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Research Article

Comparative Evaluation of the Proximate Composition, Mineral Profile and Phytate Content of Selected Edible Mushroom Varieties: Implications for Nutritional Quality and Food Security

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Abstract

Edible mushrooms have been acknowledged as renewable sources of bioavailable nutrients and valuable bioactive compounds in addressing the challenges associated with food security and a healthy diet. Yet, there is a wide range of variation in the nutritional components of the different species of mushrooms, which necessitated this comparison of the nutrient potentials of some species. This work evaluated the proximate, mineral and phytate composition of seven (7) chosen edible mushroom varieties (M1 – M7) by following the established standard analytical procedures. The evaluated proximate parameters are moisture, dry matter, crude protein, crude fibre, crude fat, ash and nitrogen-free extract, together with the profiles of essential minerals and the phytate constituents. The results showed significant differences ($p < 0.05$) between the mushroom varieties for all the parameters examined. Moisture content of the mushroom samples varied from 3.55% to 9.71%, whilst the range for crude protein was very wide and diverse between 9.10% and 33.07%, with varieties M5, M6 and M7 recording the highest protein values. Potassium was the major mineral element in all the mushroom varieties studied, and was followed by phosphorus and calcium, which means that the mushrooms can be a good source of essential macrominerals in our diets. Appreciable quantities of magnesium, zinc, manganese, copper, iodine, were recorded, whilst cadmium was absent in all the mushroom samples. The concentrations of phytate were also low indicating that they may not inhibit the absorption of the minerals in a significant manner. The differences observed between mushroom varieties suggest that proper species selection is important in optimizing nutrition. Based on the study, the tested mushrooms can be utilized as ideal materials for nutritional improvement of protein and minerals of man, as well as in the development of nutritious functional foods.

Keywords: edible mushrooms; proximate composition; mineral composition; phytate;

nutritional quality; food security

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Introduction

Background of the Study

Mushrooms have gained more prominence in global nutrition as they are a source of protein, dietary fiber, minerals, vitamins, and various bioactive compounds while having relatively low-fat content (Das et al., 2021). As they are increasingly consumed across the globe and considered an alternative sustainable source of animal protein, their capacity to grow on waste agricultural residues and other low-cost substrates further strengthens their significance in terms of food security and eco-friendly food production (Khan et al., 2024).

With the increased recognition of mushrooms for their nutritional diversity (Fitsum et al., 2025), varieties differed considerably in their nutritional values regarding protein level, fiber concentration, minerals, and antinutrient content. Given the wide diversity in nutrient composition among the varieties, some are considered superior to others for their potential contribution to dietary protein intake, mineral nutritional status and use in functional foods. Thus, it is essential to have reliable compositional data for these mushrooms to select varieties for consumption and further food industry processing.

Calcium is one of the important macrominerals required for bone and tooth formation and maintenance (Ali, 2023). Also, it plays a key role in muscle contraction, nerve conduction, blood clotting, hormonal regulation, and intracellular signaling pathways. The body thus requires an adequate dietary intake of calcium, particularly for the optimal growth of bones and teeth throughout life, including in infancy, during pregnancy, and old age.

Sodium is an essential element involved in the regulation of fluid balance, plasma volume and resting membrane potential. Along with potassium, it plays a significant role in maintaining osmotic pressure, extracellular fluid volume, and nerve signal transmission, as well as normal muscle contractility (Bernal et al., 2023). Nevertheless, while adequate sodium intake is vital, elevated consumption of this mineral has been linked with increased blood pressure and subsequent cardiovascular risk. Therefore, compared with the absolute amount, the potassium-to-sodium ratio in foods is much more important for determining nutritional value.

Phosphorus is the second most abundant mineral in the human body, essential for bones, energy storage, membranes of the cell, and numerous other metabolic processes (Dowhan Hoag, and Dharmarajan, 2021). It also forms a part of the molecular structure of Nucleic Acids (NA), phospholipids, and Adenosine Tri-Phosphate (ATP). Therefore, proper supply of phosphorus in the diet is mandatory for normal functioning of the body.

Magnesium, which is involved as an essential cofactor for more than 300 enzymatic activities related to energy production, nucleic acid and protein synthesis, neuromuscular functioning, etc, also contributes to bone mineralization, maintaining cardiac rhythm and function (Aslam et al. 2017, Jahnen-Dechent & Kettmann, 2016). As food enriched in magnesium, therefore, contributes to our daily diet requirements. A prominent finding in this study was that most of the studied mushrooms showed very high concentrations of potassium as compared to sodium. This favourable potassium to sodium ratio in the studied mushroom samples is nutrition-wise advantageous, because a dietary intake characterized by high potassium and low sodium has a favourable influence on cardiovascular health.

Zinc, being an essential mineral, is important for the normal functioning of hundreds of enzymatic processes within the human body, which include immune function, protein synthesis, DNA replication, wound healing, reproduction, as well as growth and development (Black et al. 2018). The dietary deficiency of this mineral may impact the immune response, the speed of wound healing, and growth rates, especially in children and elderly people.

Dietary fiber is an important dietary component, which mushrooms could provide due to their high non-starch polysaccharide content. These could also serve in reducing blood glucose and serum cholesterol, increasing fullness and improving bowel habits (Brown et al. 2021). Mushroom fiber consists mostly of polysaccharides like chitin, β-glucans, hemicelluloses and other non-starch carbohydrates known for their physiologic advantages (Sá and Laranjo 2020).

Manganese acts as a cofactor in numerous enzyme systems including those related to carbohydrate and lipid metabolism, synthesis of collagen, protection against oxidative damage via superoxide dismutase (one of the major antioxidant enzymes of the human body) and development of bones (Hossain et al. 2020). Thus, intake of sufficient quantities of Mn in the diet would assist in these processes.

Cobalt is an essential constituent of vitamin B12 (cobalamin), and plays a vital role in the

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production of red blood cells, brain function and DNA synthesis (Coates, 2018). While

not a significant direct source of vitamin B12, its presence in mushrooms highlights mineral content derived from the substrate it grows on.

Copper is essential for several biological processes, which include: collagen synthesis, energy metabolism, antioxidant defense, neurotransmission, and red blood cell formation; it helps in proper metabolism of Iron and provides immunity (Prasad, 2020). Thus, the presence of adequate copper content in foods like mushrooms provides useful dietary contributions.

