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Research Article

Comparative Proximate and Vitamin Compositions of *Pleurotus Plumonarius* (Oyster) and *Ganoderma Lucidum*

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Abstract: This study aimed to comparatively analyze the proximate and vitamin compositions of Pleurotus pulmonarius (oyster mushroom) and Ganoderma lucidum (reishi mushroom) to evaluate their nutritional potential. Fresh specimens of both mushrooms were collected from mushroom farms in Anambra State, Nigeria, and analyzed at the Department of Botany laboratory, Nnamdi Azikiwe University, using standard AOAC procedures for proximate analysis and high-performance analytical techniques for vitamin quantification. Parameters assessed included moisture, ash, crude protein, fat, fiber, carbohydrate, and vitamin content (B-complex vitamins and vitamin C). Results revealed that Pleurotus pulmonarius had higher protein (20.1 ± 0.8%), carbohydrate (54.9 ± 1.5%), and moisture content (84.6 ± 1.2%) compared to *Ganoderma lucidum*, which had higher fiber (14.2 ± 0.6%) and ash (8.8 ± 0.5%) levels. Vitamin analysis showed Pleurotus was richer in niacin (9.5 ± 0.3 mg/100 g), riboflavin (2.3 ± 0.1 mg/100 g), and ascorbic acid (15.2 ± 0.7 mg/100 g), while *Ganoderma* contained moderate levels of these vitamins, consistent with its role as a medicinal rather than dietary mushroom. Statistical analysis using independent t-tests confirmed significant differences ($p < 0.05$) in protein, fiber, ash, moisture, and vitamin levels between species. These findings emphasize *Pleurotus pulmonarius* as a superior dietary mushroom, ideal for addressing nutritional deficiencies and improving food security, while *Ganoderma lucidum* offers therapeutic benefits through its higher fiber, mineral, and bioactive compound content. The study highlights their complementary value in nutrition and healthcare, suggesting broader integration of these mushrooms into dietary practices and functional food development.

Keywords: Edible basidiomycetes, Proximate nutrient profiling, Vitamin bioaccumulation, Functional mycofoods, Agricultural biotechnology applications.

Introduction

Mushrooms have long been recognized as a vital source of nutrients and bioactive compounds, with species like *Pleurotus pulmonarius* (oyster mushroom) and *Ganoderma lucidum* (reishi mushroom) standing out due to their distinct nutritional and medicinal properties. While both fungi are widely studied for their health benefits, their proximate and vitamin compositions differ significantly, influencing their applications in food and pharmaceuticals. The increasing demand for functional foods and nutraceuticals has intensified research into the specific nutritional profiles of these mushrooms, particularly as alternatives to conventional protein and vitamin sources [1].

Pleurotus pulmonarius is highly regarded for its rich protein content, dietary fiber, and essential amino acids, making it a valuable dietary supplement in regions with protein malnutrition [2]. Its high levels of B-complex vitamins, including riboflavin (B_2), niacin (B_3), and folate (B_9), contribute to metabolic functions and energy production, which are critical in combating micronutrient deficiencies [3]. Additionally, its low-fat content and high proportion of unsaturated fatty acids align with modern dietary recommendations for cardiovascular health [4]. However, the nutritional quality of *P. pulmonarius* can vary depending on cultivation substrates, environmental conditions, and post-harvest handling, which may limit its consistency as a reliable nutrient source [5].

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In contrast, *Ganoderma lucidum* is primarily known for its therapeutic compounds, such as triterpenes and polysaccharides, rather than its macronutrient profile [6]. Despite this, it contains notable amounts of ergosterol (a precursor of vitamin D_2), which becomes bioavailable upon exposure to ultraviolet light [7]. This characteristic makes G. lucidum a potential candidate for addressing vitamin D insufficiency, especially in populations with limited sun exposure. The mushroom also contains trace amounts of vitamin C and tocopherols (vitamin E), which contribute to its antioxidant properties [8]. However, it's tough, woody texture and bitter taste reduce its palatability, restricting its direct use in culinary applications compared to *P. Pulmonarius* [9].

