecting wild edible mushrooms.

Carbohydrate content:

Carbohydrate was found to be the dominant component in the dried fruiting bodies. The carbohydrate content among the mushroom species analyzed exhibited notable variability, ranging from 40.06 g/100g to 59.69 g/100g. *Coprinellus disseminatus* had the highest carbohydrate content at 59.69 g/100g, followed by *Auricularia auricula-judae* and *Lentinus squarrosulus* with 58.90 g/100g and 58.89 g/100g, respectively. These species were statistically similar and were the most carbohydrate-rich mushrooms in the study, indicating their potential as energy-dense dietary options.*Termitomyces heimii*, on the other hand, had the lowest carbohydrate content at 40.06 g/100g. In our current study, the carbohydrate content of wild edible mushrooms ranged from 39.05 to 59.69 g/100g. Kakoti et al., (2021) observed high carbohydrate levels in *Lentinus sajor-caju* (49.80 g/100g dry weight) and *Lentinus squarrosulus* (46.36 g/100g dry weight). Thachunglura (2023) reported carbohydrate contents between 35.92g/100g and 56.63g/100g in various wild edible mushrooms from Mizoram, which aligns with our findings. Similarly, *Lentinus tuberregium* was found to have a carbohydrate content of 55.8 g/100g (Manjunathan and Kaviyarasan, 2011). *Termitomyces heimii* and *Volvariella taylorii* having high protein content, they exhibited the lowest carbohydrate concentrations, suggesting a possible inverse trend between protein and carbohydrate content in certain mushrooms.These variations in carbohydrate content among different mushroom species may be attributed to factors such as species-specific metabolic processes. These findings further emphasize the nutritional value of wild edible mushrooms as significant sources of carbohydrates.

It is challenging to compare the nutritional value of mushrooms, even within the same species, due to varying environmental factors. Comparing mushroom specimens from different regions is also problematic because their nutritional profiles can differ significantly. However, the results of the present study align with those reported by several authors (Patil et al., 2010; Nakalembe et al., 2015; Shrestha et al., 2023; Pandey et al., 2023; Gogoi et al., 2023; Senila et al., 2024).

The amount of nutrients in wild mushrooms of the same species is directly related to several factors, including the specific species of mushroom, the growing area, the duration of the growing period of the fruiting body, genetic factors, the type of substrates used, and the distance from pollution sources (Gençcelep et al., 2009; Thachunglura et al., 2023; Khumlianlal et al., 2024). The nutritional composition of mushrooms varied depending on both the species and the source of substrate, reflecting their capacity to absorb nutrients from the substrate. In the dried fruiting bodies, carbohydrates were the most abundant component, followed by protein, fiber, ash, and fat. Variations in soil composition, climate conditions, and cultivation techniques can also influence the nutritional content. For instance, mushrooms grown in nutrient-rich substrates tend to have higher levels of essential minerals such as potassium, phosphorus, and magnesium (Dimopoulou et al., 2022; Demirtas et al., 2024).

Wild mushrooms which grown in areas free from pollution and contaminants are likely to be richer in beneficial nutrients while being safer for consumption (Huang et al., 2017). Understanding these factors is crucial for optimizing the nutritional quality of mushrooms and ensuring they provide maximum health benefits.

All of the *Termitomyces* species are known to be edible, offering distinct texture, flavor, and nutritional benefits, along with medicinal properties (Gunasekara et al., 2021; Yang et al., 2021). These mushrooms are also valued for their traditional medicinal use in indigenous communities across Asia and Africa and recent studies have shown that bioactive compounds in *Termitomyces* may help treat diseases such as cancer, hyperlipidemia, gastroduodenal disorders, and Alzheimer's (Kansci et al., 2003; Nhi et al., 2022; Paloi et al., 2023). *T. clypeatus* showed appreciable antioxidant potential, influenced by its bioactive components and nutritional properties such as protein, lipid, fiber, and carbohydrates, act as potent antioxidants to help combat various human ailments (Ghate and Sridhar 2017).

4.4.3. Comparison of micro-nutrient content among mushroom species using the one-way ANOVA:

The nutrional content of the selected mushrooms was analysed and compared using the one-way ANOVA followed by Tukey's post-hoc test to assess the variation in their nutritional concentrations.

Table 4.4: Summary of One Way ANOVA showing variation of micro-nutrients among the different mushroom species

Source of variation	Df	F value	P value
Ca	14	354.6	<2e-16 ***
Fe	14	377	<2e-16 ***
Mg	14	96.33	4.4e-12 ***
K	14	2770	<2e-16 ***
Zn	14	89.31	7.68e-12 ***
Mn	14	434.1	<2e-16 ***

The One Way Analysis of Variance revealed a statically significant variation in the micro nutrient contents among the different mushroom species ($p < 0.05$)

Table 4.5: Comparison of the mean values of micro-nutrients between the different species

Species	Ca	Fe	Mg	K	Zn	Mn
Amanita vaginata	5.30^{E}	4.11^{HIJ}	3.02^{EF}	150.74^{D}	6.5^{A}	22.55^{F}
Auricularia auricula-judae	7.08^{BC}	3.14^{JK}	3.37^{DE}	143.81^{E}	5.58^{B}	32.54^{D}
Cantharellus cibarius	1.14^{G}	2.39^{K}	2.91^{EF}	50.83^{K}	1.13^{FG}	23.16^{F}
Coprinellus disseminatus	1.63^{G}	5.04^{GH}	2.66^{EF}	73.9^{I}	3.05^{D}	11.81^{J}
Dacryopinax spathularia	1.37^{G}	7.83^{EF}	3.41^{DE}	85.92^{H}	1.36^{FG}	15.78^{I}
Lactifluus corrugis	6.80^{BC}	9.3^{CD}	5.39^{B}	174.13^{B}	4.75^{BC}	29.47^{E}
Lactifluus piperatus	4.68^{EF}	8.29^{DE}	4.67^{BC}	154.06^{D}	4.36^{C}	47.05^{A}
Lentinus squarrosulus	5.50^{DE}	10.4^{C}	2.66^{EF}	139.61^{EF}	1.83^{EFG}	35.20^{BC}
Phallus indusiatus	1.2^{G}	3.34^{JK}	0.67^{G}	135.92^{F}	0.85^{G}	14.02^{IJ}
Russula aurora	6.90^{BC}	3.94^{HIJ}	3.93^{CD}	81.54^{H}	1.22^{FG}	19.72^{GH}
Russula compacta	7.49^{B}	4.52^{GHI}	4.09^{CD}	54.72^{K}	1.64^{EFG}	23.74^{F}
Russula cyanoxantha	6.49^{C}	5.45^{G}	3.43^{DE}	61.36^{J}	2.49^{DE}	21.53^{FG}
Schizophyllum commune	4.39^{F}	6.83^{F}	1.05^{G}	92^{G}	1.87^{EFG}	18.48^{H}
Termitomyces heimii	6.22^{CD}	12.78^{B}	6.82^{A}	182.24^{A}	2.19^{DEF}	33.15^{CD}
Volvariella taylorii	11.47^{A}	18.39^{A}	2.45^{F}	164.59^{C}	4.25^{C}	36.81^{B}

Values are expressed as means. Values in the same column with different superscript (A, B, C, D, E, F, G, H) are statistically significant at $p<0.05$

Calcium content:

The calcium (Ca) content exhibited significant variation among the different mushroom species studied, indicating the difference in their accumulation potential. *Volvariella taylorii* had the highest calcium content among the species with the value of 11.47 mg/100g, significantly outperforming all other species. This suggests that *Volvariella taylorii* may have a higher capacity for Ca uptake or efficient accumulation mechanisms, making it a potential candidate for dietary calcium enrichment or nutraceutical applications.This was followed by *Russula compacta*, with 7.5 mg/100g. In contrast, *Cantharellus cibarius* had the lowest calcium content, at 1.14 mg/100g. This value indicates that *Volvariella taylorii* and *Russula compacta* have significantly higher calcium levels compared to other species. These findings align with previous research on mushroom mineral content. For instance, a study by Kalac (2019) reported calcium levels in wild edible mushrooms ranging from 2 to 15 mg/100g, with species like *Agaricus bisporus* and *Pleurotus ostreatus* showing moderate calcium content (5–10 mg/100g). The high calcium content in *Volvariella taylorii* and *Russula compacta* is consistent with findings from other studies, which have identified certain mushroom species as potential dietary sources of calcium, particularly in regions where dairy consumption is limited (Ribeiro et al., 2017). Additionally, a study by Ouzouni et al., (2009) found that calcium levels in mushrooms can vary significantly depending on the species and growing conditions, with some species exceeding 10 mg/100g. This variability underscores the importance of species selection for dietary calcium intake. The calcium content in mushrooms, while generally lower than in dairy products, can still contribute to meeting daily requirements, especially in vegetarian or vegan diets (Kalac, 2019). The high calcium content in these mushrooms may contribute to better bone health and metabolic functions, making them more beneficial for dietary calcium intake compared to species with lower calcium content (Tang et al., 2023).

Iron content:

The iron (Fe) content in the mushroom species in the present study exhibits notable variation, with significant differences between species. This diversity in iron concentrations has important implications for their potential use as dietary sources of iron, which is an essential micronutrient for human health. *Volvariella taylorii* had the highest iron content at 18.39 mg/100g. This was followed by *Termitomyces heimii* at 12.78 mg/100g. The lowest iron content was found in *Cantharellus cibarius*, at 2.4 mg/100g. This suggests that *Volvariella taylorii* is particularly rich in iron and cadmium, as mentioned before, which is essential for blood health and oxygen transport. High iron content in these mushrooms can help prevent anaemia and support overall health (Budzyńska et al., 2021). A study by Falandysz et al., (2017) found that wild mushrooms such as *Boletus edulis* and *Cantharellus cibarius* had iron levels ranging from 2 to 20 mg/100g, with some species exceeding 15 mg/100g. Similarly, a study by Ayaz et al., (2011) reported iron concentrations in mushrooms ranging from 1.5 to 18 mg/100g, with species like *Lactarius deliciosus* and *Pleurotus* spp. showing particularly high levels. The high iron content in *Volvariella taylorii* makes it valuable dietary sources for preventing iron-deficiency anaemia, especially in populations with limited access to meat or fortified foods (Falandysz et al., 2017). Furthermore, the bioavailability of iron in mushrooms, though lower than in animal products, can be enhanced through dietary combinations with vitamin C-rich foods (Ayaz et al., 2011). Differences in iron content across species can be influenced by factors such as variations in their metal uptake mechanisms, ecological functions, and the chemical makeup of the substrates they grow on. Additionally, fungi's ability to accumulate metal ions like iron may also depend on environmental factors such as mineral content of soil and substrate, moisture, and temperature.

Magnesium content:

The magnesium (Mg) content among the mushroom species studied varies significantly ($p<0.05$). *Termitomyces heimii* was found to be the highest magnesium content among the species studied, measuring 6.83 mg/100g, followed by *Lactifluus corrugis* with 5.34 mg/100g, and *Lactifluus piperatus* at 4.68 mg/100g. Moderate magnesium levels were found in species like *Russula aurora* (3.93 mg/g), *Dacryopinax spathularia* (3.41 mg/g), and *Russula cyanoxantha* (3.43 mg/g). These mushrooms offer a more moderate source of magnesium but still provide a noteworthy contribution to the diet, especially in areas where magnesium intake may be insufficient.The lowest magnesium content was found in *Phallus indusiatus*, with the value of 0.67 mg/100g. Higher magnesium content in *Termitomyces heimii* and *Lactifluus corrugis* can contribute to muscle and nerve function, as well as energy production. Magnesium is also vital for maintaining a healthy immune system and supporting cardiovascular health (Di-Nicolantonio et al., 2018). These findings are consistent with other research on mushroom mineral content. For instance, a study by Kalac (2019) reported magnesium levels in mushrooms ranging from 0.5 to 10 mg/100g. Similarly, a study by Ouzouni et al., (2009) found that magnesium levels in wild edible mushrooms varied significantly, with some species exceeding 5 mg/100g. The magnesium content in *Termitomyces heimii* and *Lactifluus corrugis* is particularly noteworthy, as it contributes to daily magnesium intake, especially in diets lacking other magnesium-rich foods (Kalac, 2019). Additionally, magnesium in mushrooms has been linked to improved cardiovascular health and reduced risk of metabolic disorders (DiNicolantonio et al., 2018).The variation in magnesium content among species could be influenced by factors such as mineral composition of soil and substrate they grow on, ambient conditions, and the specific physiological needs and potentials of each species to absorb and accumulate magnesium.

Potassium content:

The potassium (K) content across the mushroom species analyzed reveals considerable variability, with some species showing high concentrations of this essential macronutrient ($p<0.05$). *Termitomyces heimii* had the highest potassium content (182.25 mg/100g) and this was followed by *Lactifluus corrugis* (174.13 mg/100g), and *Volvariella taylorii* (164.59 mg/100g). Several other species, such as *Lactifluus piperatus* (154.06 mg/g), *Amanita vaginata* (150.74 mg/g), and *Auricularia auricula-judae* (143.81 mg/g), also show moderate to high potassium levels. These mushrooms could offer valuable contributions to the diet, particularly in potassium-rich diets, supporting cardiovascular health and electrolyte balance. The lowest potassium content was found in *Cantharellus cibarius*, at 50.84 mg/100g. Potassium-rich species like *Termitomyces heimii* and *Lactifluus corrugis* are beneficial for maintaining fluid balance and heart function. High potassium intake from these mushrooms can help control blood pressure and reduce the risk of cardiovascular diseases (Krittanawong et al., 2021). A study by Ouzouni et al., (2009) found that potassium levels in wild edible mushrooms varied significantly, with some species exceeding 150 mg/100g. Cheung (2010) reported potassium levels in mushrooms ranging from 50 to 400 mg/100g. Similarly, a study by Barros et al., (2008) found that potassium levels in wild edible mushrooms varied significantly, with some species exceeding 160 mg/100g. Another study by Reis et al., (2012) highlighted that potassium levels in mushrooms are influenced by environmental factors such as soil composition and growing conditions, which may explain the variability observed across species. The observed variation in potassium content may be attributed to ambient conditions, substrate composition, and the difference in their mechanisms of potassium uptake and accumulation potentials. Potassium levels in mushrooms can also be influenced by their ecological roles and interactions with their growth environment.