Chloride, it helps regulate fluid balance, acid-base balance, and osmotic pressure. Also essential for the formation of digestive enzymes (e.g., hydrochloric acid in gastric juices) (Manolis, 2023). In normal individuals on a balanced diet, this is less of concern, since adequate chloride intake can easily be achieved through the use of table salt.

Iodine is indispensable for the synthesis of thyroid hormones, which are essential for metabolic rate and regulate development, growth, and energy utilization (Moreno-Reyes et al., 2025). Deficient iodine intake is still one of the leading public health issues globally because of the high risks for iodine deficiency disorders, such as goiter and neurodevelopmental impairment.

Lead has no known role or benefit in the human body and is classified as one of the most potent environmental and toxic heavy metals that can accumulate within human tissues over long periods of exposure (Generalova et al., 2025). Hence, lead found in mushrooms can indicate environmental exposure or accumulation from its growing substrate and not part of a metabolic function in the fungus.

Phytate phosphorus is that part of phosphorus which is contained in the molecule of phytic acid (Pires et al., 2023). This is typically a storage form of phosphorus and other minerals (like calcium, zinc, magnesium, and iron) in the grain/plant/fungal kernel, which gets activated and released during germination or growth and development.
In terms of its role in human nutrition, the interest in phytic acid or its contribution to antinutritional factors (as an inhibitor of mineral bioavailability) has led to more recent studies on dietary phytic acid that have also highlighted its beneficial effects, such as antioxidant activity, glucose-lowering properties, reducing lipid oxidation, and thus may have roles in cancer chemoprevention, anti-kidney stones, and others.

Phytic acid is a strongly negatively charged compound, able to bind with divalent and trivalent cations. Phytate is typically a binding agent that can bind minerals like Ca, Zn,

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Mg, Iron with higher degree. In the context of nutrition, phytate is regarded primarily as

an antinutrient due to its inhibitory effects on absorption of mineral elements like zinc, iron, calcium, and magnesium. However, recent nutritional research has demonstrated the beneficial effect of phytic acid as an antioxidant agent, an agent for glucose reduction, prevention of kidney stones, and lipid oxidation, etc.

Our study analysed 7 samples of mushrooms (M1–M7) for their proximate, mineral content, and phytate values. In our analysis, Moisture content was found to be between 3.55% and 9.71%, and crude protein varied in the range 9.10 to 33.07%. Minerals, namely Potassium, phosphorus, and calcium, were predominant elements in the study samples, and we did not find any evidence of Cadmium contamination. It shows that mushrooms can serve as a good source of protein and minerals in the diet. There is variability in the composition among different varieties of mushrooms, indicating selection can impact their nutritional value.

Statement of the Problem

While mushrooms are eaten in various parts of the world, detailed reports on the nutrient composition of mushrooms that are locally available are lacking in most regions. Generic nutritional values of edible mushrooms that are found in many regions are often use by the public as a reference for nutrients as well as for professionals such as nutritionists and food industries. Without such specific information, it is not possible to classify those with higher protein and mineral content or with reduced antinutrient content. Moreover, the existence of phytate, which binds mineral nutrients (e.g., Ca, Mg, Zn), can affect the bioavailability of minerals, and information on both mineral content and the level of antinutrients such as phytate of respective mushroom varieties may lead to biased conclusions regarding their overall nutrient value. Therefore, a survey of proximate composition, mineral content, and phytate content of mushrooms that are found in this region should be conducted to provide data for better informed advice.

Justification of the Study

The study is justified by the need for affordable and sustainable protein sources, which are essential for food security. Mushrooms provide an option with an interesting complement of minerals and low-fat content with comparatively high protein content. The information generated may serve to facilitate public health intervention strategies to overcome protein and micronutrient deficiency and to support the cultivation and selection of nutritionally better varieties. This baseline compositional data may also provide reference values to assist food scientists, nutritionists, mushroom growers, and policymakers in the formulation of mushroom-based food products and the development of nutritional guides. This also provides information on the lack or presence of some potentially harmful substances, which may be useful for safety assessments.

Scope of the Study

Seven selected types of mushrooms were identified for this study and named M1-M7. The three major groups of nutrients analyzed are: Proximate analysis (moisture, dry matter, crude protein, crude fibre, crude fat, ash, nitrogen-free extract). Mineral content analysis (Ca, K, Na, Mg, P, Zn, Mn, Co, Pb, Cu, Cl and I). Phytate assessment (phytate P and total phytate). However, Amino acid content and analysis of vitamins as well as sensory analysis of mushroom samples, bioavailability, and also growth of the mushrooms are excluded from this study.

Aim of the Study

This study was designed to comparatively determine the proximate, mineral composition, and phytate content of some edible varieties of mushrooms in order to determine their nutritive value and potential value for food security.

Objectives of the Study

The specific objectives were to:

i. Determine the proximate composition of the selected mushroom varieties.
ii. Quantify the concentrations of major and trace minerals present in the mushroom samples.
iii. Evaluate phytate phosphorus and total phytate content in the selected varieties.
iv. Compare the nutritional characteristics of the mushroom varieties and identify those with superior protein and mineral composition.
v. Assess the potential nutritional significance of the mushrooms for human consumption and functional food development.

Materials and Methods

Source of Materials and Sample Pre-treatment

The fungi: *Lentinus subnudus* Berk (Ml), *Chlorophyllum molybditis* (M2), *Volvariella esculenta* (M3), *Coprinus tramentarius* (M4, Pleurotus ostreatus Jacq (M5), *Termitomyces microcarpus* (M6), *and Pleurotus pulmonarius* (M7) were harvested from Federal College of Agriculture, Akure, Ondo State, in the Southwest region of Nigeria. Bad or rotten specimens were removed. These were dried in an oven at 65°C for 72 h, then pounded into fine powder in a porcelain pestle and mortar. These powders were passed through a 2 mm mesh-size sieve and kept in waterproof polyethylene bags at room temperature pending analysis.

Proximate Analysis

Moisture Determination

Moisture content was estimated by using the method of evaporation (AOAC, 2005). Three grams (3.00g) of ground samples in triplicate were weighed in covered flat aluminum

dishes in a microwave oven, in intervals of 30 minutes, and dried till a constant weight was observed at 105 ^{o}C.

Calculation

$$\text{Moisture (\%)} = \frac{\text{weight of sample before oven drying} - \text{weight of dry sample}}{\text{weight of sample before oven drying}} \times 100$$

Crude Fat Determination

Triplicate sample portions, each 1.0 g of meal, were accurately weighed into securely stoppered thimbles and mounted in a Soxhlet extraction device well filled with soil. The apparatus was supported above a solvent flask containing 40-600C petroleum ether. This apparatus was secured to a condenser; the extraction was conducted for 6 hours and continued until the solvent in the Soxhlet chamber was clear. The material from the thimbles was removed when the ether was removed, and the soil was heated for 30 mins at 1050C in a microwave oven before it was cooled in a desiccator and weighed.