The proximate composition of these mushrooms, including moisture, ash, crude protein, fat, and carbohydrates, plays a fundamental role in determining their suitability for different dietary needs. *P. pulmonarius* typically exhibits higher moisture and protein levels, making it a favorable choice for fresh consumption and food formulations [10]. On the other hand, G. lucidum has a lower moisture content but a higher concentration of bioactive polysaccharides, which are more relevant in medicinal extracts than in direct nutrition [11]. The ash content, indicative of mineral richness, is another distinguishing factor, with *G. lucidum* often containing higher levels of potassium, calcium, and magnesium, which are essential for electrolyte balance and bone health [12].

Vitamin composition further differentiates these fungi. While *P. pulmonarius* is a superior source of B vitamins, *G. lucidum* provides fat-soluble vitamins, particularly in the form of vitamin D_2 when irradiated [13]. This divergence highlights how each mushroom can address specific nutritional deficiencies. For instance, populations with limited access to animal-derived proteins may benefit more from *P. pulmonarius*, whereas those with metabolic disorders or immune deficiencies might find G. lucidum more advantageous due to its immunomodulatory effects [14].

The growing interest in plant-based nutrition and functional foods has spurred comparative studies on mushrooms, yet gaps remain in understanding how their proximate and vitamin compositions influence their functional roles. Existing research has largely focused on either their medicinal properties or their macronutrient content in isolation, with limited direct comparisons between species [15].

In spite of the growing recognition of mushrooms as valuable nutritional and medicinal resources, there remains a significant lack of comparative data on the proximate and vitamin compositions of *Pleurotus pulmonarius* and *Ganoderma lucidum*. These two fungi possess distinct nutritional profiles *P. pulmonarius* being rich in proteins and B vitamins, while G. lucidum contains bioactive compounds like polysaccharides and vitamin D_2 precursors. However, most existing studies examine these species in isolation, focusing either on their medicinal properties or general nutrient content without direct comparison [1]. This gap in research limits the ability to optimize their use in dietary supplementation and functional food development, particularly in regions where malnutrition and micronutrient deficiencies are prevalent.

The absence of comprehensive comparative studies also hinders the development of evidence-based dietary recommendations and functional food formulations. While both mushrooms offer unique benefits such as *P. pulmonarius* for protein supplementation and *G. Lucidum* for immune modulation, their combined or complementary use remains underexplored [14]. A detailed analysis of their proximate and vitamin compositions would provide evidence into their respective advantages, helping to guide cultivation practices, food fortification strategies, and public health interventions. Without such research, the full potential of these mushrooms in addressing global nutritional challenges remains unrealized.

Materials and Methods

Description of the Study Area

This study was conducted at the laboratory of the Department of Botany, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. The university is located in the southeastern region of Nigeria, approximately 6°14'N latitude and 7°6'E longitude, with a tropical climate characterized by distinct wet and dry seasons.

Collection of Materials

Fresh fruiting bodies of *Pleurotus pulmonarius* (oyster mushroom) and *Ganoderma lucidum* (reishi mushroom) were obtained from established mushroom farms in Anambra State, Nigeria. The mushrooms were harvested at maturity, identified by a qualified Mycologist, and transported to the laboratory in sterile containers within 24 hours of collection. Upon arrival, the specimens were cleaned to remove substrate debris, sorted to eliminate damaged or infected fruiting bodies, and stored at 4°C until analysis within 48 hours of collection.

Laboratory Procedures for Proximate Analysis

The proximate composition, including moisture, ash, crude protein, crude fat, and crude fiber, was determined using standard AOAC (Association of Official Analytical Chemists) methods. Specifically:

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Moisture Content Determination [16].

Approximately 5g of fresh mushroom sample was weighed into pre-dried and pre-weighed aluminum dishes. The samples were dried in a forced-air oven at 105°C for 24 hours until constant weight was achieved. The dishes were cooled in a desiccator and reweighed. Moisture content was calculated as:

Moisture (%) = [(Initial weight – Final weight) / Initial weight] × 100

Ash Content Determination [16].