Zinc content:

Zinc is crucial for immune function, wound healing, and growth. The Zn content determined across the studied mushroom species demonstrates considerable interspecific variation, reflecting differences in their absorption and accumulation potentials.In this study, *Amanita vaginata* had the highest zinc content at 6.50 mg/100g, followed by *Auricularia auricula-judae* (5.58 mg/100g) and *Lactifluus piperatus* (4.36 mg/100g). Other mushrooms with moderately high Zn levels include *Lactifluus corrugis* (4.75 mg/g), *Lactifluus piperatus* (4.36 mg/g), and *Volvariella taylorii* (4.25 mg/g). These species could also contribute meaningfully to dietary zinc intake and support metabolic and immune health, particularly in plant-based diets where zinc bioavailability is sometimes lower.*Phallus indusiatus* had the lowest zinc content at 0.85 mg/100g. These findings are consistent with other studies on mushroom zinc content. For instance, a study by Falandysz et al., (2017) reported zinc levels in mushrooms ranging from 0.5 to 10 mg/100g, with species like *Boletus edulis* and *Cantharellus cibarius* showing moderate zinc content (2–5 mg/100g). Similarly, a study by Ayaz et al., (2011) found that zinc concentrations in mushrooms varied significantly, with some species exceeding 5 mg/100g. The high zinc content in *Amanita vaginata* and *Auricularia auricula-judae* makes them valuable dietary sources for supporting immune function and overall health (Falandysz et al., 2017). Additionally, zinc in mushrooms has been linked to improved wound healing and growth in populations with limited access to animal products (Ayaz et al., 2011). Another study by Ouzouni et al., (2009) highlighted that zinc levels in mushrooms are influenced by environmental factors such as soil composition and growing conditions, which may

Manganese content:

Manganese is important for bone formation, metabolism, and antioxidant functions. The analysis of Mn content across the studied mushroom species reveals significant interspecific variation, reflecting the difference in their absorption and accumulation potentials.In this study, *Lactifluus piperatus* had the highest manganese content at 47.05 mg/100g, followed by *Volvariella taylorii* (36.82 mg/100g). This suggests that these species have a strong capacity to accumulate Mn and could possibly serve as a valuable natural source of this micronutrient in human diets. Moderately high Mn levels were observed in *Lentinus squarrosulus* (35.20 mg/g), *Termitomyces heimii* (33.15 mg/g), and *Auricularia auricula-judae* (32.54 mg/g).On the other hand, *Coprinellus disseminatus* (11.81 mg/g), *Phallus indusiatus* (14.02 mg/g), and *Dacryopinax spathularia* (15.78 mg/g) exhibit the lowest Mn content these results are consistent with other research on mushroom manganese content. For example, a study by Kalac (2019) reported manganese levels in edible mushrooms ranging from 10 to 50 mg/100g. Ouzouni et al., (2009) found that manganese levels in wild edible mushrooms varied significantly, with some species exceeding 40 mg/100g. The high manganese content in *Lactifluus piperatus* and *Volvariella taylorii* is particularly beneficial for supporting bone health and metabolic functions (Li and Yang, 2018). Additionally, manganese in mushrooms has been linked to improved antioxidant activity and blood sugar regulation (Kalac, 2019). The observed variations in Mn content are likely influenced by species-specific physiological mechanisms, environmental conditions (e.g., Mn availability in substrates), and the metabolic pathways involved in metal uptake and accumulation.

While mushrooms are not as mineral-rich as some plant-based foods, they can still complement dietary intake, especially for individuals with dietary restrictions. For calcium, *Volvariella taylorii* (11.47 mg/100g) is far below kale (150 mg/100g) but can still contribute to calcium intake in dairy-limited diets (USDA, 2023; Tang et al., 2023). In contrast, *Volvariella taylorii* (18.39 mg/100g) outperform spinach (2.7 mg/100g) in iron content, making them valuable for preventing iron-deficiency anaemia (Budzyńska et al., 2021). Similarly, *Lactifluus piperatus* (47.05 mg/100g) surpasses almonds (2.3 mg/100g) in manganese, supporting bone health and antioxidant functions (Li and Yang, 2018). However, mushrooms like *Termitomyces heimii* (6.83 mg/100g) provide less magnesium than almonds (270 mg/100g), and their potassium content (*Termitomyces heimii*: 82.25 mg/100g) is lower than bananas (358 mg/100g) (USDA, 2023). Despite this, mushrooms like *Amanita vaginata* (6.50 mg/100g) offer zinc levels comparable to chickpeas (1.5 mg/100g), supporting immune health (Falandysz et al., 2017). Overall, mushrooms are a valuable supplementary source of minerals, particularly for iron and manganese, in diverse diets.

The mineral content in mushrooms is largely determined by the ability of the growing mycelium to bioaccumulate minerals from the cultivation of substrate. Minerals are crucial for numerous bodily functions, including the formation of strong bones, the transmission of nerve impulses, and the regulation of muscle function. They also support metabolic processes and help maintain fluid balance. By fulfilling these essential roles, minerals contribute significantly to overall health, helping to prevent deficiencies and ensuring a long, healthy life (Gharibzahedi and Jafari, 2017). Given the substantial health benefits mushrooms offer through their mineral content, it's crucial to understand the balance between beneficial minerals and potentially harmful heavy metals. While mushrooms absorb essential minerals that are vital for human health, they are also capable of accumulating heavy metals from their growing environment. This ability to bioaccumulate metals poses a dual-edged aspect to mushroom consumption: on one hand, they can provide a rich source of nutrients; on the other, they may carry contaminants, especially when grown near polluted areas or on substrates containing metal residues. To mitigate health risks, it's essential to monitor the sources of mushrooms and assess their heavy metal content regularly. Macrofungi have the capability to accumulate high levels of mineral elements even in soil with low concentrations of metals. The concentration of minerals correlates directly with factors such as species, geographical region of growth, fruiting body maturation period, substrates, and proximity to pollution sources (Gucia et al., 2012; Bellettini et al., 2019).

PHOTOPLATES

Photo plate 1: *Amanita fulva* (Schaeff.) Secr

Photo plate 2: *Amanita jacksonii* Pomerl. (1984)

Photo plate 3: *Amanita phalloides* (Fr.) (1833)

Photo plate 4: *Amanita vaginata* (Bull.) Lam. (1783)

Photo plate 5: *Auricularia auricula-judae* (Bull.) J. Schröt., (1888)

Photo plate 6: *Cantharellus tropicalis*

Photo plate 7: *Clavulinopsis laeticolor* (Berk. and Curtis) R.H. Petersen (1965)

Photo plate 8: *Coprinellus disseminates* Pers. (1938)

Photo plate 9: *Dacryopinax spathularia* (Schwein.), (1948)

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Photo plate 12: *Ganoderma applanatum* Pers. Pat., (1889)

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Photo plate 14: *Lactifluus corrugis* (Peck) Kuntze, (1891)

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Photo plate 23: *Russula aurora* Krombh. (1845)

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Photo plate 27: *Russula emetica* (Schaeff.) Pers. (1796)

Photo plate 28: *Schizophyllum commune* Fr. (1821)

Photo plate 29: *Scleroderma verrucossum* (Bull.) Pers. (1801)

Photo plate 30: *Termitomyces heimii* Natarajan (1979)

Photo plate 31: *Trametes elegans* (Fr.) Spreng.(1838)

Photo plate 32: *Volvariella taylorii* (Berk. and Broome) Singer (1951)

CHAPTER-5

SUMMARY AND CONCLUSION

Chapter 5

SUMMARY AND CONCLUSION

Fungi are a group of eukaryotic organisms that are ancient, although they are not as ancient as bacteria, which are estimated to have existed for approximately 3.5 billion years, according to fossil evidence. However, the Ordovician period, which occurred approximately 460 to 455 million years ago, is the time period during which the earliest known fungus fossils were discovered (Redecker et al., 2000). Fungi, which include molds, yeasts, and mushrooms, can be either unicellular, as in yeasts, or multicellular, as in molds. They are classified as biotrophs, saprotrophs, or necrotrophs according to their nutritional strategies, and they reproduce by generating and dispersing spores (Carris et al., 2012). Through absorptive heterotrophy, they acquire organic compounds for sustenance (Worrall, 1999). They primarily reproduce through spores, which may be single-celled or multicellular, and their structure typically consists of hyphae, thread-like structures with cell membranes (Islam et al., 2017).

Mizoram's woodlands are home to a variety of wild mushrooms including edible species, which the inhabitants adore. These wild edible mushrooms are gathered from the forest and constitute an important element of the diet during the monsoon season, when they are abundant. Despite the fact that this cuisine is extremely popular in the region, data on the nutritional content of the wild edible mushrooms present in the northeastern region is very limited (Aghar-Murughar, 2004).

Few researchs done in Mizoram evaluated the nutritional characteristics of various types of wild edible mushrooms. Thachunglura et al., (2023) indicated that *Pleurotus giganteus* possesses substantial quantities of minerals and protein. This species was characterized through DNA research and possesses a substantial fruiting body, rendering it a suitable food source. Chawngthu et al., (2023) investigated the nutritional value of *Lentinula edodes*, or shiitake mushroom, emphasizing its advantageous features; nevertheless, the mineral content in this specimen was not evaluated. Thachunglura et al., (2024) assessed 10 additional mushroom species from the Mamit and Champhai areas, discovering that certain species contain significant levels of nutrients and minerals. However, edible mushroom species from Aizawl district have not been examined for their nutritional value.

Therefore, the present study, titled "Investigation on the Nutrient Content in Wild Mushrooms of Aizawl District, Mizoram", was conducted in three locations within Aizawl District with objective of morphological identification of wild mushrooms, analysis of macro nutrient content in wild mushrooms and analysis of micro nutrient content in wild mushrooms.. Aizawl is the largest city and capital of Mizoram, India. It is situated in the north of the Tropic of Cancer, on a ridge at an elevation of 1132 mts (3715 feet) ASL, with the Tlawng river valley to the west and the Tuirial river valley to the east.

The mushroom specimens were collected from Mizoram University campus, Hlimen Forest, and Lungleng Forest during the rainy season from 2019 to 2022. The collected species were identified based on their morphological characteristics. The study aimed to collect, identify, and evaluate the nutritional properties of edible wild mushrooms. However, not all species were assessed for their nutritional properties. Some species were excluded from analysis because they were inedible, and among the edible species, a few species were also not evaluated.

Identification of specimen was done using the morphological characters like color of the fruiting body (stipe and pileus), size, shape, coordinates and collection site of the mushrooms. Processing of specimen was done immediately after collection using a sharp knife to clean and remove forest debris and wood substrates. The freshly collected mushroom samples were oven dried at 40 °C to 60 °C for three consecutive days and grounded into a fine powder for further bio chemical analysis. The estimation of moisture content, fat content, fiber, protein, carbohydrates and micro-nutritional properties (minerals) includeing calcium (Ca), iron (Fe), magnesium (mg), potassium (K), zinc (Zn) and manganese (Mn) was done.

During the study, a total of 32 mushroom specimens were identified. The 32 species are namely *Amanita fulva, Amanita jacksonii, Amanita phalloides, Amanita vaginata, Auricularia auricula-judae, Cantharellus cibarius, Clavulinopsis laeticolor, Coprinellus disseminates, Dacryopinax spathularia, Fistulina hepatica, Ganoderma adspersum, Ganoderma applanatum, Ganoderma lucidum, Lactifluus* *corrugis, Lactifluus piperatus, Lentinus squarrosulus, Lycoperdon perlatum, Microporus xanthopus, Phallus indusiatus, Pleurotus pulmonarius, Pycnoporus coccineus, Podoscypha petalodes, Russula aurora, Russula bertulatum, Russula compacta, Russula cyanoxantha, Russula emetic, Schizophyllum commune, Scleroderma verrucossum, Termitomyces heimii, Trametes elegans* and *Volvariella taylorii.*

Lactifluus piperatus, Microporus xanthopus, Schizophyllum commune, and *Trametes elegans* were present at all collection sites, while the Russulaceae family showed the greatest diversity with seven species. Among the species identified, *Lactifluus corrugis* (Pa uithin), *Lactifluus piperatus* (Pa lengvar), *Lentinus squarrosulus* (Pa chang), *Russula cyanoxantha* (Pa lengvar), *Russula compacta* (Pa leng), *Schizophyllum commune* (Pasi), *Termitomyces heimii* (Pasawntlung), and *Volvariella taylorii* (Changel pa) are consumed by the Mizo people. Other species, such as *Auricularia auricula-judae* (Pu vana beng), *Cantharellus cibarius, Phallus indusiatus,* and *Pleurotus pulmonarius,* are eaten by a smaller number of people. Additionally, many wild edible mushrooms, including the nutritious *Fistulina hepatica,* are not widely recognized for their edibility, and several species remain unconsumed due to limited knowledge of mycology. Wild edible mushrooms have enormous promise for delivering long-term solutions in food supply and security. These mushrooms can help to alleviate food scarcity and play an important role in guaranteeing a steady food supply. They are especially important in rural communities, where they provide a variety of benefits that improve nutrition and economic stability. Aside from their dietary benefits, wild edible mushrooms promote local livelihoods through foraging and selling, so improving the general well-being and resilience of rural communities.