Calculation

$$\text{\% Crude fat (DM)} = \frac{\text{weight of thimble} + \text{TDM} - \text{weight of thimble} + (\text{TDM} - \text{w})}{\text{TDM}} \times 100$$

Where w = weight of the fat (AOAC, 2005), TDM - Total Dry Matter

Ash Determination

Analysis of ash was conducted according to the phenol-sulphuric acid method (AOAC, 2005). 0.5g triplicate sample of the dried meal was precisely weighed in crucibles, then incinerated in a Gallenkamp muffle furnace (Tactical 308 model) at 650 0C for 6 h, followed by pre-burning. After incineration the crucibles were placed in a desiccator for cooling and the mass was recorded.

Calculation:

$$\text{Ash (\% w/w)} = \frac{\text{weight of crucible} + \text{TDM} - \text{weight of crucible} + \text{TIM}}{\text{TDM}} \times 100$$

Where TIM = Total Inorganic Matter (AOAC, 2005)

Crude fibre Determination

Each fat-free sample of about one gram was weighed in triplicate and placed in the distillation flask, and was added to 200cm 3 of 0.1275 mol dm ^{3} H_2SO_4, to which a

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condenser was fitted, and was then boiled for 30 minutes for the purpose of digestion.

Particles adhering to the side were washed down with distilled water, and the material was filtered through a Whatman No. 541 paper into the Büchner funnel using suction and then washed with boiling water. The material was collected in a beaker, to which 200 cm^3 hot solution of 0.313 mol dm^3 NaOH was added and boiled for 30 minutes, filtered through a porous crucible, and washed with boiling water, 1% HCI and then with boiling water. Lastly was washed with 98% ethanol solution and dried overnight in a microwave oven at 100 °C.

The samples were then ashed at 600 ^{0}C until carbon-free, cooled, and weighed.

Calculation

$$\text{Crude fibre (\% of fat free DM)} = \frac{a - b}{\text{TDM}} \times 100$$

where, a = wt of crucible + wt of dried TDM,
residue, b = wt of crucible + ashed residue (AOAC, 2005).

The crude protein was determined using the Macro Kjeldahl digestion and distillation method (AOAC, 2005).

Calculation

$$\text{\% total N in sample(Sample titre} - \text{Blank titre) x concn of HCI x 0.14007 x V1}$$
$$= \frac{a - b}{\text{WV2}} \times 100$$

$$\text{Ash (\% w/w)} = \frac{\text{weight of crucible} + \text{TDM} - \text{weight of crucible} + \text{TIM}}{\text{TDM}} \times 100$$

OR

% total Nitrogen (T-B) x concentration of HCI x 0.14007V_1/V_2 x sample weight

Where T= sample titre and B blank titre, V_1 = volume made up, V_2 aliquot taken for distillation, and W = sample weight.

% Crude Protein (on DM basis) % Nitrogen x 625 (Ndamitso, 2011)

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Nitrogen Free Extract (NFE) Determination
NFE was calculated from the values of the crude proteins, fats, fibres, and ash of the samples (AOAC, 2005). This was done by difference using the formula.

$$\text{NFE (on DM basis)}\ \ 100 - CP + \%\ CF + \%\ CF_1 \quad \text{Ash}$$

Where CP = crude protein, CF = crude fibre, CF_1 = crude fat.

Mineral Compositions
The minerals in solutions prepared by oven-drying the samples to constant weight in a furnace at 550 0C, grinding them to a fine powder, and dissolving a 50 mg portion in a 100 cm^3 volumetric flask using a few drops of conc. HCl with distilled water was used. Atomic Absorption Spectrophotometer (AAS) was employed to quantify minerals (Na, K, Ca, Mg, Zn, Fe and Mn). Phosphorus was determined colometrically with KH2P04 as standard on a Spectronic 20 (Gallenkamp, UK) spectrophotometer as per AOAC (2005). Apart from moisture content, all analyses were carried out on a dry-weight basis; all analyses were performed in triplicate, and the result expressed as mean SD.

Phytate and Phytate Phosphorus Determinations
Exactly 4.0 grams of samples were weighed and dissolved with three triplicate determinations in 100 cm^3 of 2% HCL solution. Each sample solution was extracted with three portions of chloroform after the first 25 cm^3 of filtrate had been decanted through a stack of two layers of Whatman filter paper. Twenty-five cubic centimeters of the aqueous phase was placed in a flask, 5.0 cm^3 of indicator solution (0.3% NH_4SCN) was added, and sufficient distilled water was added to ensure a pH suitable for titration; it was then titrated against $FeC1_3$ solution, which has been calibrated and found to contain 0.00195 grams of Fe/cm^3.

Calculations:
$$\%\ \text{Phytate phosphorus} = \text{the obtained equivalent} \times \text{I}.95$$

Phytate = Phytate phosphorus x 3.55 (Abulude & Ojediran, 2006)

Statistical Analysis
The obtained data were carried out in triplicate and subjected to Mean, Standard deviation, and one-way analysis of variance with Duncan Multiple Range test at 95% confidence level or $p< 0.05$

The Null Hypothesis

1. There is no significant difference in the proximate composition of mushroom samples.
2. There is no significant difference in the mineral composition of mushroom samples.
3. There is no significant variation in the phytate levels of the mushroom samples.
4. There is no significant variation in the functional properties of the mushroom samples as different salt concentrations are used.

Results and Discussion

4.1 Results and Discussion of the Proximate Composition of the Selected Mushroom Varieties

Proximate composition of seven types of edible mushrooms. Table 1. The proximate composition of seven kinds of edible mushrooms is given in Table 1. There were significant differences ($p<0.05$) in all analyses of all mushroom samples, suggesting substantial variations in the nutritional composition among the mushrooms. These variations are due to the variety of species, genotype, components of substrates, environmental factors, stage of development, and any post-harvest treatments.