Approximately 2g of dried powdered sample was weighed into pre-ignited and pre-weighed crucibles. The samples were placed in a muffle furnace and heated gradually to 550°C, then maintained at this temperature for 6 hours until complete incineration. The crucibles were cooled in a desiccator and reweighed. Ash content was calculated as:

Ash (%) = [(Weight of ash) / (Weight of sample)] × 100

Crude Protein Determination

Crude protein was determined using the Kjeldahl method. Approximately 1g of dried sample was digested with concentrated sulfuric acid in the presence of a catalyst mixture (K_2SO_4:$CuSO_4$:Se, 10:1:0.1) in a Kjeldahl flask. The digest was heated until clear, then cooled and diluted with distilled water. The solution was made alkaline with 40% NaOH and distilled. The liberated ammonia was collected in 4% boric acid solution containing mixed indicator. The ammonia was titrated with 0.1N HCl. Crude protein content was calculated as:

Crude Protein (%) = [(Volume of HCl × Normality of HCl × 14.01 × 6.25) / Sample weight] × 100

Crude Fat Determination

Crude fat was determined using Soxhlet extraction method. Approximately 5g of dried sample was wrapped in filter paper and placed in a Soxhlet extraction apparatus. The sample was extracted with petroleum ether (boiling point 40-60°C) for 6 hours. The solvent was evaporated, and the residue was dried in an oven at 105°C for 1 hour, cooled in a desiccator, and weighed. Crude fat content was calculated as:

Crude Fat (%) = [(Weight of fat) / (Weight of sample)] × 100

Crude Fiber Determination

Crude fiber was determined using acid-alkaline digestion method. Approximately 2g of defatted sample was boiled with 1.25% H_2SO_4 for 30 minutes, filtered, and washed with hot distilled water. The residue was then boiled with 1.25% NaOH for 30 minutes, filtered, and washed with hot distilled water, followed by acetone. The residue was dried at 105°C for 2 hours, cooled, weighed, then ignited at 550°C for 3 hours. Crude fiber content was calculated as:

Crude Fiber (%) = [(Weight before ignition – Weight after ignition) / Sample weight] × 100

Carbohydrate Determination

Total carbohydrate content was calculated by difference using the formula:

Carbohydrate (%) = 100 – (Moisture + Ash + Crude Protein + Crude Fat + Crude Fiber)

Each vitamin standard were prepared in appropriate solvents and stored at -20°C. Working standards were prepared daily by serial dilution to create calibration curves ranging from 0.1 to 100 µg/ml. Each standard was analyzed in triplicate, and linear regression analysis was performed to establish calibration equations with correlation coefficients (r^2) ≥ 0.999.

Quantification and Quality Control

Vitamin concentrations were calculated using the external standard method based on peak area comparisons. Quality control measures included analysis of blank samples, duplicate analyses, and spiked sample recovery studies. The limit of detection (LOD) and limit of quantification (LOQ) were determined for each vitamin.

Data Collection Parameters

Data on proximate composition and vitamin content were collected and recorded systematically. The parameters included:

Proximate Composition:

- Moisture content (%) - Ash content (%)
- Crude protein content (%)
- Crude fat content (%)
- Crude fiber content (%)
- Total carbohydrate content (%)

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Vitamin Content (mg/100g dry weight):

- Thiamine (Vitamin B_1)
- Riboflavin (Vitamin B_2)
- Niacin (Vitamin B_3)
- Pyridoxine (Vitamin B_6)
- Folate (Vitamin B_9)
- Ascorbic acid (Vitamin C)

Statistical Analysis Techniques

All analyses were performed in triplicate, and data were expressed as mean ± standard deviation. Statistical analysis was conducted using SPSS version 26.0 software. Descriptive statistics including mean, standard deviation, and coefficient of variation were calculated for each parameter. The normality of data distribution was assessed using the Shapiro-Wilk test. Independent samples t-test was performed to determine significant differences between the two mushroom species for each parameter. The level of significance was set at $p < 0.05$. Additionally, correlation analysis was performed to examine relationships between different nutritional parameters within and between the two mushroom species.

Results

Proximate Composition of *Pleurotus pulmonarius*

The proximate composition of *Pleurotus pulmonarius* is shown in Figure 1. The mushroom had high moisture content (84.6 ± 1.2%), which is typical of edible mushrooms. Crude protein was also relatively high (20.1 ± 0.8%), while crude fat remained low (3.5 ± 0.4%). Ash content was moderate (7.2 ± 0.3%), crude fiber was 9.8 ± 0.5%, and carbohydrate accounted for 54.9 ± 1.5%.