The present findings indicate that the state has a diverse range of edible mushrooms. The nutritional profiling of wild edible mushrooms demonstrates that these mushrooms are rich in vital elements, making them valuable additions to well-balanced diets. This rich fungal biodiversity not only expands dietary alternatives, but also offers chances to include nutrient-dense foods into daily nutrition. The present study highlights the potential of mushrooms to greatly improve health and well-being, supporting both individual dietary needs and broader nutritional programs.

The major findings on analytical aspects of mushrooms are as follows:

1. Moisture content varied from lowest in *Volvariella taylorii* (12.72 g/100g) to highest in *Russula aurora* (13.26 g/100g).
2. Ash content ranged from lowest in *Cantharellus cibarius* (3.74 g/100g) to highest in *Termitomyces heimii* (8.41 g/100 g).
3. Fat content was lowest in *Auricularia auricula-judae* (1.77 g/100g) and highest in *Russula aurora* (4.6 g/100 g).
4. Crude fibre content varied from lowest in *Phallus indusiatus* (5.09 g/100g) to highest in *Volvariella taylorii* (12.53 g/100 g).
5. Protein content ranged from lowest in in *Russula cyanoxaantha* (14.42 g/100g) to highest in *Termitomyces heimii* (30.35 g/100 g).
6. Carbohydrate content was lowest in *Termitomyces heimii* (40.06 g/100 g) and highest in *Coprinellus disseminatus* (59.69 g/100 g).
7. Calcium (Ca) content ranged from lowest in *Cantharellus cibarius* (1.14 mg/100 g) to highest in *Volvariella taylorii* (11.47 mg/100 g).
8. Iron (Fe) content was lowest in *Cantharellus cibarius* (2.4 mg/100 g) and highest in *Volvariella taylorii* (18.39 mg/100 g).
9. Magnesium (Mg) content was the lowest in *Phallus indusiatus* (0.67 mg/100g) and highest in *Termitomyces heimii* (6.82 mg/100 g).
10. Potassium (K) content varied from lowest in *Cantharellus cibarius* (50.84 mg/100 g) to highest in *Termitomyces heimii* (182.25 mg/100 g).
11. Zinc (Zn) content ranged from lowest in *Phallus indusiatus* (0.85 mg/100 g) to highest in *Amanita vaginata* (6.50 mg/100 g).
12. Manganese (Mn) content was lowest in *Dacryopinax spathularia* (15.78 mg/g) highest in *Lactifluus piperatus* (47.05 mg/100 g).

In conclusion, mushrooms play a vital role in enhancing both nutrition and livelihoods, especially in regions like Aizawl district where natural conditions are ideal for their growth. As a rich source of protein, essential nutrients, and with minimal fat content, mushrooms offer a healthy, sustainable alternative to meat and dairy, an important consideration in the face of rising environmental concerns. Their potential to be integrated into low-calorie diets further highlights their relevance in promoting public health. Beyond their dietary value, mushroom cultivation also opens doors to income generation and rural development, presenting a promising alternative to traditional practices like jhum farming. Looking ahead, future studies could focus on identifying and cultivating more indigenous mushroom species, exploring their medicinal properties, and improving processing and storage techniques. With proper research and investment, mushrooms could become a cornerstone of sustainable agriculture, nutrition, and economic growth in Mizoram and beyond.

REFERENCES

REFERENCES

A.O.A.C. (1990). Official Method of Analysis 15th Edition, Association of Official Analytical Chemists Washington, D. U.S.A.

Adebayo, A., Olayemi, F., and Oboh, G. (2019). *Mineral profile of wild edible mushrooms*. Journal of Medicinal Food, 22(3), 234–240.

Afiukwa, C. Oko, A. Afiukwa J. N., Ugwu, P. C., Ali Fredrick, U., and Ossai, E. (2013). Proximate and mineral element compositions of five edible wild grown mushroom species in abakaliki, Southeast Nigeria. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 4. 1056-1064.

Alam, N., Khan, A., Hossain, M. S., Amin, S. M. R. and Khan, L. A., (2007), Nutritional Analysis of Dietary Mushroom- Pleurotus Florida Eger and Pleurotus sajur-caju (Fr) Singer. Bangladesh J. Mushroom., 1(2): 1-7.

Anderson, P., Lee, J., and Kumar, V. (2022). *Trace elements in edible fungi: A nutritional evaluation*. Fungal Nutrition Journal, 12(1), 45–53.

Anschau, A. Caruso, C. S. Kuhn, R. C. and Franco, TT. (2017). Validation of the Sulfo- Phosphovanillin (SPV) Method for the determination of lipid content in oleaginous microorganisms, Brazilian Journal of Chemical Engineering, Vol. 34, No. 01:19 – 27.

Ao T, and Deb C.R. (2019). Nutritional and antioxidant potential of some wild edible mushrooms of Nagaland, India. Journal of Food Science and Technology, 56(2), 1084–1089.

Arnolds, E. (1992). The analysis and classification of fungal communities with special reference to macrofungi. Fungi in Vegetation Science, 7–47. https://doi.org/10.1007/978-94-011-2414-0_2

Assemie, A., and Abaya, G. (2022). The Effect of Edible Mushroom on Health and Their Biochemistry. International journal of microbiology, 2022, 8744788. https://doi.org/10.1155/2022/8744788.

Ayaz, F. A., Torun, H., Özel, A., Col, M., Duran, C., Sesli, E., and Colak, A. (2011). Nutritional value of wild mushrooms collected from the Black Sea region of Turkey. *Turkish Journal of Biochemistry, 36*(3), 213-221.

Ayimbila, F., and Keawsompong, S. (2023). Nutritional Quality and Biological Application of Mushroom Protein as a Novel Protein Alternative. Current nutrition reports, 12(2), 290–307. https://doi.org/10.1007/s13668-023-00468-x.

Badalyan, S. M. (2003). Antioxidant Activity of Culinary-Medicinal Mushroom *Flammulina velutipes* (W. Curt.:Fr.) P. Karst. (Agaricomycetideae). International Journal of Medicinal Mushrooms, 5(3), 10. https://doi.org/10.1615/interjmedicmush.v5.i3.50

Bano, Z. and Rajanatharam, S., (1988), Pleurotus mushroom Part II. Chemical composition, nutritional value, post-harvest physiology, preservation and role as human food. Critical Reviews in Food Science and Nutrition., 27: 87-158.

Bano, Z., Srinivasan, K. S., and Srinivasta, H. C., (1963), Amino acid composition of the protein from a mushroom (Pleurotus sp.). Applied microbiology and biotechnology. 11(3): 184-187.

Barros, L., Baptista, P., Correia, D. M., Casal, S., Oliveira, B., and Ferreira, I. C. F. R. (2008). Fatty acid and sugar compositions, and nutritional value of five wild edible mushrooms from Northeast Portugal. *Food Chemistry*, 105(1), 140–145. https://doi.org/10.1016/j.foodchem.2007.03.052

Barros, L., Baptista, P., Correia, P., , Morais, J. S., and Ferreira, I. C. F. R. (2007). Effects of conservation treatment and cooking on the chemical composition and antioxidant activity of Portuguese wild edible mushrooms. *Journal of Agricultural and Food Chemistry*, 55(12), 4781–4788.

Barros, L., Baptista, P., Estevinho, L. M., and Ferreira, I. C. (2008). Effect of fruiting body maturity stage on chemical composition and antioxidant activity of wild edible mushrooms. *Food and Chemical Toxicology*, 46(8), 2742–2747.

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*(8), 2742-2747.

Barros, L., et al., (2008). Evaluation of antioxidant activity of Agaricus sp. mushrooms by chemical and biochemical assays. *Food Chemistry*, 111(1), 61–66.

Barros, L., Ferreira, M.-J., Queirós, B., Ferreira, I. C., and Baptista, P. (2008). Total phenols, ascorbic acid, β-carotene and lycopene in Portuguese wild edible mushrooms and their antioxidant activities. *Food Chemistry*, 103(2), 413–419.

Bates, S.C. (2006). A Preliminary Checklist of Arizona Macrofungi. Canotia, 2(2), 47–78.

Beelman, R. B., Royse, D. J., and Chikthimmah, N. (2003). Bioactive Components in Button Mushroom *Agaricus bisporus* (J. Lge) Imbach (Agaricomycetideae) of Nutritional, Medicinal, and Biological Importance (Review). International Journal of Medicinal Mushrooms, 5(4), 18. https://doi.org/10.1615/interjmedicmush.v5.i4.10

Bell, V., Silva, C. R. P. G., Guina, J., and Fernandes, T. H. (2022). Mushrooms as future generation healthy foods. *Frontiers in nutrition*, *9*, 1050099. https://doi.org/10.3389/fnut.2022.1050099

Bellettini M.B, Fiorda FA, Maieves H.A, Teixeira G.L, Ávila S, Hornung, PS, Júnior A.M, and Ribani R.H. (2019). Factors affecting mushroom *Pleurotus* spp. Saudi journal of biological sciences, 26(4), 633–646. https://doi.org/10.1016/j.sjbs.2016.12.005

Bhambri, A., Srivastava, M., Mahale, V. G., Mahale, S., and Karn, S. K. (2022). Mushrooms as Potential Sources of Active Metabolites and Medicines. Frontiers in Microbiology, 13. https://doi.org/10.3389/fmicb.2022.837266

Bisht, N. S. (2011). Wood decaying fungi of Mizoram. Government of India: Department of Environment and Forest.

Bonfante, P., and Genre, A. (2010). Mechanisms underlying beneficial plant–fungus interactions in mycorrhizal symbiosis. Nature Communications, 1(1).

https://doi.org/10.1038/ncomms1046

Budzyńska, S., Siwulski, M., Magdziak, Z., Budka, A., Gąsecka, M., Kalac, P., Rzymski, P., Niedzielski, P., and Mleczek, M. (2021). Influence of Iron Addition (Alone or with Calcium) to Elements Biofortification and Antioxidants in *Pholiota nameko*. Plants (Basel, Switzerland), 10(11), 2275. https://doi.org/10.3390/plants10112275

Buswell, J. A., (1996), Lignocellyulolytic enzyme profiles of edible mushroom fungi. World Journal on Microbiology and Biotechnology. 12: 537-542.

Caglarirmak, N., Unal, K., and Otles, S. (2002). Nutritional value of edible wild mushrooms collected from the Black Sea region of Turkey. *Micologia Aplicada International, 14*(1), 1–5.

Carrasco, J., Zied, D. C., Pardo, J. E., Preston, G. M., and Pardo-Giménez, A. (2018). Supplementation in mushroom crops and its impact on yield and quality. AMB Express, 8(1), 146. https://doi.org/10.1186/s13568-018-0678-0

Carris, L.M., Little, C.R. and Stiles, C.M. (2012) Introduction to Fungi. The Plant Health Instructor.

Chada, K. L. and Sharma, S. R., (1995), Mushroom research in India-History, Infrastructure and Achievements. In: KL Chadha (Eds.). Adv. Horticulture, MPH (Malhotra Publishing House): New Delhi: 1-8.

Chang, S. T. (1980), Mushroom as human food. Bioscience. 30: 339-401.

Chang, S. T., and Buswell, J. A., (1996), Mushroom nutraceuticals. World Journal on Microbiology and Biotechnology. 12: 473–476.

Chang, S. T., and Miles P.G. (2004). Mushrooms Cultivation, Nutritional Value, Medicinal Effects and Environmental Impact (p. 436). Boca Raton, FL CRC Press

Chawngthu, Z., Tluanga, L., Zothanzama, J., Thachunglura, V.L., Lalbiakmawia, B., Renthlei, L. (2023). Wood rotting polyporales from the biodiversity reserves within the Indian subtropical habitat. Indian Journal Microbiology Research, 10(3):140-148

Chawngthu, Z., Vabeikhokhei, J.M.C, Zomuanpuii, R., Mandal, S.D., and Zothanzama, J. (2021). A new species of Ophiocordyceps (Ophiocordycipitaceae) from Mizoram, India. Phytotaxa, 500(1), 11–20.

https://doi.org/10.11646/phytotaxa.500.1.2

Chelladurai, G. Mohan Raj J. and Sasirekhamani M. (2014), In Vitro cultivation technology and nutritional status of milky mushroom (*Calocybe Indica*). African journal of Biotechnology, Vol. 13 (38): 3901-3906.

Chen, L., Wang, Y., and Zhao, H. (2020). *Nutritional composition of edible fungi*. Journal of Food Biochemistry, 44(8), e13240.

Chen, Y., Svenning, J.-C., Wang, X., Cao, R., Yuan, Z., and Ye, Y. (2018). Drivers of Macrofungi Community Structure Differ between Soil and Rotten-Wood Substrates in a Temperate Mountain Forest in China. Frontiers in Microbiology, 9. https://doi.org/10.3389/fmicb.2018.00037

Chinara, N., and Mahapatra, S. S. (2020). Evaluation of Different Substrates for Production of Milky Mushroom (*Calocybe indica* Pandamp;C) in Odisha. International Journal of Current Microbiology and Applied Sciences, 9(6), 3195–3200. https://doi.org/10.20546/ijcmas.2020.906.382

Chugh, R. M., Mittal, P., Mp, N., Arora, T., Bhattacharya, T., Chopra, H., Cavalu, S., and Gautam, R. K. (2022). Fungal Mushrooms: A Natural Compound with Therapeutic Applications. Frontiers in pharmacology, 13, 925387. https://doi.org/10.3389/fphar.2022.925387

Crisan, E. V., and Sands, A. (1978). Nutritional value. Academic Press.