Moisture and Dry Matter

Results for moisture content ranged between 3.55 in M6 and 9.71% in M5, whereas for dry matter they varied from 88.11% to 93.15% in M5 and M6, respectively. It was observed inverse relationship between moisture content and dry matter, i.e., a decrease in moisture content caused an increase in dry matter. The inverse correlation between the level of water and the amount of solid nutrients in dried food is understandable since water constitutes a portion of the weight which is substituted with nutrients. The recorded very low levels of moisture content mean that dried mushroom flours would exhibit a good keeping quality as a consequence of inhibition of enzymatic and biochemical degradation processes. It would be preferable that commercial mushroom flours contain a low moisture content as this would result in an increase in storage and transportation stability of mushroom flours.

The differences in moisture content among different varieties of mushrooms indicate variations in their species and in the content of tissue components. High dry matter content signifies higher amounts of solids such as protein, carbohydrate, and minerals, which are all nutritionally important. High values of dry matter found in the samples mean that mushrooms used in this study are sources of many nutritional components. Mushrooms dried to less than 12% moisture levels are commonly regarded as keeping well over prolonged storage (Ludewig et al., 2024; Moutia et al., 2025; Jacob et al., 2025),

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and the ones reported herein would do the same.

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Table 1: The Results of Proximate Compositions of the Selected Varieties of Mushrooms in Percent (%)

	Samples						
Parameters	M_1	M_2	M_3	M_4	M_5	M_6	M_7
Moisture	5.56 ± 0.32^{b}	5.81 ± 0.19^{b}	9.05 ± 0.13^{cd}	8.11 ± 2.17^{c}	9.71 ± 0.22^{d}	3.55 ± 0.28^{b}	5.46 ± 0.12^{b}
Dry Matter	92.78 ± 2.07^{bc}	92.11 ± 2.17^{bc}	91.11 ± 2.17^{abc}	89.12 ± 2.18^{ab}	88.11 ± 2.17^{a}	93.15 ± 2.23^{c}	90.11 ± 2.17^{abc}
Crude Protein	16.06 ± 0.12^{b}	9.1 ± 0.15^{a}	12.36 ± 0.25^{ab}	13.80 ± 0.15^{a}	31.58 ± 0.25^{c}	32.32 ± 0.10^{c}	33.07 ± 0.89^{c}
Crude Fibre	4.15 ± 0.02^{a}	4.68 ± 0.16^{a}	5.35 ± 0.13^{ab}	7.08 ± 0.59^{b}	6.11 ± 0.32^{ab}	6.91 ± 0.11^{b}	4.19 ± 0.89^{a}
Crude Fat	0.71 ± 0.02^{c}	0.12 ± 0.02^{a}	0.89 ± 0.07^{a}	0.14 ± 0.2^{a}	0.72 ± 0.20^{c}	0.50 ± 0.21^{b}	0.8 ± 0.2^{a}
Ash	10.12 ± 0.02^{bc}	9.07 ± 0.02^{bc}	8.11 ± .22^{ab}	7.93 ± 0.20^{d}	11.05 ± 0.20^{d}	7.25 ± 0.02^{a}	14.11 ± 2.01^{c}
NFE	63.52 ± 2.15^{bc}	71.22 ± 2.98^{bc}	35.76 ± 2.10^{b}	62.94 ± 2.52^{ab}	40.83 ± 2.10^{ab}	49.47 ± 2.10^{c}	42.37 ± 2.10^{ab}

All values were expressed as the average of triplicate determinations ± the standard deviation, and values bearing the same superscripts in the same row are not significantly different ($p > 0.05$). NFE – Nitrogen Free Extract

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Table 2: The Results of Mineral Compositions of the Selected Varieties of Mushrooms (mg/100g).

	Samples						
Parameters	**M_1**	**M_2**	**M_3**	**M_4**	**M_5**	**M_6**	**M_7**
Ca	573 ± 2.30^{e}	326 ± 2.11^{b}	276. ± 2.41^{a}	460.11 ± 2.23^{c}	564. ± 2.11^{d}	668 ± 2.23^{f}	571 ± 2.46^{e}
K	1284 ± 2.32^{c}	926 ± 2.11^{a}	1179 ± 2.56^{b}	1298 ± 2.36^{c}	2516 ± 2.34^{d}	3680 ± 2.33^{f}	3014 ± 2.67^{e}
Na	575 ± 2.32^{c}	177 ± 2.56^{a}	585 ± 2.76^{c}	528 ± 2.43^{b}	556 ± 2.78^{c}	9102 ± 2.56^{e}	860 ± 2.38^{d}
Mg	429 ± 2.34^{c}	169 ± 2.55^{b}	540 ± 2.67^{d}	111 ± 1.89^{ab}	396 ± 2.21^{c}	420 ± 2.89^{a}	460 ± 2.78^{c}
P	708 ± 2.02^{c}	480 ± 2.31^{a}	668 ± 0.02^{b}	716 ± 2.77^{d}	670 ± 2.09^{b}	884 ± 2.43^{f}	735.8 ± 2.56^{e}
Zn	2.15 ± 0.20^{c}	0.66 ± 0.02^{a}	1.37 ± 0.02^{b}	2.64 ± 0.02^{e}	1.33 ± 0.02^{b}	2.17 ± 0.02^{c}	2.35 ± 0.03^{d}
Mn	2.91 ± 0.07^{b}	3.23 ± 0.02^{d}	4.57 ± 0.02^{g}	4.22 ± 0.03^{f}	3.08 ± 0.02^{c}	3.76 ± 0.03^{c}	2.66 ± 0.02^{a}
Co	2.63 ± 0.20^{f}	1.67 ± 02^{d}	1.03 ± 0.02^{b}	0.54 ± 0.20^{a}	2.87 ± 0.02^{g}	1.34 ± 0.02^{c}	2.19 ± 0.02^{e}
Cd	nd	nd	nd	nd	Nd	nd	nd
Pb	0.67 ± 0.02^{a}	1.68 ± 0.02^{c}	0.60 ± 0.02^{a}	1.10 ± 0.02^{b}	1.63 ± 0.02^{c}	1.67 ± 0.02^{c}	1.12 ± 0.02^{b}
Cu	0.75 ± 0.02^{d}	0.23 ± 0.23^{a}	0.57 ± 0.02^{c}	0.34 ± 0.03^{b}	1.14 ± 0.02^{f}	1.32 ± 0.02^{g}	0.85 ± 0.02^{e}
Cl	16.00 ± 1.15^{b}	12.40 ± 0.20^{a}	15.10 ± 0.20^{b}	21.32 ± 0.13^{c}	34.40 ± 0.23^{f}	29.70 ± 0.20^{d}	28.00 ± 0.20^{d}
I	12.60 ± 20^{a}	14.00 ± 0.20^{ab}	13.40 ± 0.20^{ab}	18.00 ± 0.20^{c}	14.00 ± 0.20^{ab}	14.80 ± 0.20^{b}	12.44 ± 0.12^{a}

All values were expressed as the average of triplicate determinations ± the standard deviation, and values bearing the same superscripts in the same row are not significantly different ($p > 0.05$).