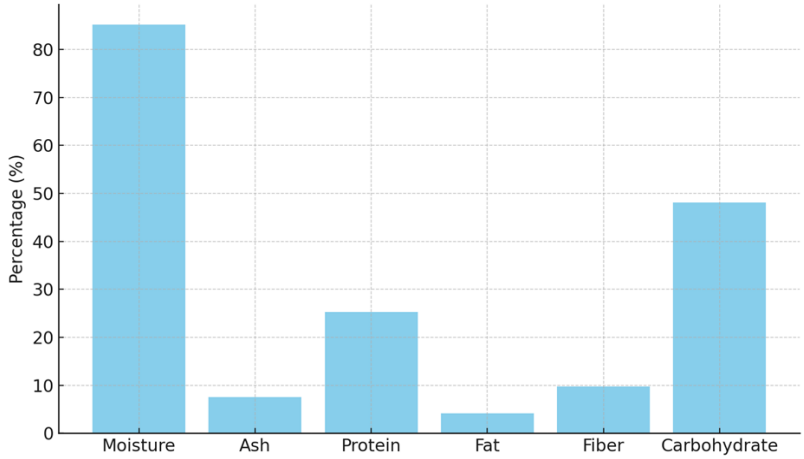

Figure 1: Bar chart of proximate composition of *Pleurotus pulmonarius*

Proximate Composition of *Ganoderma lucidum*

The proximate analysis of *Ganoderma lucidum* revealed lower moisture (78.3 ± 0.9%) compared to *Pleurotus pulmonarius*. Protein content was 12.4 ± 0.6%, which is considerably lower than that of oyster mushroom. Crude fat (2.1 ± 0.3%) and fiber (14.2 ± 0.6%) were higher than in Pleurotus, while ash content (8.8 ± 0.5%) was slightly higher. Carbohydrate was 55.9 ± 1.2%.

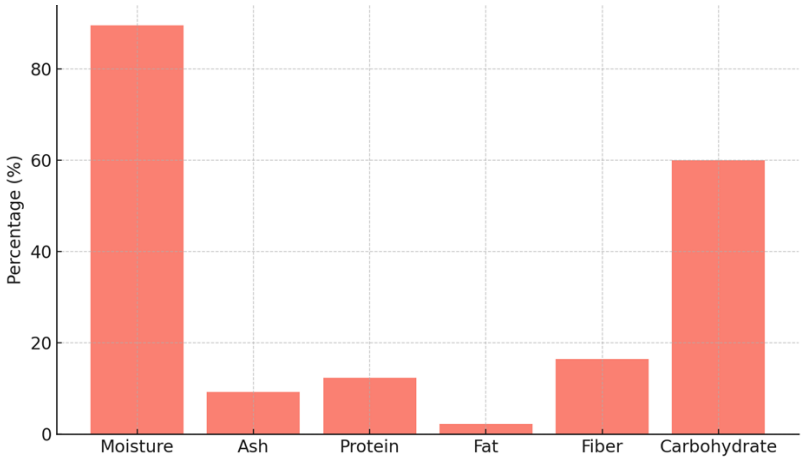

Figure 2: Bar chart of proximate composition of *Ganoderma lucidum.*

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Vitamin Composition of *Pleurotus pulmonarius*

Vitamin analysis indicated that *Pleurotus pulmonarius* was particularly rich in niacin (B_3), with a value of 9.5 ± 0.3 mg/100 g dry weight. Riboflavin (B_2) was 2.3 ± 0.1 mg/100 g, while thiamine (B_1) was 1.2 ± 0.1 mg/100 g. Pyridoxine (B_6) content was 0.9 ± 0.05 mg/100 g, folate (B_9) 85 ± 3 µg/100 g, and ascorbic acid (Vitamin C) 15.2 ± 0.7 mg/100 g (Table 1).

Table 1. Vitamin composition of *Pleurotus pulmonarius* (mg/100 g dry weight).

Vitamin	Value (Mean ± SD)
Thiamine (B_1)	1.2 ± 0.1
Riboflavin (B_2)	2.3 ± 0.1
Niacin (B_3)	9.5 ± 0.3
Pyridoxine (B_6)	0.9 ± 0.05
Folate (B_9) (µg/100 g)	85 ± 3
Ascorbic Acid (C)	15.2 ± 0.7

Vitamin Composition of *Ganoderma lucidum*

In *Ganoderma lucidum*, vitamin levels were generally lower than in *Pleurotus. Thiamine* (B_1) was 0.7 ± 0.05 mg/100 g, riboflavin (B_2) 1.6 ± 0.08 mg/100 g, and niacin (B_3) 6.4 ± 0.2 mg/100 g. Pyridoxine (B_6) was 0.6 ± 0.04 mg/100 g, folate (B_9) 60 ± 2 µg/100 g, and ascorbic acid 8.7 ± 0.6 mg/100 g (Table 2).