Cui, J., and Chisti, Y. (2003). Polysaccharopeptides of *Schizophyllum commune*: the molecular weight fractionation and immunological activity. *International Journal of Medicinal Mushrooms*, 5(4), 385–394.

Cui, J., and Chisti, Y. (2003). Polysaccharopeptides of *Schizophyllum commune*: the molecular weight fractionation and immunological activity. *International Journal of Medicinal Mushrooms*, 5(4), 385–394.

Demirban A. (2001). Heavy metal bioaccumulation by mushrooms from artificially fortified soils. Food Chemistry 74.3 : 293-301.

Demirbas, A. (2002). Metal ion uptake by mushrooms from natural and artificially enriched soils. Food Chemistry, 78, 89–93.

Demirtas, N., Sengul, G. F., Dizeci, N., and Yildirim, O. (2024). Exploring the chemical composition and nutritional properties of six edible mushroom species from Turkey. Journal of Food Composition and Analysis, 133, 106477. https://doi.org/10.1016/j.jfca.2024.106477

Dimopoulou, M., Kolonas, A., Mourtakos, S., Androutsos, O., and Gortzi, O. (2022). Nutritional Composition and Biological Properties of Sixteen Edible Mushroom Species. Applied Sciences, 12(16), 8074. https://doi.org/10.3390/app12168074

DiNicolantonio, J. J., Liu, J., and O'Keefe, J. H. (2018). Magnesium for the prevention and treatment of cardiovascular disease. Open heart, 5(2), e000775. https://doi.org/10.1136/openhrt-2018-000775

Dix, N.J. and Webster, J. (1995) Fungi of extreme Environments. Fungal Ecology, Springer, Dordrecht, 322-340.

Doley, K., and Borde, M. (2021). Arbuscular mycorrhizal (AM) fungi: Potential role in sustainable agriculture. Fungi Bio-Prospects in Sustainable Agriculture, Environment and Nano-Technology, 203–225. https://doi.org/10.1016/b978-0-12-821394-0.00009-3

Dubois, M., Gilles, K.A., Hamilton, J. K., Rebers, P.A. and Smith. F. (1956). Colorimetric method for determination of sugars and related substances. Analytical Chemistry, 28: 350-356.

Ediriweera, A.N., Karunarathna, S.C., Yapa, P.N., Schaefer, D.A., Ranasinghe, A.K., Suwannarach, N., and Xu, J. (2022). Ectomycorrhizal Mushrooms as a Natural Bio-Indicator for Assessment of Heavy Metal Pollution. Agronomy, 12(5), 1041. https://doi.org/10.3390/agronomy12051041

Egli, S. (2011). Mycorrhizal mushroom diversity and productivity—an indicator of forest health? Annals of Forest Science, 68(1), 81–88. https://doi.org/10.1007/s13595-010-0009-3

El-Ramady, H., Törős, G., Badgar, K., Llanaj, X., Hajdú, P., El-Mahrouk, M. E., Abdalla, N., and Prokisch, J. (2022). A Comparative Photographic Review on Higher Plants and Macro-Fungi: A Soil Restoration for Sustainable Production of Food and Energy. Sustainability, 14(12), 7104. https://doi.org/10.3390/su14127104

Elsakhawy, T., Omara, A. E.-D., Abowaly, M., El-Ramady, H., Badgar, K., Llanaj, X., Törős, G., Hajdú, P., and Prokisch, J. (2022). Green Synthesis of Nanoparticles by Mushrooms: A Crucial Dimension for Sustainable Soil

Management. Sustainability, 14(7), 4328. https://doi.org/10.3390/su14074328

Falandysz, J., Borovička, J., and Chudzyński, K. (2017). Macro and trace mineral constituents and radionuclides in mushrooms: Health benefits and risks. *Applied Microbiology and Biotechnology, 101*(2), 569-583.

Fang, W., Devkota, S., Arunachalam, K., Phyo, K. M. M., and Shakya, B. (2023). Systematic review of fungi, their diversity and role in ecosystem services from the Far Eastern Himalayan Landscape (FHL). Heliyon, 9(1), e12756.

Field, K. J., Daniell, T., Johnson, D., and Helgason, T. (2020). Mycorrhizas for a changing world: Sustainability, conservation, and society. Plants, People, Planet, 2(2), 98–103. Portico. https://doi.org/10.1002/ppp3.10092

Fischer, M. W., and Money, N. P. (2010). Why mushrooms form gills: efficiency of the lamellate morphology. Fungal biology, 114(1), 57–63. https://doi.org/10.1016/j.mycres.2009.10.006

Frąc, M., Hannula, S. E., Bełka, M., and Jędryczka, M. (2018). Fungal Biodiversity and Their Role in Soil Health. Frontiers in Microbiology, 9. https://doi.org/10.3389/fmicb.2018.00707

Fu Z, Liu G, Wang L. (2020). Assessment of potential human health risk of trace element in wild edible mushroom species collected from Yunnan Province, China. Environ Sci Pollut Res Int. 27(23):29218-29227. https://doi.org/10.1007/s11356-020-09242-w.

Garcia-Rubio, R., de Oliveira, H. C., Rivera, J., and Trevijano-Contador, N. (2020). The Fungal Cell Wall: Candida, Cryptococcus, and Aspergillus Species. Frontiers in Microbiology, 10. https://doi.org/10.3389/fmicb.2019.02993

Gençcelep, H, Uzun, Y, Tunçtürk, Y, and Demirel, K. (2009). Determination of mineral contents of wild-grown edible mushrooms. Food Chemistry, 113(4), 1033–1036. https://doi.org/10.1016/j.foodchem.2008.08.058

Gharibzahedi S.M.T, and Jafari S.M. (2017). The importance of minerals in human nutrition: Bioavailability, food fortification, processing effects and nanoencapsulation. Trends in Food Science and Technology, 119–132. https://doi.org/10.1016/j.tifs.2017.02.017

Ghate, S.D. and Sridhar, K R. (2017). Bioactive Potential of Lentinus squarrosulus and Termitomyces clypeatus from the Southwestern region of India. Indian J.

Nat. Prod. Resour. 8(2), 120–131.

Giri, S., and Rana, P. (2012). Nutritional and mineral composition of *Russula* species: a wild edible mushroom of Darjeeling Himalaya. *Journal of Applied Pharmaceutical Science*, 2(10), 160–163.

Giusti, A., Ricci, E., Gasperetti, L., Galgani, M., Polidori, L., Verdigi, F., Narducci, R., and Armani, A. (2020). Molecular Identification of Mushroom Species in Italy: An Ongoing Project Aimed at Reinforcing the Control Measures of an Increasingly Appreciated Sustainable Food. Sustainability, 13(1), 238. https://doi.org/10.3390/su13010238

Gogoi, J., Sharma, M., and Sharma, C. L. (2023). Nutrient analysis of some selected wild edible plants traditionally consumed by the Wancho tribe of Arunachal Pradesh, India. Vegetos. https://doi.org/10.1007/s42535-023-00660-y

González, A., Cruz, M., Losoya, C., Nobre, C., Loredo, A., Rodríguez, R., Contreras, J., and Belmares, R. (2020). Edible mushrooms as a novel protein source for functional foods. Food and amp; Function, 11(9), 7400–7414. https://doi.org/10.1039/d0fo01746a

Gucia, M., Jarzyńska, G., Rafał, E., Roszak, M., Kojta, A.K., Osiej, I., Falandysz, J. (2012). Multivariate analysis of mineral constituents of edible Parasol Mushroom (*Macrolepiota procera*) and soils beneath fruiting bodies collected from Northern Poland. Environmental Science and Pollution Research. 2012;19:416-31. https://doi.org/10.1007/s11356-011-0574-5

Gunasekara, N.W., Nanayakkara, C.M., Karunarathna, S.C., Wijesundera, R.L.C. (2021). Nutritional aspects of three *Termitomyces* and fourother wild edible mushroom species from Sri Lanka. Chiang MaiJournal of Science 48:1236−46.

Gupta, R. S., (1986). Mushroom cultivation. Indian Horticulture Journal, 31(1): 1-7.

Gupta, S., Summuna, B., Gupta, M., and Annepu, S. K. (2019). Edible Mushrooms: Cultivation, Bioactive Molecules, and Health Benefits. Reference Series in Phytochemistry, 1815–1847. https://doi.org/10.1007/978-3-319-78030-6_86

Hall, I. Stephenson, L.S. Buchanan, P. Yun, W. L. J. and Cole, A. (2003). Edible and poisonous mushrooms of the world, Timber Press, Inc.: 13-26.

Hawksworth D. L. (1991). The fungal dimension of biodiversity: Magnitude, significance, and conservation. Mycol. Res. 95, 641–655

Hawksworth D. L., and Lücking R. (2017). Fungal diversity revisited: 2.2 to 3.8 million species. Microbiol. Spectr. 5,

He, M.Q., Wang, M.Q., Chen, Z.-H., Deng, W.Q., Li, T.-H., Vizzini, A., Jeewon, R., Hyde, K. D., and Zhao, R.L. (2022). Potential benefits and harms: a review of poisonous mushrooms in the world. Fungal Biology Reviews, 42, 56–68. https://doi.org/10.1016/j.fbr.2022.06.002

Heleno, S. A., Barros, L., Sousa, M. J., Martins, A., and Ferreira, I. C. F. R. (2015). Tocopherols composition of Portuguese wild mushrooms with antioxidant capacity. *Food Chemistry, 119*(4), 1443–1450. https://doi.org/10.1016/j.foodchem.2009.09.025

Heleno, S. A., Barros, L., Sousa, M. J., Martins, A., and Ferreira, I. C. (2010). Tocopherols composition of Portuguese wild mushrooms with antioxidant capacity. *Food Chemistry*, 119(4), 1443–1450.

Heleno, S. A., et al. (2015). Bioactivity of mushroom extracts: Focus on antioxidant and antimicrobial properties. *Food Chemistry*, 130(3), 478–484.

Huang, M., Zeng, H., and Xu, B. (2017). Health and Risk Assessment by ICP-OES of Heavy Metals and Trace Minerals in Commercial Mushrooms Marketed in China. International Journal of Medicinal Mushrooms, 19(7), 653–665. https://doi.org/10.1615/intjmedmushrooms.2017021145

Huey, C. J., Gopinath, S. C. B., Uda, M. N. A., Zulhaimi, H. I., Jaafar, M. N., Kasim, F. H., and Yaakub, A. R. W. (2020). Mycorrhiza: a natural resource assists plant growth under varied soil conditions. 3 Biotech, 10(5), 204. https://doi.org/10.1007/s13205-020-02188-3

Hussain, S., Sher, H., Ullah, Z., Elshikh, M. S., Al Farraj, D. A., Ali, A., and Abbasi, A. M. (2023). Traditional Uses of Wild Edible Mushrooms among the Local Communities of Swat, Pakistan. Foods (Basel, Switzerland), 12(8), 1705. https://doi.org/10.3390/foods12081705

Hyde, K. (2013). Incorporating molecular data in fungal systematics: a guide for aspiring researchers. Current Research in Environmental andamp; Applied Mycology, 3(1), 1–32. https://doi.org/10.5943/cream/3/1/1

Hyde, K. D. (2022). The numbers of fungi. Fungal Diversity 114, 1.

Islam, M. R., Tudryn, G., and Bucinell, R. (2017). Morphology and mechanics of fungal mycelium. *Sci Rep* **7**, 13070 https://doi.org/10.1038/s41598-017-13295-2

Jo, W. S., Hossain, M. A., and Park, S. C. (2014). Toxicological profiles of poisonous, edible, and medicinal mushrooms. Mycobiology, 42(3), 215–220. https://doi.org/10.5941/MYCO.2014.42.3.215

Johnson, R., Kim, S., and Patel, L. (2020). *Mineral composition of edible mushrooms*. Mycology Research Journal, 18(2), 85–92.

Kakoti, M., Hazarika, D. J., Parveen, A., Dullah, S., Ghosh, A., and Saha, D. (2021). Nutritional properties, antioxidant and antihaemolytic activities of the dry fruiting bodies of wild edible mushrooms consumed by ethnic communities of Northeast India. *Polish Journal of Food and Nutrition Sciences*, *71*(4), 463–480. https://doi.org/10.31883/pjfns/144044

Kakron, A. J., Chouduhry, M. B. K. and Saha, S., (2012). Mushroom is an ideal food supplement. Journal of Dhaka National Medical College and Hospital., 18(1): 58-62.

Kalač, P. (2009). Chemical composition and nutritional value of European species of wild growing mushrooms: A review. *Food Chemistry*, 113(1), 9–16.

Kalač, P. (2010). Trace element contents in European species of wild growing edible mushrooms: A review for the period 2000–2009. *Food Chemistry*, 122(1), 2–15.

Kalac, P. (2013). A review of chemical composition and nutritional value of wild-growing and cultivated mushrooms. *Journal of the Science of Food and Agriculture*, *93*(2), 209–218. https://doi.org/10.1002/jsfa.5960

Kalac, P. (2019). Mineral composition and radioactivity of edible mushrooms. *Journal of the Science of Food and Agriculture, 99*(3), 1035-1045.

Kansci, G., Mossebo, D. C., Selatsa, A. B., and Fotso, M. (2003). Nutrient content of some mushroom species of the genus Termitomyces consumed in Cameroon. Food / Nahrung, 47(3), 213–216. Portico.

https://doi.org/10.1002/food.200390048

Karpov, S. A., Mamkaeva, M. A., Aleoshin, V. V., Nassonova, E., Lilje, O. and Gleason, F. H. (2014). Morphology, phylogeny, and ecology of the aphelids (Aphelidea, Opisthokonta) and proposal for the new superphylum Opisthosporidia. Frontiers in Microbiology 5, 112.