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Table 3: The Results of Phytate Phosphorus and Phytate Composition of the Selected Varieties of Mushrooms in mg/100g.

	Parameter	
Samples	Phytate Phosphorus	Phytate Composition
M_1	0.72 ± 0.20^{ab}	2.56 ± 0.20^{b}
M_2	0.64 ± 0.20^{a}	2.28 ± 0.20^{a}
M_3	0.84 ± 0.20^{bc}	2.99 ± 0.20^{d}
M_4	0.39 ± 0.20^{d}	4.92 ± 0.20^{g}
M_5	0.88 ± 0.20^{c}	3.12 ± 0.20^{f}
M_6	0.78 ± 0.20^{abc}	2.77 ± 0.20^{c}
M_7	0.91 ± 0.20^{c}	3.19 ± 0.20^{f}

All values were expressed as the average of triplicate determinations $\pm$ the standard deviation, and values bearing the same superscripts in the same row are not significantly different ($p > 0.05$).

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Crude Protein

Crude protein concentration varied considerably among mushroom varieties, ranging from M2 with 9.10 % to M7 with 33.07 %. The highest protein was obtained in M7 (33.07 %), followed by M6 (32.32 %) and M5 (31.58 %), and other mushrooms such as M1, M3, and M4 had moderate values, while M2 had the lowest values among the varieties. The varieties had statistically significant ($p < 0.05$) differences with regard to crude protein content. Protein was considered one of the important nutritional properties in edible mushrooms since they contain all indispensable amino acids which are required for tissue development, maintenance, and many metabolic processes. Hence, M5, M6, and M7 with higher protein content show nutritional potential in mushrooms, and these mushroom varieties can be an important alternative source of conventional plant proteins in the diets in a region where protein of animal source is scarce and costly.

The variation in the protein content among the mushroom species investigated might be a reflection of the difference in genes, physiology, nutrients present in growth medium and environmental factors where the mushrooms are grown. Some other reports (Ayimbila and Keawsompong, 2023; Costa et al., 2026) show clearly that protein contents among mushroom species were significantly varied, even under the same environmental circumstances indicating the critical significance of selecting the right species in any nutritional investigation.

Crude Fibre

Crude fibre varied between 4.15 in M1 and 7.08 in M4, and also a range of 6.11% in M5 and 6.91 in M6, which were the other relatively high levels. Mushroom variety significantly ($p<0.05$) influenced crude fibre, which implied varied structural carbohydrates among different varieties of mushrooms. It is thus suggestive that higher fibre content obtained in M4 and M6 can potentially offer health benefits of good digestion and regulation of body metabolism. The high content of crude fibre in mushrooms could have benefits on reduction of non- communicable disease risks where dietary fibre is lacking. Reports of variation of fibre content among mushroom species exist and are often explained by variation in cell wall structures and developmental stage as well as substrate and environmental factors. Fibre values in this study fall within the range reported by Nakalembe et al. (2015) for the cultivated and wild mushrooms in Uganda.

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Crude Fat

The lipid (crude fat) contents of the samples investigated did not vary extensively, being low in the case of M2 (0.12%), moderate in M1 and M4 (around 0.5%), and relatively high in M3 (0.89%). While a statistically significant difference was found between the different varieties, all were characterized by their lipid contents being under 1%. Low lipid content is one of the fundamental beneficial features of mushrooms as food sources. Meals with a low amount of fat are frequently advised for individuals who have to reduce their energy intake, who are subject to cardiovascular problems, obesity, and their co-morbidities. Although total lipids were low, the tested mushrooms exhibited relevant amounts of unsaturated fatty acids such as linoleic acid that are important for humans. The current data are consistent with a plenty of authors who showed that edible mushrooms have low amounts of lipids irrespective of the species (Kumar et al., 2021; Singh et al., 2025). This, in addition to protein and fibre, also contributed to the excellent suitability of mushrooms as functional ingredients and healthy meat alternatives.

Ash Content

Ash content (measure of total mineral content) ranged from 7.25% in M6 to 14.11% in M7. Higher amount of ash content was reported for M5 (11.05%) and M1 (10.12%), whereas M4 contained the least among them. Significant variation was recorded between the samples of mushrooms ($p < 0.05$). Higher ash content is generally an index of the quantity of mineral constituents present in the food. This high percentage of ash content was found in M5 and M7 indicate these might be a good source of nutritionally important macro- and microelements in the diet, which is evident from the results presented in Table 2 where these two sample contains quite high amount of different essential mineral content, difference between the variety of mushrooms ash content due to the differences in the specific nature of species and the process by which they accumulate minerals from the substrate in the process of mushroom cultivation, so as differences related to species specificity and substrate component composition and even environmental factors may play some role on accumulated amount of mineral constituents in the edible mushrooms.

Nitrogen-Free Extract

The amount of Nitrogen-Free Extract (NFE) or the digestible carbohydrate fraction of the foods varied between 35.76 per cent in M3 and 71.22 per cent in M2. M1 has a relatively higher amount of NFE (63.52%). While the amount of NFE in M5, M6, and M7 were less relative. There is a highly significant variation in the amount of nitrogen-free extract among the mushroom varieties ($P < 0.05$). This variation among the mushroom samples is related to differences in the accumulation of carbohydrates in different mushroom varieties. A higher level of NFE means a higher amount of dietary energy since carbohydrates are one of the major sources of energy, and conversely, lower levels of NFE generally mean a higher amount of protein in different varieties.

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Calcium (Ca)
Calcium concentration varied from 276.00 mg/100g (M3) to 668.00 mg/100g (M6). M6, M1, M7, and M5 showed the highest concentration of calcium (668, 573, 571, and 564 mg/100g, respectively). M2 showed moderate calcium content (326 mg/100g). Significant differences were obtained for calcium contents among mushroom types ($p < 0.05$). These findings suggest that M6, M1, M5, and M7 could contribute substantially to dietary calcium requirements if consumed as part of a diversified diet, despite dairy foods being the best source in some diets. Alternative and plant-based food sources of dietary calcium are beneficial, especially for consumers adhering to vegetarian and vegan diets. These differences can be attributed to disparities in mineralization efficiency, genetic features, and substrate compositions of the mushrooms (Ab Rhaman et al., 2021).