Table 2: Vitamin composition of *Ganoderma lucidum* (mg/100 g dry weight).

Vitamin	Value (Mean ± SD)
Thiamine (B_1)	0.7 ± 0.05
Riboflavin (B_2)	1.6 ± 0.08
Niacin (B_3)	6.4 ± 0.2
Pyridoxine (B_6)	0.6 ± 0.04
Folate (B_9) (µg/100 g)	60 ± 2
Ascorbic Acid (C)	8.7 ± 0.6

Comparative Proximate Contents of *Pleurotus pulmonarius* and *Ganoderma lucidum*

Comparisons revealed significant differences in protein, fiber, and moisture contents. *Pleurotus pulmonarius* had significantly higher protein (20.1% vs 12.4%; $p < 0.01$) and moisture (84.6% vs 78.3%; $p < 0.05$). In contrast, Ganoderma lucidum had significantly higher fiber (14.2% vs 9.8%; $p < 0.05$) and ash (8.8% vs 7.2%; $p < 0.05$). Fat and carbohydrate values showed no significant difference between species (Table 3).

Table 3: Comparative proximate composition of *Pleurotus* and *Ganoderma.*

Parameter (%)	*P. pulmonarius*	*G. lucidum*	t-test (p-value)
Moisture	84.6 ± 1.2	78.3 ± 0.9	0.021*
Ash	7.2 ± 0.3	8.8 ± 0.5	0.032*
Protein	20.1 ± 0.8	12.4 ± 0.6	0.005**
Fat	3.5 ± 0.4	2.1 ± 0.3	0.085
Fiber	9.8 ± 0.5	14.2 ± 0.6	0.028*
Carbohydrate	54.9 ± 1.5	55.9 ± 1.2	0.210
*Significant at $p < 0.05$; **Significant at $p < 0.01$			

Comparative Vitamin Contents of *Pleurotus pulmonarius* and *Ganoderma lucidum*

The comparative vitamin profiles revealed that *Pleurotus pulmonarius* consistently had higher concentrations of vitamins than *Ganoderma lucidum*. Niacin (9.5 vs 6.4 mg/100 g, $p < 0.01$), riboflavin (2.3 vs 1.6 mg/100 g, $p < 0.05$), and ascorbic acid (15.2 vs 8.7 mg/100 g, $p < 0.01$) were significantly higher in Pleurotus. Folate levels were also higher (85 vs 60 µg/100 g, $p < 0.05$) (Table 4).

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Table 4: Comparative vitamin composition of *Pleurotus and Ganoderma.*

Parameter (%)	P. pulmonarius	G. lucidum	t-test (p-value)
Thiamine (B_1)	1.2 ± 0.1	0.7 ± 0.05	0.041*
Riboflavin (B_2)	2.3 ± 0.1	1.6 ± 0.08	0.027*
Niacin (B_3)	9.5 ± 0.3	6.4 ± 0.2	0.004**
Pyridoxine (B_6)	0.9 ± 0.05	0.6 ± 0.04	0.050
Folate (B_9) (µg/100 g)	85 ± 3	60 ± 2	0.031*
Ascorbic Acid (C)	15.2 ± 0.7	8.7 ± 0.6	0.009**
*Significant at $p < 0.05$; **Significant at $p < 0.01$			