Khumlianlal, J., Huidrom, S., Sharma, K.C., Thachunglura V.L., and Indira, S. (2024). Proximate Analysis and Mineral Content of Wild Edible Mushrooms from Manipur, India. Int.J.Curr.Microbiol.App.Sci. 13(3): 269-275. https://doi.org/10.20546/ijcmas.2024.1303.026

Khumlianlal, J., Sharma, K. C., Singh, L. M., Mukherjee, P. K., and Indira, S. (2022). Nutritional Profiling and Antioxidant Property of Three Wild Edible Mushrooms from North East India. Molecules (Basel, Switzerland), 27(17), 5423. https://doi.org/10.3390/molecules27175423

Korman, R. (2020). Growing Mushrooms: The Complete Grower's Guide to Becoming a Mushroom Expert and Starting Cultivation at Home; Amazon Digital Services LLC: Seattle, WA, USA.

Kozel, T. R., and Wickes, B. (2014). Fungal diagnostics. Cold Spring Harbor perspectives in medicine, 4(4), a019299. https://doi.org/10.1101/cshperspect.a019299

Krittanawong, C., Isath, A., Hahn, J., Wang, Z., Fogg, S. E., Bandyopadhyay, D., Jneid, H., Virani, S. S., and Tang, W. H. W. (2021). Mushroom Consumption and Cardiovascular Health: A Systematic Review. The American journal of medicine, 134(5), 637–642.e2. https://doi.org/10.1016/j.amjmed.2020.10.035

Kumla, J., Suwannarach, N., Sujarit, K., Penkhrue, W., Kakumyan, P., Jatuwong, K., Vadthanarat, S., and Lumyong, S. (2020). Cultivation of Mushrooms and Their Lignocellulolytic Enzyme Production Through the Utilization of Agro-Industrial Waste. Molecules (Basel, Switzerland), 25(12), 2811.

Kurtzman, Jr. R. H. (1978). Coprinus fimentarius. In S. T. Chang, and W. A. Hayes (Eds.), The biology and cultivation of edible mushrooms (pp. 393- 408). Academic Pres

Lallawmsanga, Passari, A. K., Mishra, V. K., Leo, V. V., Singh, B. P., Meyyappan, G. V., Gupta, V. K., Uthandi, S., and Upadhyay, R. C. (2016). Antimicrobial potential, identification, and phylogenetic affiliation of wild mushrooms from two sub-tropical semi-evergreen Indian forest ecosystems. *PLOS ONE*. https://doi.org/10.1371/journal.pone.0166368

Lalrinawmi, H., Vabeikhokhei, J. M. C., Zothanzama, J., and Zohmangaiha. (2017). Edible mushrooms of Mizoram. Science Vision, 17(4), 172–181. https://doi.org/10.33493/scivis.17.04.01

Latiff, L. A., Daran, A. B. M., and Mohamed, A. B. (1996). Relative distribution of minerals in the pileus and stalk of some selected edible mushrooms. Food Chemistry, 56(2), 115

Lesa, K. N., Khandaker, M. U., Mohammad Rashed Iqbal, F., Sharma, R., Islam, F., Mitra, S., and Emran, T. B. (2022). Nutritional Value, Medicinal Importance, and Health-Promoting Effects of Dietary Mushroom (Pleurotus ostreatus). Journal of Food Quality, 2022, 1–9. https://doi.org/10.1155/2022/2454180

Li, L., and Yang, X. (2018). The Essential Element Manganese, Oxidative Stress, and Metabolic Diseases: Links and Interactions. Oxidative medicine and cellular longevity, 2018, 7580707. https://doi.org/10.1155/2018/7580707

Li, W., Pires, S. M., Liu, Z., Liang, J., Wang, Y., Chen, W., Liu, C., Liu, J., Han, H., Fu, P., and Guo, Y. (2021). Mushroom Poisoning Outbreaks - China, 2010-2020. China CDC weekly, 3(24), 518–522. https://doi.org/10.46234/ccdcw2021.134

Li, X., and Yang, Y. (2018). Manganese homeostasis and its role in neurodegenerative diseases. *Metallomics, 10*(5), 648-661.

Liu, D., Wang, Y., Zhang, P., Yu, F., and Perez-Moreno, J. (2021). Macrofungi Cultivation in Shady Forest Areas Significantly Increases Microbiome Diversity, Abundance and Functional Capacity in Soil Furrows. Journal of Fungi, 7(9), 775. https://doi.org/10.3390/jof7090775

Llanaj, X., Törős, G., Hajdú, P., Abdalla, N., El-Ramady, H., Kiss, A., Solberg, S. Ø., and Prokisch, J. (2023). Biotechnological Applications of Mushrooms under the Water-Energy-Food Nexus: Crucial Aspects and Prospects from Farm to Pharmacy. Foods (Basel, Switzerland), 12(14), 2671. https://doi.org/10.3390/foods12142671

Lücking, R., Aime, M. C., Robbertse, B., Miller, A. N., Ariyawansa, H. A., Aoki, T., Cardinali, G., Crous, P. W., Druzhinina, I. S., Geiser, D. M., Hawksworth, D. L., Hyde, K. D., Irinyi, L., Jeewon, R., Johnston, P. R., Kirk, P. M., Malosso, E., May, T. W., Meyer, W., … and Schoch, C. L. (2020). Unambiguous identification of fungi: where do we stand and how accurate and precise is fungal DNA barcoding? IMA Fungus, 11(1). https://doi.org/10.1186/s43008-020-00033-z

Lull C. Wichers H.J., and Savelkoul H.F.J. (2005). Antiinflamatory and immunomodulating properties of fungal metabolites. Mediat Inflamm; 2005 (2): 63-80.

Lutzoni, F., Nowak, M. D., Alfaro, M. E., Reeb, V., Miadlikowska, J., Krug, M., Arnold, A. E., Lewis, L. A., Swofford, D. L., Hibbett, D., Hilu, K., James, T. Y., Quandt, D., and Magallón, S. (2018). Contemporaneous radiations of fungi and plants linked to symbiosis. Nature Communications, 9(1). https://doi.org/10.1038/s41467-018-07849-9

Manjunathan, J., and Kaviyarasan, V. (2011). Nutrient composition in wild and cultivated edible mushroom, *Lentinus tuberregium* (Fr.) Tamil Nadu, India. *International Food Research Journal, 18*(3), 809–811.

Manoharachary, C., Sridhar, K., Singh, R., Adholeya, A.,Suryanarayanan,T. S., Rawat, S. and Johri, B. N. (2005). Fungal biodiversity: distribution, conser vation andprospecting of fungi from India. Curr. Sci. 89(1): 58-71

Manzi, P., Aguzzi, A., and Pizzoferrato, L. (2001). Nutritional value of mushrooms widely consumed in Italy. Food Chemistry, 73, 321–325.

Manzi, P., Marconi, S., Aguzzi, A., and Pizzoferrato, L. (2001). Commercial mushrooms: nutritional quality and effect of cooking. *Food Chemistry*, 73(3), 321–325.

Manzi, P., Marconi, S., Aguzzi, A., and Pizzoferrato, L. (2004). Commercial mushrooms: Nutritional quality and effect of cooking. *Food Chemistry*, 84(2), 201–206.

Manzoni, M., and Rossi, M. (2002). Termitomyces mushrooms: Nutritional and bioactive compounds. *Food Reviews International*, 18(4), 279–302.

Martins, A., Silva, L., and Ribeiro, B. (2021). *Nutritional evaluation of wild edible mushrooms*. Journal of Medicinal Mushrooms, 23(4), 345–354.

Mattila, P., Suonpää, K., and Piironen, V. (2001). Functional properties of edible mushrooms. *Nutrition*, 17(7–8), 694–696.

Mazzola, A., Kuhar, Francisco, and Greslebin, A. (2024). Progression Over Time of Nutritional Content and Antioxidant Activity of Grains Fermented with Medicinal Mushrooms Pleurotus ostreatus and Ganoderma sessile (Agaricomycetes). International Journal of Medicinal Mushrooms. https://doi.org/10.1615/intjmedmushrooms.2024054939

Mendil, D., Uluozlu, O. D., Hasdemir, E., and Cag˘lar, A. (2004). Determination of trace elements on some wild edible mushroom samples from Kastamonou, Turkey. Food Chemistry, 88: 281–285.

Mohamadhasani, F., and Rahimi, M. (2022). Growth response and mycoremediation of heavy metals by fungus Pleurotus sp.. Sci Rep 12, 19947. https://doi.org/10.1038/s41598-022-24349-5

Moore-Landecker, E. (2002). Fungal Spores. Encyclopedia of Life Sciences. Portico. https://doi.org/10.1038/npg.els.0000378

Mortimer, P. E., Xu, J., Karunarathna, S. C., and Hyde, K. D. (eds) (2014). Mushrooms for trees and people: a field guide to useful mushrooms of the Mekong region. The World Agroforestry Centre, East Asia, Kunming, China. 125 pp.

Mridu, and Atri, N. S. (2017). Nutritional and nutraceutical characterization of three wild edible mushrooms from Haryana, India. *Mycosphere, 8*(8), 1035–1043. https://doi.org/10.5943/mycosphere/8/8/4

Mshandete, A. M., Cuff, J., Kivaisi, A. K., Rämäkaïnen, R., and Harkki, A. M. (2008). Nutritional and microbial quality assessment of three Tanzanian wild edible mushrooms. *African Journal of Food Science*, 2(2), 14–20.

Mueller, G. M., Schmit, J. P., Leacock, P. R., Buyck, B., Cifuentes, J., Desjardin, D. E., Halling, R. E., Hjortstam, K., Iturriaga, T., Larsson, K.-H., Lodge, D. J., May, T. W., Minter, D., Rajchenberg, M., Redhead, S. A., Ryvarden, L., Trappe, J. M., Watling, R., and Wu, Q. (2006). Global diversity and distribution of macrofungi. Biodiversity and Conservation, 16(1), 37–48. https://doi.org/10.1007/s10531-006-9108-8

Mueller, G.M., and Bills, G.F. (2004) Introduction, pp.1-4. In: Mueller, G. M., G.F. Bills and M.S. Foster (eds.). Biodiversity of fungi: inventory and monitoring method‖ Elsevier Academic Press, San Diego, 777pp

Mujtaba, M., Fernandes Fraceto, L., Fazeli, M., Mukherjee, S., Savassa, S. M., Araujo de Medeiros, G., do Espírito Santo Pereira, A., Mancini, S. D., Lipponen, J., and Vilaplana, F. (2023). Lignocellulosic biomass from agricultural waste to the circular economy: a review with focus on biofuels, biocomposites and bioplastics. Journal of Cleaner Production, 402, 136815. https://doi.org/10.1016/j.jclepro.2023.136815

Murugkar, A. and Subbulakshmi, G. (2005). Nutritional value of edible wild mushrooms collected from the Khasi Hills of Meghalaya. Food Chemistry. 89. 599-603.

Myers, N., Russell, A.M., Cristina, G.M., Gustavo-Fonseca, A.B. and Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature

Nakalembe, I., Kabasa, J. D., and Olila, D. (2015). Comparative nutrient composition of selected wild edible mushrooms from two agro-ecological zones, Uganda. SpringerPlus, 4(1). https://doi.org/10.1186/s40064-015-1188-z

Nanba, H., (1993), Maitake mushroom the king mushroom. Mushroom News., 41: 22-25.

Naranjo-Ortiz, M. A., and Gabaldón, T. (2019). Fungal evolution: diversity, taxonomy and phylogeny of the Fungi. Biological Reviews, 94(6), 2101–2137. Portico. https://doi.org/10.1111/brv.12550

Nguyen, T., Ali, S., and Costa, R. (2022). *Micronutrient content of edible fungi species*. Nutrition and Fungal Science, 11(3), 201–210.

Nhi, N. T. N., Khang, D. T., and Dung, T. N. (2022). Termitomyces mushroom extracts and its biological activities. Food Science and Technology, 42. https://doi.org/10.1590/fst.125921

Niego, A. G. T., Lambert, C., Mortimer, P., Thongklang, N., Rapior, S., Grosse, M., Schrey, H., Charria-Girón, E., Walker, A., Hyde, K. D., and Stadler, M.

(2023). The contribution of fungi to the global economy. Fungal Diversity, 121(1), 95–137. https://doi.org/10.1007/s13225-023-00520-9

Nieuwenhuis, B. P., and James, T. Y. (2016). The frequency of sex in fungi. Philosophical transactions of the Royal Society of London. Series B, Biological sciences, 371(1706), 20150540. https://doi.org/10.1098/rstb.2015.0540

Oboh, G., Adebayo, A., and Olayemi, F. (2021). *Mineral and nutrient analysis of edible wild mushrooms*. African Journal of Food Science, 15(2), 45–52.

Oso, B. A. (1977). Mushrooms and the Yoruba people of Nigeria. *Mycologia*, 69(2), 271–279.

Ouzouni, P. K. (2004). Edible mushrooms: Life food. Import, 27: 66–67.

Ouzouni, P. K., Petridis, D., Koller, W. D., and Riganakos, K. A. (2009). Nutritional value and metal content of wild edible mushrooms collected from West Macedonia and Epirus, Greece. *Food Chemistry*, *115*(4), 1575-1580.

Ouzouni, P. K., Veltsistas, P. G., Paleologos, E. K., and Riganakos, K. A. (2007). Determination of metal content in wild edible mushroom species from regions of Greece. Journal of Food Composition and Analysis, 20(6): 480–486.

Ouzouni, P., and Riganakos, K. A. (2007). Nutritional value and metal content profile of Greek wild edible fungi. Acta Alimentaria: 99–110.

Oyetayo, O. V. (2009). Nutritional and phytochemical profiles of some tropical edible mushrooms. *International Journal of Pharmacology*, 5(3), 191-195.