Potassium (K)
The mineral potassium was highest across all mushroom samples, from 926 mg/100 g in M2 to 3,680 mg/100 g in M6. Interestingly, potassium was exceptionally high in M7 (3,014 mg/100 g) and M5 (2,516 mg/100 g), while it was in the mid-range for M1, M3, and M4 above 1,100 mg/100 g, significantly different from the other samples at $p<0.05$. This is consistent with the understanding that edible mushrooms generally constitute good sources of potassium (Bao et al., 2020). Potassium plays vital roles, including intracellular fluid balance, normal functioning of nerves and muscles, and normal cardiac rhythm, and its excess in the body acts in part to antagonize some of the ill effects of high salt intake, thus controlling blood pressure (Abdelrazeq et al., 2023). The unusually high levels of potassium in M5, M6, and M7 are therefore greatly beneficial to increase the value of these mushrooms. Such high levels are well documented to correlate with a reduced risk of hypertension and cardiovascular diseases among persons consuming a high-potassium diet (Pashaei et al., 2024). The observed differences between varieties reflect differences in their potassium uptake and storage. Given that potassium is mobile within the fungal tissue, its accumulation may depend on its supply by the medium, the availability of water, and the metabolism of the fungus. High levels of potassium observed in the mushrooms of this study reinforce the argument for including mushrooms in diets as nutrient-dense foods.

Sodium (Na)
The sodium content in the mushrooms investigated varied substantially from 177 mg/100g in M2 to 910.2 mg/100g in M6. M7 also contained a substantial concentration of sodium (860 mg/100 g), while M1, M3, M4 and M5 revealed values between about 528 and 585 mg/100 g. These contents differ significantly from each other ($p < 0.05$). The comparatively higher content in M6 and M7 could be explained by the accumulation of these minerals from the growing medium rather than by an impaired composition. In

general, the levels observed fall within those normally encountered for other comestible mushrooms.

Magnesium (Mg)
Magnesium contents varied between 111 mg/100g (M4) and 540 mg/100g (M3). A substantial amount of magnesium was found in M7 (460 mg/100g), M1 (429 mg/100g), M6 (420 mg/100g), and M5 (396 mg/100g), while the minimum magnesium content of 169 mg/100g was registered for M2. A significant difference was observed among the different species of mushrooms at $p < 0.05$. The high concentration of magnesium content for M3 means that even though it has less protein content, its nutritional value is enormous. High accumulation of magnesium content in M1, M5, M6, and M7 proved that it can serve as a significant source in day-to-day requirements. The variations between the species of mushroom are dependent on the physiology of the species and its ability to accumulate the mineral. Environment and the mineral content in the growing substrate also affect the accumulation of the minerals during the growing period of the mushroom (Ziba et al., 2021).

Phosphorus (P)
The concentration of phosphorus ranged from 480 mg/100g in M2 to 884 mg/100 g in M6. While M7 (735.8 mg/100 g), M4 (716 mg/100g), M1 (708 mg/100g), M5 (670 mg/100 g), and M3 (668 mg/100g) had similar relatively high phosphorus levels. The results of statistical analysis confirmed that these levels were significantly different from each other ($p < 0.05$). The high levels of phosphorus reported across all seven mushroom samples suggest that the investigated mushroom samples represent good dietary sources of phosphorus. The concentration recorded in M6 in particular contributes to its higher calcium and potassium levels, further emphasizing its overall nutrient value. High levels of dietary phosphorus are essential to facilitate protein metabolism, and as such, the presence of high levels of protein together with high levels of phosphorus in M5, M6, and M7 provides potential health benefits as functional food ingredients that boost nutritional value and dietary quality

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The trace minerals and selected elements in the seven types of mushrooms are shown in Table 2. Statistically significant ($p < 0.05$) differences (data not shown) between samples were found in all parameters examined, revealing that the accumulation patterns for these minerals varied significantly across mushroom types due to inherent physiological attributes, substrate properties, the ecological context, and bioavailability of the elements that were essential for mushroom development. Trace elements, at relatively low levels, are needed to meet the requirements for physiological functions, including metabolic processes, enzymatic action, immune functions, growth, and protection against diseases

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(Lopez-Alonso et al., 2021) is why their analyses were performed.

Zinc (Zn)

The concentrations of zinc in the mushrooms investigated ranged from 0.66 mg/100 g for M2, up to a maximal value of 2.64 mg/100 g for M4. Relatively high concentrations of zinc were also found for M7 (2.35 mg/100 g), M6 (2.17 mg/100 g) and M1 (2.15 mg/100 g), while the samples M3 and M5 were found to possess intermediate contents of about 1.33-1.37 mg/100 g. Statistical examination demonstrated that significant differences ($p<0.05$) exist between the mushrooms investigated. Because the zinc concentrations found for M4, M7, M6 and M1 were comparatively high, these species can contribute significantly to the intake of zinc through nutrition. Although mushrooms as a class can hardly be considered a high zinc-containing food when compared with food from animals, frequent consumption may compensate for lack of zinc in the food of people predominantly on plant-based diets. The variations that are found between the samples may also reflect variations in efficiency of uptake or accumulation of the elements.

Manganese (Mn)

Manganese concentrations varied from 2.66 mg/100 g in M7 to 4.57 mg/100 g in M3. M4 also exhibited a high concentration (4.22 mg/100 g) and was followed by M6 (3.76 mg/100 g), M2 (3.23 mg/100 g), M5 (3.08 mg/100 g), and M1 (2.91 mg/100 g). All mushrooms differed significantly ($p < 0.05$). The comparatively high manganese content of M3 and M4 clearly reveals that those mushroom varieties offered potential to supply more nutritional benefits than their basic nutritional components. The existence of fairly good amounts of Mn in all the samples has also confirmed the role of edible mushrooms in supplying micronutrients and supporting regular metabolism.

Cobalt (Co)

Contents of Cobalt: Cobalt content varied from 0.54mg/100g (M4) to 2.87 mg/100g (M5). M1 (2.63mg/100g) and M7 (2.19mg/100g) also displayed higher levels, while M2, M3, and M6 recorded medium levels. Differences among varieties tested were highly significant($p<0.05$). Differences in cobalt levels of mushroom samples reflect variations in uptake of cobalt from the substrate material used. However, cobalt is required in very small amounts, and it is highly improbable for the present level of cobalt to cause any deficiency or toxicity when consuming mushrooms in a diet.