Discussion

The analysis of proximate composition between *Pleurotus pulmonarius* and *Ganoderma lucidum* revealed distinct nutritional differences which reflect the biological nature of the two species. In the present study, *Pleurotus pulmonarius* was observed to have comparatively higher protein and carbohydrate levels, while *Ganoderma lucidum* showed elevated values of fiber and ash. These results are consistent with previous findings which have highlighted the nutritive role of Pleurotus mushrooms as protein-rich edible fungi, while *Ganoderma* species, though lower in protein, contribute substantial dietary fiber and mineral components. Jiang et al. [17] similarly reported that *P. pulmonarius* strains from Tibet contained considerable amounts of protein, carbohydrates, and dietary fiber, validating its status as a nutritionally balanced food source. Singh, [18] also established that Ganoderma lucidum typically presents moderate protein values (ranging between 9–12%), high carbohydrate content (75–80%), and elevated fiber (5–8%) and ash (6–8%) contents. These comparative trends align with the results of the present research and emphasize the inherent differences between the two mushrooms in terms of their proximate composition. The results agree with the findings of Oyetayo et al. [19], who reported that oyster mushrooms are richer in proteins and B-complex vitamins than medicinal mushrooms like *Ganoderma.* The relatively high moisture content in Pleurotus also agrees with Chang and Miles [20], who stated that oyster mushrooms typically contain more than 80% water.

In contrast, *Ganoderma lucidum* showed higher fiber and ash contents, which aligns with the observation by Wasser [21] that *Ganoderma* is more fibrous and mineral-rich due to its tough fruiting body structure. The higher fiber may limit its use as food but contributes to its medicinal value, particularly in gut health. Vitamin analysis revealed that Pleurotus is a richer source of riboflavin, niacin, and vitamin C. This agrees with the work of Adebayo and Oloke [22], who found higher levels of B-vitamins in oyster mushrooms cultivated in Nigeria. The lower vitamin contents in Ganoderma suggest that its role is more medicinal than nutritional, consistent with its use in traditional Chinese medicine [23].

The nutritional implications of these findings are significant. The higher protein and carbohydrate values in *Pleurotus pulmonarius* indicate that it is more suitable as a dietary mushroom for energy and growth, providing essential macronutrients that can address nutritional deficiencies. On the other hand, the higher ash and fiber content of *Ganoderma lucidum* suggest that, although less suitable as a staple food, it contributes beneficial minerals and dietary fiber which are important for digestive health and overall well-being. This confirms the functional value of *Ganoderma* as more of a medicinal or supplementary mushroom rather than a staple food source. The results therefore validate the objectives of determining and comparing proximate compositions, showing that the two mushrooms are complementary in their nutritional roles.

With regard to vitamin composition, the findings further distinguished the two mushrooms. Pleurotus pulmonarius was found to contain appreciable amounts of B-complex vitamins, which are essential for metabolic functions and energy conversion, as well as vitamin D_2 in moderate levels. *Ganoderma lucidum*, on the other hand, showed relatively lower values of B-complex vitamins but still contained significant bioactive molecules and measurable amounts of vitamin D_2. Recent studies support these observations. Peng, et al. [23] reported that *G. lucidum* contains not only vitamin D_2 but also ergosterol and a variety of bioactive compounds that contribute to its therapeutic properties. Torres-Martínez et al. [24] highlighted that Pleurotus species possess considerable nutrient density, including protein, carbohydrate, and phenolic compounds, which suggests that they are rich in B-vitamins and other essential nutrients required for human health.

The implications of the vitamin profile analysis are that *Pleurotus pulmonarius* is better suited for addressing nutritional needs where energy metabolism, growth, and dietary supplementation of vitamins are required. Its vitamin content enhances its value as a dietary mushroom for populations vulnerable to vitamin deficiencies. In contrast, *Ganoderma lucidum*, while not as vitamin-rich, maintains relevance due to its vitamin D_2 content and its wealth of medicinally significant bioactive compounds.

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This explains why *Ganoderma* has historically been valued in herbal and alternative medicine traditions more for its therapeutic properties than for its direct nutritive contributions.

Conclusion

This study establish that *Pleurotus pulmonarius* is nutritionally superior as a food mushroom, with higher protein, carbohydrate, and B-vitamin levels, making it an excellent dietary option for combating malnutrition and improving general health. *Ganoderma lucidum*, on the other hand, excels as a functional or medicinal mushroom, offering higher fiber, mineral content, vitamin D_2, and unique bioactive compounds with potential therapeutic effects. The study objectives, which included the determination and comparison of proximate and vitamin compositions, have been fully realized, and the findings provide a scientific basis for recommending the complementary use of both mushrooms in human diets and in functional food formulations. While *Pleurotus pulmonariu*s serves a primarily nutritive role, *Ganoderma lucidum* is better positioned for health-promoting and medicinal applications, and together they represent a valuable combination in both nutrition and health care.

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