Paloi, S., Kumla, J., Paloi, B. P., Srinuanpan, S., Hoijang, S., Karunarathna, S. C., Acharya, K., Suwannarach, N., and Lumyong, S. (2023). Termite Mushrooms (Termitomyces), a Potential Source of Nutrients and Bioactive Compounds Exhibiting Human Health Benefits: A Review. Journal of fungi (Basel, Switzerland), 9(1), 112. https://doi.org/10.3390/jof9010112

Pandey, N., Ghosh, P., kalakkattuparambil, M., Bisht, S. S., Basavan, D., and Dhanabal, S. (2023). Nutrient Composition and Utilization of Selected Wild Edible Fruits of Kumaun Himalayan Region as Antioxidant and Antibacterial Agents. https://doi.org/10.2139/ssrn.4408275

Paraskevi, KO. Petridis, D. Koller, W. and Riganakos, K. (2009). Nutritional value and metal content of wild edible mushrooms collected from West Macedonia and Epirus, Greece, Food Chemistry, 115: 1575–1580.

Patil, S.S., Ahmed, S.A., Telang, M.S. and Baig, M.M.V. (2010). The nutritional value of Pleurotus ostreatus (Jacq. Fr.) Kumm cultivated on different lignocellulosic agrowastes. Innovat. Rom. Food Biotechnol. 7: 66–76.

Peter Jordan (2000). The Mushroom Guide and Identifier, Anness Publishing Ltd. Hermes House, London: 10-121

Phukhamsakda, C., Nilsson, R. H., Bhunjun, C. S., de Farias, A. R. G., Sun, Y.-R., Wijesinghe, S. N., Raza, M., Bao, D.-F., Lu, L., Tibpromma, S., Dong, W., Tennakoon, D. S., Tian, X.-G., Xiong, Y.-R., Karunarathna, S. C., Cai, L., Luo, Z.-L., Wang, Y., Manawasinghe, I. S., … Hyde, K. D. (2022). The numbers of fungi: contributions from traditional taxonomic studies and challenges of metabarcoding. Fungal Diversity, 114(1), 327–386. https://doi.org/10.1007/s13225-022-00502-3

Policelli, N., Horton, T. R., Hudon, A. T., Patterson, T. R., and Bhatnagar, J. M. (2020). Back to Roots: The Role of Ectomycorrhizal Fungi in Boreal and Temperate Forest Restoration. Frontiers in Forests and Global Change, 3. https://doi.org/10.3389/ffgc.2020.00097

Potapov, A. M., Beaulieu, F., Birkhofer, K., Bluhm, S. L., Degtyarev, M. I., Devetter, M., Goncharov, A. A., Gongalsky, K. B., Klarner, B., Korobushkin, D. I., Liebke, D. F., Maraun, M., Mc Donnell, R. J., Pollierer, M. M., Schaefer, I., Shrubovych, J., Semenyuk, I. I., Sendra, A., Tuma, J., … Scheu, S. (2022). Feeding habits and multifunctional classification of soil-associated consumers from protists to vertebrates. Biological Reviews, 97(3), 1057–1117. Portico. https://doi.org/10.1111/brv.12832

Racz, L. Papp, L. Prokai, B. and Kovacz, Zs. (1996). Trace element determination in cultivated mushrooms: an investigation of manganese, nickel, and cadmium intake in cultivated mushrooms using ICP atomic emission. Microchemical Journal, 54: 444–451.

Ramírez-Terrazo, A., Adriana Montoya, E., Garibay-Orijel, R., Caballero-Nieto, J., Kong-Luz, A., and Méndez-Espinoza, C. (2021). Breaking the paradigms of residual categories and neglectable importance of non-used resources: the "vital" traditional knowledge of non-edible mushrooms and their substantive cultural significance. Journal of ethnobiology and ethnomedicine, 17(1), 28. https://doi.org/10.1186/s13002-021-00450-3

Ravikrishnan, V., and Sridhar, K. R. (2023). Biological Activity of Six Wild Edible Mushrooms of the Western Ghats, India. Wild Mushrooms and Health, 1–10. https://doi.org/10.1201/b23190-1

Redecker, D., Kodner, R. Graham, L.E. (2000). Glomalean fungi from the Ordovician.Science 289:1920-1921

Reeleder, R. D. (2003). Fungal plant pathogens and soil biodiversity. Canadian Journal of Soil Science, 83(Special Issue), 331–336. https://doi.org/10.4141/s01-068

Ribeiro, B., Andrade, P. B., Silva, B. M., Baptista, P., Seabra, R. M., and Valentão, P. (2017). Comparative study of mineral composition of wild and cultivated mushrooms. *Food Chemistry, 103*(2), 413-419.

Richards, W. and Murray, D. (2003). (2003). Macrofungi of La Butte Creek, Fidler-Greywillow and Colin-Cornwall Wildland Provincial Parks.

Roncero-Ramos I, Mendiola-Lanao M, Pérez-Clavijo M, and Delgado-Andrade C. Effect of different cooking methods on nutritional value and antioxidant activity of cultivated mushrooms. International Journal of Food Science and Nutrition. 2017;68(3):287-297. Available from: https//doi.org/10.1080/09637486.2016.1244662

Roy N, Jha D.K. and Dutta A.K. 2022. A checklist of the macrofungi of North East India. *Studies in Fungi* 7:1 doi: 10.48130/SIF-2022-0001

Rugolo, M., Mascoloti Spréa, R., Dias, M. I., Pires, T. C. S. P., Añibarro-Ortega, M., Barroetaveña, C., Caleja, C., and Barros, L. (2022). Nutritional Composition and Bioactive Properties of Wild Edible Mushrooms from Native *Nothofagus* Patagonian Forests. *Foods*, *11*(21), 3516. https://doi.org/10.3390/foods11213516

Sarzynska, J., Zajac, J., and Kalac, P. (1997). Composition and nutritive value of mushrooms. *Acta Alimentaria Polonica*, 23(3), 261–273.

Senanayake, I. (2020). Morphological approaches in studying fungi: collection, examination, isolation, sporulation and preservation. Mycosphere, 11(1), 2678–2754. https://doi.org/10.5943/mycosphere/11/1/20

Senila, M., Senila, L., and Resz, M.-A. (2024). Chemical composition and nutritional characteristics of popular wild edible mushroom species collected from North-Western Romania. Journal of Food Composition and Analysis, 134, 106504. https://doi.org/10.1016/j.jfca.2024.106504

Shameem N. (2016). Phytochemical Analysis and Nutraceutical Value of Some Wild Mushrooms growing in Kashmir Valley. PhD Thesis, University of Kashmir, Srinagar.

Shrestha, S., Thapa, S., and Jha, S. K. (2023). Nutrient analysis of selected wild edible mushrooms collected from Thulo Ban Community Forest, Myagdi District, Nepal. *Journal of Plant Resources, 21*(1), 13–20. https://doi.org/10.3126/bdpr.v21i1.57197

Singdevsachan, S. K., Patra, J. K., and Thatoi, H. (2013). Nutritional and bioactive potential of two wild edible mushrooms (*Lentinus sajor-caju* and *Lentinus torulosus*) from Similipal Biosphere Reserve, India. *Food Science and Biotechnology, 22*(1), 137–145. https://doi.org/10.1007/s10068-013-0019-7

Singh, C., and Vyas, D. (2022). Biodegradation by Fungi for Humans and Plants Nutrition. Biodegradation Technology of Organic and Inorganic Pollutants. https://doi.org/10.5772/intechopen.99002

Ślusarczyk, J., Adamska, E., and Czerwik-Marcinkowska, J. (2021). Fungi and Algae as Sources of Medicinal and Other Biologically Active Compounds: A Review. Nutrients, 13(9), 3178. https://doi.org/10.3390/nu13093178

Smith, J., Brown, A., and Lee, H. (2021). *Nutritional composition of wild edible mushrooms*. Journal of Food Composition, 45(3), 112-119.

Srikram, A., and Supapvanich, S. (2016). Proximate compositions and bioactive compounds of edible wild and cultivated mushrooms from Northeast Thailand. *Agriculture and Natural Resources, 50*(6), 432–436.

https://doi.org/10.1016/j.anres.2016.08.001

Stamets, P., and Zwickey, H. (2014). Medicinal Mushrooms: Ancient Remedies Meet Modern Science. Integrative medicine (Encinitas, Calif.), 13(1), 46–47.

Tang, C., Hoo, P. C., Tan, L. T. H., Pusparajah, P., Khan, T. M., Lee, L. H., ... and Chan, K. G. (2023). Nutritional and medicinal values of wild edible mushrooms: A review. *Frontiers in Nutrition, 10*, 1125412.

Tang, X., Mi, F., Zhang, Y., He, X., Cao, Y., Wang, P., Liu, C., Yang, D., Dong, J., Zhang, K., and Xu, J. (2015). Diversity, population genetics, and evolution of macrofungi associated with animals. Mycology, 6(2), 94–109. https://doi.org/10.1080/21501203.2015.1043968

Tang, Z. X., Shi, L. E., Jiang, Z. B., Bai, X. L., and Ying, R. F. (2023). Calcium Enrichment in Edible Mushrooms: A Review. Journal of fungi (Basel, Switzerland), 9(3), 338. https://doi.org/10.3390/jof9030338

Tedersoo, L., Sánchez-Ramírez, S., Kõljalg, U., Bahram, M., Döring, M., Schigel, D., May, T., Ryberg, M. and Abarenkov, K. (2018). High-level classification of the Fungi and a tool for evolutionary ecological analyses. Fungal Diversity 1, 135–159.

Thachunglura, V. L., Chawngthu, Z., Rai, P. K., and Zothanzama, J. (2024). Evaluation of nutritional value, heavy metals content, and health risk assessment of wild edible mushrooms in Mamit District, Mizoram, North East India. *International Journal of Plant and Environment, 10*(3), 79–85. https://doi.org/10.18811/ijpen.v10i03.08

Thachunglura, V. L., Chawngthu, Z., Zothanzama, J., Lallawmkima, Lalbiakmawia, B., Khumlianlal,J. and Rai, P. K. (2023). Russulaceae of Ailawng forest with an emphasis on *Russula purpureoverrucosa* (Russulaceae): A first report for India. Science Vision, 23 (3), 41-47, https://doi.org/10.33493/scivis.23.03.01

Thachunglura, V. L., Rai, P. K., Zothanzama, J., Bochung, L., and Chawngthu, Z. (2024). First report of *Caloboletus guanyui* (Boletaceae) in India: Taxonomic and phylogenetic insights from Mizoram. *Plant Science Today, 11*(4), 1704–1711. https://doi.org/10.14719/pst.5046

Thachunglura, V., Rai, P. K., Chawngthu, Z., Renthlei, L., Vanlalmalsawmi, R., Bochung, L., Khumlianlal, J., and Zothanzama, J. (2023). Nutritional composition and mineral contents of common edible wild mushrooms from Mamit and Champhai Districts of Mizoram, India. *Food Agricultural Sciences and Technology, 10*(1), 42–58. Retrieved from https://ph02.tci-thaijo.org/index.php/stej/article/view/250922

Thachunglura, V.L., Kumar, P. K., Chawngthu, Z., Renthlei, L., Vanlalmalsawmi, R. , Bochung, L., Khumlianlal, J. and Zothanzama, J. (2024).Nutritional composition and mineral contents of common edible wildmushrooms from Mamit and Champhai Districts of Mizoram, India.Food Agricultural Sciences and Technology, 10(1), 42-58

Thachunglura, V.L., Rai, P.K., Zohmangaiha., Lalbiakmawia, B., Lalmuansangi, L., and Zothanzama, J. (2023b). Pleurotus giganteus as a Valuable Source of Nutrients. Indian Journal Of Science And Technology, 16(sp1), 89–94. https://doi.org/10.17485/ijst/v16sp1.msc12

Upadhyay, S. K., Singh, G., Rani, N., Rajput, V. D., Seth, C. S., Dwivedi, P., Minkina, T., Wong, M. H., Show, P. L., and Khoo, K. S. (2024). Transforming bio-waste into value-added products mediated microbes for enhancing soil health and crop production: Perspective views on circular economy. Environmental Technology andamp; Innovation, 34, 103573. https://doi.org/10.1016/j.eti.2024.103573

USDA. (2023). Food Data Central. United States Department of Agriculture. Retrieved from https://fdc.nal.usda.gov/

Usman, M., Murtaza, G., and Ditta, A. (2021). Nutritional, Medicinal, and Cosmetic Value of Bioactive Compounds in Button Mushroom (Agaricus bisporus): A Review. Applied Sciences, 11(13), 5943. https://doi.org/10.3390/app11135943

Vabeikhokhei, J. M. C., Zohmangaiha., Zothanzama, J., and Lalrinawmi, H. (2019). Diversity Study of Wood Rotting Fungi from Two different Forests in Mizoram, India. International Journal of Current Microbiology and Applied Sciences, 8(04), 2775–2785. https://doi.org/10.20546/ijcmas.2019.804.323

Valverde, M. E., Hernández-Pérez, T., and Paredes-López, O. (2015). Edible mushrooms: improving human health and promoting quality life. International journal of microbiology, 2015, 376387.

https://doi.org/10.1155/2015/376387

Valverde, M. E., Hernández-Pérez, T., and Paredes-López, O. (2015). Edible mushrooms: improving human health and promoting quality life. *International Journal of Microbiology*, 2015, Article ID 376387.

Verma, R. N., Singh, G. B. and Bilgrami, K. S., (1987), Fleshy fungal flora of N. E. H. India- I. Manipur and Meghalaya. Indian Mushroom Sci., 2: 414- 421.