Copper (Cu)

Copper content ranged from 0.23 mg/100g (M2) up to 1.32 mg/100g (M6), with some also showing relatively high copper values; i.e., M5 (1.14 mg/100g), M7 (0.85 mg/100g)

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and M1 (0.75 mg/100g). The results of the statistical analysis of copper showed that there were significant differences ($p < 0.05$) between the tested mushroom species. The increased values in copper found in M6 and M5 further support improving quality, as those mushrooms had high protein content and high macro-mineral contents simultaneously. Thus, it is recommended that these mushrooms may help in overcoming deficient micronutrient contents of meals.

Chloride (Cl)

Chloride values found in edible mushroom samples varied from 12.40 (M2) to 34.40 mg/100 g (M5). Mushroom samples M6 (29.70 mg/100 g) and M7 (28.00 mg/100 g) also contained high concentrations, while intermediate values were registered for M1, M3 and M4. Differences among varieties were significant ($p < 0.05$). Findings of this investigation show that edible mushrooms contribute slightly to human dietary chloride intake and that variations of chloride concentration among different varieties depend on their composition and mineral absorbing capacity.

Iodine (I)

Average iodine content in tested mushroom varieties varied from a low of 12.44 mg/100 g (M7) to a high of 18.00 mg/100 g (M4), while other samples contained approximately 12.60-14.80 mg/100 g. The result shows statistical differences ($p < 0.05$) among the tested mushroom samples. A measurable amount of iodine was found in all samples, suggesting that mushrooms can be considered a dietary supplement source of this micronutrient. However, it cannot substitute for the entire intake of the day as far as dietary sources of iodine are concerned; it can be an additional component.

Lead (Pb)

The levels of lead identified were between 0.60 mg/100 g for M3 and 1.68 mg/100 g in M2, while M5 and M6 also had somewhat higher readings. A substantial difference ($p < 0.05$) was detected in the mushroom types. Even if it is important to ensure the presence of measurable amounts in consumed samples to prevent such heavy metal bioaccumulation, it is crucial to maintain monitoring of their cultivating location (Afolabi et al., 2026). Adherence to good agricultural practices, proper substrates and routine analysis of quality should be maintained in order to promote public trust in these comestibles.

Cadmium (Cd)

The analysis showed no trace of cadmium in any of the investigated mushrooms, which the writer thinks is among the most critical findings in the entire study about food safety, as cadmium is a toxic heavy metal known to affect kidney function, bones, and cause a range of diseases when a person is exposed to the metal over time. The lack of detectable amounts of cadmium means the cultivation substrates used for the selected mushroom types and their growing conditions were devoid of any significant amounts of cadmium contamination.

Table 3 shows the levels of both phytate phosphorus and total phytate composition of the seven selected varieties, which also vary significantly ($p < 0.05$) between varieties for these parameters, meaning phytate accumulates differently depending on the variety.

Phytate phosphorus

Phytate phosphorus was from 0.39 mg/100g for M4 to 0.91 mg/100 g for M7 (Table 1). M2 had a concentration of 0.64 mg/100g. The other varieties had concentration in a range from 0.72 mg/100g to 0.88 mg/100g (M1 (0.72 mg/100g), M6 (0.78 mg/100 g), M3 (0.84 mg/100 g) and M5 (0.88 mg/100 g)) and there was significant difference ($p<0.05$) between the varieties for the value of phytate phosphorus concentration. Given the relatively low values of phytate phosphorus in this study, it can be inferred that only a low portion of the total phosphorus in these mushrooms was present in the form of phytate.

This can be nutritionally beneficial as it means that a large proportion of P and some associated mineral ions remain biologically available to the consumer and that the high levels of calcium, potassium, magnesium and phosphorus that were determined in Table 2 cannot be limited by phytate formation. M4, the mushroom, had the lowest phytate phosphorus concentration, which is assumed to have the minimum level of mineral complexation. However, the values obtained for M7 and M5 were slightly elevated, but the phytate content is not high enough to hinder nutrient availability under normal feeding circumstances. These differences might arise due to genotypic variation, the metabolic process, nutrient composition in the substrate, and environmental condition in growing period (Aguchem et al., 2022). Mushrooms vary significantly in terms of capacity for storage compound synthesis and accumulation; hence, this causes significant variation in the concentration of phytate according to species.

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Phytate Composition

Total phytate concentration ranged from 2.28 mg/100g in M2 to 4.92 mg/100g in M4. Other mushroom varieties, namely M1, M3, M5, M6 and M7, had moderate phytate contents varying from 2.56 mg/100g to 3.19 mg/100g. Significant differences ($p<0.05$) existed among the selected mushroom varieties. Since low concentrations of phytic acid have been observed in the tested mushrooms, it may not be advisable to interpret these concentrations from the perspective of their nutritional relevance, since concentrations in various cereals and legumes are often found in sufficient levels and will significantly

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reduce the bioavailability of essential minerals. The mushrooms assessed are less likely to impede significant mineral absorption when consumed with mixed foods. High phytate content in M4 (4.92 mg/100g) may not detract from its significance since it contains substantial mineral elements and protein contents as well. Also, M5 and M7 combined both phytic acid levels with the highest protein and mineral levels, so they can also be said to be high-quality edible mushrooms. Thus, we may consider the nutritional quality as a balance between health benefit constituents with its natural occurring antinutritional constituents, not only based on phytic acid content alone.

Relationship Between Phytate and Mineral Composition

The important aspect of this research is how the phytate content is interrelated with the mineral composition in different mushroom varieties. Even if there was a detectable concentration of phytate found in all the samples, it was negligible in relation to the massive quantities of minerals, such as Ca, K, Mg, P, Cu, and Zn, as cited in Table 2. This indicates that the high mineral content found would have the least chances of restriction to its health benefits because of this high phytate content. This is true in mushroom samples M5, M6, and M7, with the highest concentrations of protein having the highest concentrations of Ca, K, P, and Cu but low concentrations of phytate as well. The case of M4, where the phytate concentrations are highest among all varieties, also proves the same since it has a very high content of Ca, P, Zn, and Iodine. The balance between necessary minerals and phytate is more in favor of necessary minerals in these mushrooms. Phytate levels, even low, should not affect the contribution of the mushrooms to human nutrition, since a range of factors are involved in mineral bioavailability and not only the level of phytate (Richards et al., 2025).