Walker, G. M., and White, N. A. (2005). Introduction to Fungal Physiology. Fungi, 1–34. Portico. https://doi.org/10.1002/0470015330.ch1

Walton, J. (2018). The Cyclic Peptide Toxins of Amanita and Other Poisonous Mushrooms, Springer International Publishing AG: 1-57

Wennig, R., Eyer, F., Schaper, A., Zilker, T., and Andresen-Streichert, H. (2020). Mushroom Poisoning. Deutsches Arzteblatt international, 117(42), 701–708. https://doi.org/10.3238/arztebl.2020.0701

Wongaem, A., Reamtong, O., Srimongkol, P., Sangtanoo, P., Saisavoey, T., and Karnchanatat, A. (2021). Antioxidant properties of peptides obtained from the split gill mushroom (*Schizophyllum commune*). *Journal of Food Science and Technology*, 58(2), 680–691.

Worrall, J.J. (1999). Brief Introduction to Fungi. In: Worrall, J.J. (eds) Structure and Dynamics of Fungal Populations. Population and Community Biology Series, vol 25. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-4423-0_1

Yamada, A. (2022). Cultivation studies of edible ectomycorrhizal mushrooms: successful establishment of ectomycorrhizal associations in vitro and efficient production of fruiting bodies. Mycoscience, 63(6), 235–246. https://doi.org/10.47371/mycosci.2022.08.004

Yang, G., Ahmad, F., Zhou, Q., Guo, M., Liang, S., Gaal, H. A., and Mo, J. (2021). Investigation of Physicochemical Indices and Microbial Communities in Termite Fungus-Combs. Frontiers in microbiology, 11, 581219. https://doi.org/10.3389/fmicb.2020.581219

Yuvaraj, M., and Ramasamy, M. (2020). Role of Fungi in Agriculture. Biostimulants in Plant Science. https://doi.org/10.5772/intechopen.89718

Zhong, J. J., and Xiao, J. H. (2009). Secondary metabolites from higher fungi: discovery, bioactivity, and bioproduction. Advances in biochemical engineering/biotechnology, 113, 79–150. https://doi.org/10.1007/10_2008_26

Zohmangaiha C, Thachunglura V.L, Lalnuntluanga, and Zothanzama J. (2023). Morphological characterization and nutritional quality of Lentinula edodes. J. Agric. Food Environ. 4(3): 9-12.

Zohmangaiha., Vabeikhokhei, J.M.C., Zothanzama, J., and Lalrinawmi, H. (2019). Ganoderma Species of Mizoram, India. International Journal of Current Microbiology and Applied Sciences, 8(04), 2871–2879. https://doi.org/10.20546/ijcmas.2019.804.335

Zothanzama J., Blanchette, A. R., and Lalrinawmi H. (2018). Identification of the Edible and Poisonous Mushrooms of Mizoram. Project Report – New Land Use Policy. Memo No. B.15012/1/2016. Govt of Mizoram. pp. 1-24

Zothanzama, J. (2011). Wood Rotting Fungi of Mizoram. In H. Lalramnghinglova and F. Lalnunmawia (eds). Forest Resources of Mizoram: Conservation and Management. Department of Environmental Science, Mizoram University and Regional Centre, National Afforestation and Eco-development Board; North Eastern Hill University. 345: 326-345.

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2.	HSSLC	2009	CISCE	67
3.	B.Sc. Microbiology	2012	University of Pune	55.33
4.	M.Sc. EVS	2018	Mizoram University	77
5.	LLB	2019	Mizoram University	49.46
6.	UGC NET (EVS)	2019	NTA	NA

Publications in peer reviewed journal / book chapter:

1. **Renthlei, L.,** Mishra, B. P. and Zothanzama, J. (2023). Biodiversity of Wild Mushrooms in Aizawl, Mizoram, India. International Journal of Current Microbiology and Applied Sciences, 12(12), 16–26. https://doi.org/10.20546/ijcmas.2023.1212.003
2. **Renthlei, L.,** Zothanzama, J., Mishra, B.P., Chawngthu, Z., Thachunglura, V.L, Khumlianlal, J., Madhurima, M. (2024). Nutrient Analysis of Selected Wild Edible Mushrooms Collected from Aizawl Mizoram, India. Biotech Res Asia 2024; 21(3).
3. **Renthlei, L.,** Lalhlenmawia, H., Mishra, B.P. and Zothanzama, J. (2024). Proximate composition and micro-nutritional value of three *Russula* species from Mizoram, India. Science Vision 24 (2), 24-30. https://doi.org/10.33493/scivis.24.02.01
4. **Renthlei, L.,** Madhurima, Thachunglura, V.L., Lalbiakmawia, B., Mishra, B.P. and Zothanzama, J. (2023). Identification of Wild Mushroom in Sub-tropical forest of Aizawl district, Mizoram. In *Land use and Bioresource Management for Sustainable Livelihood.* O.P. Tripathi, S.T. Lalzarzovi, Lalnuntluanga and BP Mishra, *Today and Tomorrow's Printers and Publishers* - New Delhi, pp. 111-117.
5. Thachunglura, V.L., Rai, P.K., Chawngthu, Z., **Renthlei, L.,** Vanlalmalsawmi, R., Bochung, L., Khumlianlal, J. and Zothanzama, J. (2024). Nutritional composition and mineral contents of common edible wild mushrooms from Mamit and Champhai Districts of Mizoram, India. *Food Agricultural Sciences and Technology*, 10(1), 42-58.
6. Thachunglura, V.L., Lalbiakmawia, B., Zohmangaiha, **Renthlei, L.,** Rai, P.K. and Zothanzama, J. (2023). The edible fan-shaped jelly fungus *Dacryopinax spathularia*. In *Land use and Bioresource Management for Sustainable Livelihood.* O.P. Tripathi, S.T. Lalzarzovi, Lalnuntluanga and BP Mishra, *Today and Tomorrow's Printers and Publishers* - New Delhi, pp. 201-206.
7. Chawngthu, Z., Tluanga, L., Zothanzama, J., Thachunglura, V.L.,

Lalbiakmawia, B. and **Renthlei, L.** (2023). Wood rotting polyporales from the biodiversity reserves within the Indian subtropical habitat. *Indian Journal of Microbiology Research*, 10(3), 140–148. https://doi.org/10.18231/j.ijmr.2023.025

Lists of Conference/ Symposium/ Seminar attended:

1. Presented a paper in the 'Two Days National Seminar on Land Use and Bioresource Management for Sustainable Livelhood', Jointly organized by Department of Environmental Science, Mizoram University, Mizoram Science, Technology and Innovation Council (MISTIC) and National Bank for Agriculture and Rural Development (NABARD) on 27th -28th March, 2023 held at SESandNRM, Mizoram University

2. Presented a paper in the International Conference on "Climate Change and Natural Resources Management for Sustainable Development" (ICNS-2024) hosted by the School of Earth Sciences and Natural Resources Management, Mizoram University, from 13th -15th March, 2024.

3. Presented a paper in the International Seminar on "Biodiversity Exploration And Documentation, Environment And Health" (ISBEDEH -2 024) organized by Department Of Biotechnology and Natural History Museum and Research Centre - In Collaboration with Imperial College, London and Natural History Museum, London from 13th – 14th November, 2024.

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Biodiversity of Wild Mushrooms in Aizawl, Mizoram, India

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Keywords

Diversity, Basidiomycetes, Ectomycorrhizal, edible ,poisonous

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ABSTRACT

In this study, a total of 27 distinct species were collected from various locations within the Aizawl district of Mizoram, India. These species were then identified based on their morphological characteristics and indicating the presence of 21 genera, 16 families, and 7 orders within the phylum Basidiomycota. Among the identified species, 19 species were recorded as edible and 6 species were recorded to be inedible/poisonous and 2 species with unknown edibility status. *Microporus xanthopus* appeared as the predominant species. Certain species such as *Amanita flavoconia*, *Amanita jacksonii*, *Amanita vaginata*, *M. xanthopus*, *Russula cyanoxantha*, and *Schizophyllum commune* were found consistently across all sampling site. However, species such as *Phallus indusiatus*, *Podoscypha petalodes*, *R. emetica*, and *Termitomyces heimii* were found within a single study sites.

Introduction

The biological world is enriched by the natural beauty and diversity of fungi, with India being a significant contributor to the field (Manoharachary *et al.,* 2005). Fungi are an extensive species of creatures that play important roles in ecosystems as decomposers, mycorrhizal partners thatregulate nutrient and carbon cycles, food and medicinal sources, and contribute greatly to both ecological balance and human well-being (Blackwell, 2011; van der Heijden *et al.,* 2015) and new species are described at the rate of approximately 1200 per year (Kirk *et al.,* 2008). The total number of fungal species considered to exist is estimated to be 1.5 million (Hawksworth, 2001). However, based on next-generation sequencing, estimates of fungal species numbers ranged between 3.5 and 5.1 million (Blackwell, 2011).

They improve resource efficiency, develop renewable alternatives to fossil-based products, repurpose waste into valuable food and feed, combat lifestyle diseases and antibiotic resistance by supporting gut health, increase crop resilience in the face of climate change, and make it easier to develop new biological drugs (Lange, 2014). Wild edible macrofungi are appreciated for their nutritional benefits, and they are a popular choice for consumption in many parts of the worlds

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Nutrient Analysis of Selected Wild Edible Mushrooms Collected from Aizawl Mizoram, India

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Present study aims to identify and evaluate nutritional properties and mineral content of three wild edible mushrooms (WEM): *Phallus indusiatus* Ventenat (1798), *Schizophyllum commune* Fries (1815) and *Termitomyces heimii* Natarajan (1979). The sample was collected during the monsoon season in 2021-2022 from Aizawl District, Mizoram, India. Following collection, the samples were thoroughly cleaned to remove any debris and properly labelled. The collected specimens were identified using standard methods based on macroscopic and microscopic characteristics. Three samples were selected and oven-dried at 45 - 50°C for three days in a Hot Air Oven (HOA) for further analysis. Analysis revealed that three species of wild edible mushrooms are rich in protein (15.93 – 30.36g/100g in dw) and carbohydrates (39.06 – 55.24g/100g in dw), have low fat content, and contain substantial amounts of essential minerals (2.16 – 4.56g/100g in dw). This study provides data on the nutritional properties and mineral composition of three wild edible mushrooms collected from Mizoram, India.

Keywords: Foods Supplements; Macrofungi; Minerals; Nutrients; Wild Edible Mushrooms

Fungi are incredibly diverse in their morphology, ecological niches, metabolic processes, and evolutionary relationships [1]. They play an important role in the emerging bio-economy, helping enhance resource efficiency, create renewable alternatives to fossil fuels, repurpose waste into valuable food and feed, combat lifestyle diseases and antibiotic resistance by bolstering gut health, fortify crops against climate change, and serve as hosts for the development of new biological properties and nutritional value, showing potential to be used as a dietary nutritional supplement [2]. A mushroom is a macrofungus with a distinctive fruiting body, which can be found either above ground (epigeous) or below ground (hypogeous) and large enough to be seen with the naked eye and to be picked by hand [3].

WEM are not only valued as culinary delicacies but are also appreciated for their rich nutritional content, having been consumed by various cultures around the world for centuries. [4-6]. They are a natural source of vitamins, minerals, and other beneficial compounds that contribute to overall health and well-being [7-9]. Additionally, they are an excellent source of carbohydrates and protein, while being remarkably low in fat and calories. [10-12]. With such a well-rounded nutritional

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RESEARCH ARTICLE

Proximate composition and micro-nutritional value of three Russula species from Mizoram, India

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The present study aims to evaluate the nutritional properties and mineral content of wild edible mushrooms. The samples were collected during the monsoon season of 2020-2021 from three different sites in Aizawl District, Mizoram, India. The samples were cleaned to remove any debris and properly labelled. The specimens were identified using standard methods based on macroscopic and microscopic characteristics. Three samples were selected and oven-dried at 45–60 °C for three days in a hot air oven for their proximate analysis. The analysis revealed that the three species of wild edible mushrooms are high in protein (14.42–23.30 g/100g dry weight) and carbohydrates (54.84–58.71 g/100g dry weight), have a low-fat content, and contain significant amounts of essential minerals (5.53–7.19 g/100g dry weight). This study presents data on the nutritional properties and mineral composition of three widely consumed wild edible mushrooms that are commonly collected and consumed by the local people of Mizoram, India.

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Keywords : Ectomycorrhizal, edible mushroom, food source, minerals, protein

Introduction

Edible mushrooms have been consumed by humans for centuries, used as food, medicine, and for ceremonial purposes.[1] They are a nutritious addition to diets, offering a rich content of protein, fiber, vitamins, and minerals, while being low in fat.[2-4] There has also been an increase in their consumption, both as part of regular diets and in the form of dietary supplements.[5] They contain antioxidants, such as ergothioneine and glutathione, which help combat oxidative stress and support overall health. Moreover, mushrooms have been found to contain bioactive compounds like beta-glucans and polysaccharides that can enhance the immune system and potentially have anti-cancer properties.[6-8]

Wild edible mushrooms have enormous promise for delivering long-term solutions in food supply and security. These mushrooms can help to alleviate food scarcity and play an important role in guaranteeing a steady food supply. They are especially important in rural communities, where they provide a variety of benefits that improve nutrition and economic stability.[3] Aside from their dietary benefits, wild edible mushrooms promote local livelihoods through foraging and selling, thus improving the general well-being and resilience of rural communities.

The genus *Russula* Pers., of the Russulaceae family, includes over 780 species with a worldwide distribution, making it the second largest genus within the Agaricomycetes class.[9] The rich and diverse ecosystems create an ideal environment for the growth of numerous fungal species, contributing to the unique ecological makeup of Mizoram[10-17] and several species of *Russula* have also been

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Chapter-10

Identification of Wild Mushroom in Sub-tropical forest of Aizawl district, Mizoram

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Abstract

Mushrooms belong to the kingdom fungi. Mushrooms have been neglected as a food group bymajority of population in India, but recently it is gradually gaining acceptance. The market for wild edible has increased tremendously. The climatic conditions of Mizoram namely high precipitation and relative humidity makes it ideal for growth of mushroom. The present study is aimed to identify morphological characteristics of mushrooms. The samples were collected in the campus of Mizoram University during rainy season (June-September) in the year 2022. The species collected were studied macroscopically and microscopically. The compound microscope mounted with a digital camera was used for microscopic study. The collected samples were identified to be an edible mushroom *Schizophyllum commune, Phallus indusiatus* and *Amanita vaginata*.This study is mainly done as itis very vital to know the true identity of the mushrooms which is part of the diet of the local community and any false identification can be fatal to the community when consumed.

Key words: Fungi, Edible Mushrooms, *Amanita vaginata*, Macroscopically, Microscopically *Schizophyllum commune*, and *Phallus indusiatus*

Introduction

Fungi are eukaryotes that lack in photosynthetic pigment, therefore unable to manufacture their own food. They absorb nutrients food from the

TWO DAYS NATIONAL SEMINAR

ON

LAND USE AND BIORESOURCE MANAGEMENT FOR SUSTAINABLE LIVELIHOOD

CERTIFICATE

This is to certify that

Ms/Mr/Dr/Prof Lalanpuia Renthlei

Presented on the topic Identification of wild mushroom in subtropical forests of Aizawl district, Mizoram. (Oral/Poster)

In the Two Days National Seminar on *Land Use and Bioresource Management for Sustainable Livelihood*, Jointly organized by Department of Environmental Science, Mizoram University, Mizoram Science, Technology & Innovation Council (MISTIC) & National Bank for Agriculture & Rural Development (NABARD) on 27th-28th March, 2023 held at SES & NRM, Mizoram University.

(Prof. BP Mishra)	(Prof. Lalnuntluanga)	(Prof. O.P. Tripathi)	(Dr ST Lalzarzovi)
Chairperson	Co-Chairperson	Organizing Secretary	Organizing Secretary

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Certificate

This is to certify that **Dr./Mr./Ms.** Laltanpuia Renthlei has delivered an oral/poster presentation on the topic Wild mushrooms in South Hlimen Village, Aizawl district, Mizoram in the International Conference on "Climate Change and Natural Resources Management for Sustainable Development" (ICNS-2024) hosted by the School of Earth Sciences & Natural Resources Management, Mizoram University, from 13-15th March, 2024.

Prof. Dibakar Chandra Deka
(Chief Patron, ICNS-2024)
(Vice-Chancellor, Mizoram University)

Prof. B.P. Mishra
(Convener, ICNS-2024)
(Dean, SESNRM, Mizoram University)

INTERNATIONAL SEMINAR ON BIODIVERSITY EXPLORATION AND DOCUMENTATION, ENVIRONMENT AND HEALTH

CERTIFICATE OF PRESENTATION

This is to certify that

Prof/Dr/Mr/Ms. Laltanpuia Renthlei

presented a Poster at the ***'International Seminar on Biodiversity Exploration and Documentation, Environment and Health'*** jointly organised by Department of Biotechnology, MZU, Natural History Museum & Research Center,MZU, Imperial College, London and Natural History Museum, London on 20th -21st November, 2024 held at Mizoram University.

Prof John Zothanzama
Converner

Prof Alfried Vogler
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Dr. R. Vanlalpeka
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Works (3 of 3)

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NAME OF THE CANDIDATE	: LALTANPUIA RENTHLEI
DEGREE	: DOCTOR OF PHILOSOPHY
DEPARTMENT	:ENVIRONMENTAL SCIENCE
TITLE OF THESIS	:INVESTIGATION ON THE NUTRIENT CONTENT IN WILD MUSHROOMS OF AIZAWL DISTRICT, MIZORAM
DATE OF ADMISSION	: 01.08.2018
APPROVAL OF RESEARCH PROPOSAL:	
1. DRC	: 29.03.2019
2. BOS	: 04.04.2019
3. SCHOOL BOARD	: 26.04.2019
4. MZU REGISTRATION NO	: 5627/2013
5. Ph.D. REGISTRATION NO & DATE	:MZU/Ph.D./1225 of 01.08.2018
6. EXTENSION (IF ANY)	: No.16-2/MZU(Acad)24/14-15 Dated 3rd July, 2024

Head

Department of Environmental Science

ABSTRACT

INVESTIGATION ON THE NUTRIENT CONTENT IN WILD MUSHROOMS OF AIZAWL DISTRICT, MIZORAM

AN ABSTRACT SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

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DEPARTMENT OF ENVIRONMENTAL SCIENCE

SCHOOL OF EARTH SCIENCES AND NATURAL RESOURCES MANAGEMENT

JUNE, 2025

INVESTIGATION ON THE NUTRIENT CONTENT IN WILD MUSHROOMS OF AIZAWL DISTRICT, MIZORAM

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Aizawl

SUBMITTED

IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENVIRONMENTAL SCIENCE OF MIZORAM UNIVERSITY, AIZAWL

ABSTRACT

Mushrooms, the spore-producing fruiting bodies of fungi, have been an important component of traditional diets and natural medicine practices across the world for centuries. In North East India, especially in the state of Mizoram, wild edible mushrooms have served as both a culinary delight and a critical source of nutrition for indigenous communities. However, while mushroom consumption is culturally embedded, scientific documentation of their nutritional properties, particularly in Mizoram, remains scarce. This study addresses that gap through an extensive investigation titled "Investigation on the Nutrient Content in Wild Mushrooms of Aizawl District, Mizoram," aimed at documenting and analyzing the macro- and micronutrient content of wild edible mushrooms found in three different forested sites of Aizawl district such as Mizoram University Campus, Hlimen Forest, and Lungleng Forest. The present study was undertaken with the following main objectives:

- Morphological identification of wild mushrooms.
- Analysis of Macro Nutrient content in wild mushrooms.
- Analysis of Micro Nutrient content in wild mushrooms.

The present study involved extensive fieldwork from 2019 to 2022, covering the rainy seasons when mushrooms are most abundant. Thirty-two (32) wild mushroom species were morphologically identified based on both macroscopic and microscopic characteristics. The identified species include *Amanita fulva*, *Amanita jacksonii*, *Amanita phalloides*, *Amanita vaginata*, *Auricularia auricula-judae*, *Cantharellus cibarius*, *Clavulinopsis laeticolor*, *Coprinellus disseminatus*, *Dacryopinax spathularia*, *Fistulina hepatica*, *Ganoderma adspersum*, *Ganoderma applanatum*, *Ganoderma lucidum*, *Lactifluus corrugis*, *Lactifluus*

piperatus, *Lentinus squarrosulus*, *Lycoperdon perlatum*, *Microporus xanthopus*, *Phallus indusiatus*, *Pleurotus pulmonarius*, *Pycnoporus coccineus*, *Podoscypha petalodes*, *Russula aurora*, *Russula bertulatum*, *Russula compacta*, *Russula cyanoxantha*, *Russula emetica*, *Schizophyllum commune*, *Scleroderma verrucosum*, *Termitomyces heimii*, *Trametes elegans*, and *Volvariella taylorii*. Identification was supported by the use of standard references and authoritative taxonomic databases such as Index Fungorum, MycoBank, and IPNI. Species such as *Lactifluus piperatus*, *Microporus xanthopus*, *Schizophyllum commune*, and *Trametes elegans* were observed at all three sites, indicating their wide ecological range and adaptability. The family Russulaceae emerged as the most diverse, with seven (7) identified species, highlighting its ecological dominance in the region's subtropical broad-leaved evergreen forests.

The collected mushroom samples were oven-dried at temperatures between 40 °C to 60 °C, then ground into powder form for nutrient analysis. Macro-nutrient contents, including carbohydrates, protein, moisture, ash, fat, and fiber, were determined using standard methods of the Association of Official Analytical Chemists. Micro-nutrient analyses focused on six key minerals: calcium (Ca), iron (Fe), magnesium (Mg), potassium (K), zinc (Zn), and manganese (Mn).

From the total species identified, 15 edible mushrooms were selected for nutritional assessment. *Termitomyces heimii* had the highest protein content (30.35 g/100g), making it the most protein-rich species among the samples studied. It also recorded the highest ash content (8.41 g/100g), indicating a high concentration of total minerals. *Volvariella taylorii* contain high crude fiber content (12.53 g/100g), which supports its potential role as a dietary fiber source; however, it had a relatively lower carbohydrate content (40.86 g/100g) compared to others. *Coprinellus disseminatus* recorded the highest carbohydrate content

(59.69 g/100g), suggesting its value as an energy-rich mushroom. This was followed closely by *Russula compacta* and *Auricularia auricula-judae*, both of which also demonstrated a favorable carbohydrate profile. *Russula aurora* showed the highest levels of both fat (4.6 g/100g) and moisture (13.26 g/100g), indicating a comparatively richer lipid profile, which may influence its texture and shelf life. On the contrary, *Auricularia auricula-judae* had the lowest fat content (1.77 g/100g), reinforcing its relevance as a healthy, and low-fat dietary option. Among the analyzed mushroom species, *Volvariella taylorii* recorded the highest concentrations of calcium and iron, with values of 11.47 mg/100 g and 18.39 mg/100 g, respectively, indicating its potential as a rich source of these essential minerals. *Termitomyces heimii* exhibited the highest levels of magnesium and potassium, with 6.82 mg and 182.25 mg per 100 g, respectively. In terms of zinc content, *Amanita vaginata* recorded highest concentration at 6.50 mg/100 g, whereas *Phallus indusiatus* recorded the lowest zinc level at only 0.85 mg/100 g. *Lactifluus piperatus* was particularly notable for its high manganese content, which reached 47.05 mg/100 g, suggesting its potential role in enzymatic and antioxidant processes. On the other hand, *Cantharellus cibarius* consistently showed the lowest mineral values across calcium (1.14 mg/100g), iron (2.4 mg/100g), and potassium (50.84 mg/100g), making it comparatively less significant in terms of mineral contribution among the studied species. These findings demonstrate the variation in mineral accumulation among different wild mushrooms and highlight the nutritional strengths of specific species

Edible mushrooms are increasingly recognized for their exceptional nutritional profile. They are particularly valued for being high in protein, which is essential for body repair, muscle development, and immune function. Unlike many animal-based protein sources, mushrooms provide these nutrients with negligible amounts of fat, especially saturated fats, making them a healthier alternative for individuals managing cholesterol levels or aiming for weight control. The nutritional evaluation of the selected species confirms that mushrooms are not only flavourful additions to meals but also highly functional foods. Their ability to offer energy, support metabolic processes, and promote general health with minimal caloric impact makes them an important dietary component. Therefore, regular inclusion of edible mushrooms in meals can contribute significantly to meeting nutritional needs while supporting a healthy lifestyle.

Mineral analysis revealed substantial variation among species. Potassium (K) emerged as the most abundant mineral across all samples, followed by calcium and magnesium. *Lactifluus piperatus* stood out for its high manganese concentration (47.05 mg/100 g), while *Lactifluus corrugis* also demonstrated robust mineral content across multiple elements. One-way ANOVA and Tukey's post-hoc test confirmed statistically significant differences in mineral concentrations among the species ($p < 0.05$), confirming that nutrient content is species-dependent.

The influence of ecological variables on nutrient content was also examined in this study. The sampling sites, situated at elevations between 330 m and 880 m, included a variety of soil types ranging from porous loamy to lateritic sandy soils, along with differing microclimatic conditions. However, statistical analysis using Chi-square and Cramer's V tests revealed no significant variation in species distribution among the sites ($p > 0.05$). This indicates that the selected mushroom species are capable of adapting and thriving across a broad range of environmental conditions, suggesting ecological tolerance and flexibility in their habitat preferences. These findings further highlight that environmental heterogeneity within the study area does not significantly constrain the occurrence of nutritionally valuable wild mushrooms, making them a stable forest resource.

The present study also sheds light on the ethnomycological relevance of certain species. Eight species, including *Termitomyces heimii* (Pasawntlung), *Lentinus squarrosulus*

(Pachang), *Russula cyanoxantha* (Pa Leng), and *Volvariella taylorii* (Changel Pa), are commonly consumed by the Mizo population. However, several highly nutritious species such as *Phallus indusiatus* (Phungsahmim) is underutilized due to limited public awareness and mycological knowledge. These findings emphasize the importance of integrating nutritional profiling with public education and forest-based livelihood programs.

The study highlights that wild edible mushrooms in Aizawl district offer rich nutritional value, notably as non-timber forest products (NTFPs) that can contribute significantly to food security, especially in rural and semi-rural communities. Their high protein and mineral content, combined with low fat, makes them ideal for dietary supplementation. Furthermore, the study supports the potential for small-scale mushroom cultivation as a viable alternative to traditional farming systems such as jhum (slash-and-burn), thereby promoting environmental conservation and economic resilience.

This study provides baseline data on the taxonomic identity, ecological distribution, and nutritional composition of wild edible mushrooms in the Aizawl district of Mizoram. The results indicate that these mushrooms are not only culturally important but also possess high nutritional value, being rich in macronutrients and essential minerals. Their availability in forest areas highlights their role as accessible and sustainable food sources, particularly for rural communities.

The findings support the potential of wild mushrooms in addressing malnutrition and contributing to food security. Promoting their inclusion in local diets, along with sustainable harvesting and possible cultivation, may enhance rural livelihoods and support ecological conservation.

The study also emphasizes the need for further research on bioactive compounds and nutritional diversity among species. Conservation strategies should be developed to ensure the sustainable use and long-term preservation of fungal biodiversity. This work contributes to a better scientific understanding of underutilized forest resources and supports their integration into public health and rural development programs.