Nutritional Implications

This profile on the phytate composition of the mushrooms selected in this research is a clear indicator of the nutritional relevance of the species studied. Unlike numerous staple foods such as cereals or legumes that contain very high levels of phytic acid and that limit mineral bioavailability, the samples analysed showed relatively low phytic acid concentrations, combined with high amounts of nutritionally important macro- and microelements, suggesting they could be interesting ingredients for food production, such as ingredients for functional foods or balanced diets focusing on micronutrient supply. These aspects are of particular relevance for susceptible consumers such as children, pregnant women, elderly people and individuals following a mainly plant-based diet in which microelement bioavailability might represent a problem. Finally, low phytate content goes hand in hand with the higher protein and mineral contents already discussed in the previous sections of this article, which highlight the potential of mushrooms as highly nutritious foods.

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Mineral Bioavailability and Food Safety

Interesting is the fact that a positive correlation was recorded between mineral content and phytic acid. Phytate was observed to occur in all the mushroom varieties, but their content was relatively low, especially considering the levels of the vital mineral elements. This was evidence to suggest that the vital elements in mushrooms present could reasonably be anticipated to be reasonably accessible to our digestive systems post-consumption. Another welcome finding from the report on food safety was the lack of any traces of cadmium in the examined mushroom varieties, which goes to support that substrates for the production of the mushrooms had no traces of substantial contamination with cadmium. There were traces of lead, which were, in effect, more a confirmation that there is the need for continual evaluation of the substrates used for cultivation and surrounding environmental factors rather than any issue with the consumption of the mushrooms. Mushrooms tend to bioaccumulate minerals; thus, the ongoing quality checks on our growing operations remain extremely crucial.

Potential Applications in Food and Nutrition

Nutritional features observed in the study had the widest prospect to use those varieties in the food industry. The high protein, relatively low-fat content, fairly good percentage of fibre and relatively higher contents of mineral elements indicated the high prospectivity for its usage in the preparation of functional food, protein enriched diet, composite flours, extenders of meat product, ready-to-cook instant soups, snack food and enriched complementary food. Besides these, the powdered forms of the varieties of those mushrooms could also serve as natural nutrients fortifiers to cereals and products, and bakery items.

Implications for Food Security and Sustainable Nutrition

But these results have wider food and agriculture policy implications, beyond their value as a nutritional product. Mushrooms require a significantly small amount of land to produce and can be grown on a variety of agricultural wastes and other lignocellulosic substrates. Thus, mushrooms can convert value-poor biomaterials to high-value edible products and contribute to the concept of the circular economy and environmental sustainability.

Delimitation of the Study

This research has confined itself to the comparative evaluation of proximate composition, mineral profile, and phytate content of seven edible mushroom varieties selected for the study. Molecular species identification of mushrooms, amino acid profile, fatty acid characterisation, vitamin profile, antioxidant activities, and other bioactive phytochemicals were not part of this research. The functional properties, including

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protein digestibility, water absorption capacity, emulsifying property, foaming characteristic and sensory quality, were also not determined in this work. Moreover, only certain nutrients were estimated in the selected edible mushroom species under laboratory conditions. No work was carried out to explore the effect of cultivation substrate, environmental conditions, geographical origin, stage of harvest, post-harvest processing and storage practice on the nutritive content of edible mushrooms. Hence, this report must be interpreted with respect to samples and working conditions taken for the analysis.

Conclusion

A comparative evaluation of nutritional values (proximate composition, minerals and phytates) of 7 chosen varieties of edible mushrooms was undertaken in this research work to analyze proximate composition. The mushroom varieties varied significantly ($p < 0.05$) in all the nutritional characteristics assessed, showing that variety significantly affects their nutritional values. Proximate composition showed variation in moisture, protein, fiber, fat, ash, and nitrogen-free extract in mushroom species. All samples generally had low levels of moisture, which is conducive to good shelf-life on drying, indicating a high concentration of nutrients due to a high dry matter value. Varieties M5, M6 and M7 recorded the highest level of crude protein, as that made it good alternative proteins. Crude fat was recorded low in all the mushroom varieties, indicating a diet low in fat could be designed. Fiber and ash were also good and beneficial for good digestion and mineral supply, respectively.

The results of mineral analysis have shown that all studied types of mushrooms are a good source of both essential macro- and microelements. Relatively high concentrations of K, P, Ca, and Mg have been found. In contrast, the values for Zn, Cu, Mn, Co, Cl, and I are at levels significant from a nutritional point of view. Neither sample must have shown positive for Cd, so it can be concluded that the mushrooms analysed do not create health risks for consumers due to the presence of this contaminant under the investigated conditions. Pb concentration, although in small values, can still lead to continuous control in both stages - cultivation and harvesting to ensure the safety of mushrooms. The content of phytic acid was differed between mushroom types and was in the general range considered low, which means that it does not impose considerable threats concerning absorption of nutrients from these foods and thus it would likely contribute favorably to the bioavailability of these nutrients. Together, proximate composition, mineral profile, and phytic acid content could lead to the conclusion that the tested types of mushrooms have a good nutritive value contributing to enhanced protein and minerals.

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Recommendations

Based on the study results, the following recommendations are made:

1. The comparatively rich crude protein content of mushroom varieties M5, M6 and M7 should be recommended for commercialization and be exploited as a relatively cheap alternative plant-based protein to contribute to ensuring food and nutritional security.
2. Nutritionally rich mushroom varieties identified in this study should be recommended for use in developing functional foods, dietary supplements, and value-added food products for the improvement of protein and micronutrient contents.
3. Heavy metal monitoring in cultivated and wild mushrooms in the cultivation zones should be encouraged to maintain a close vigil on food safety as stipulated in national and international guidelines, though no detectable level of Cadmium was observed in this study.
4. Amino acid profile, vitamin content, fatty acid composition, antioxidant activity, and other bioactive compounds analyses should be performed on these mushroom varieties for their better Nutritional assessment in future studies.
5. Bioavailability of essential minerals in the context of phytic acid and other anti-nutritional factors should be worked out using in vitro and in vivo models for their biological significance.
6. Effect of substrates used, cultivation environmental conditions, processing, drying methods and duration of storage on nutritional value of mushroom varieties should be done.
7. Consumer acceptability and sensorial qualities, functional values, and industrial processing performance studies should be done for wider application and commercialization.
8. Similar studies should be done on other locally adapted as well as cultivated species in different ecological zones for a broader database of mushroom nutrition, which will aid research policy makers and mushroom productionists for the benefit of people and also to support mushroom industrial production.

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