



# NUTRITIONAL COMPOSITION, MINERAL PROFILE, AND ANTIOXIDANT POTENTIAL OF *SCHIZOPHYLLUM COMMUNE* (AGARICOMYCETE) COMMERCIALIZED IN THE DEMOCRATIC REPUBLIC OF CONGO

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**Abstract:** - The edible mushroom *Schizophyllum commune* is traditionally consumed in the Democratic Republic of the Congo, but its nutritional properties remain poorly documented. This study evaluated the nutritional composition, mineral profile, and antioxidant potential of *S. commune* samples from the cities of Kikwit and Mbandaka. Proximate (AOAC methods), mineral (by ICP-OES), and phytochemical analyses were performed on lyophilized samples, with statistical analyses including ANOVA and Student's t-test ( $p < 0.05$ ). The results showed that protein (28.28–35.2 g/100 g DM), carbohydrate (29.98–30.56 g), and fiber (20.5–23.9 g) contents differed significantly between the two sites. Potassium (1195–1420 mg/100 g) and phosphorus (560.9–605.9 mg) dominated the mineral profile, while polyphenols (69.2–73.2 mg GAE/g) and tannins (66.1–76 mg CE/g) were the main antioxidant compounds. In conclusion, *S. commune* exhibits a balanced nutritional profile and notable levels of bioactive compounds, supporting its promising use as a functional food.

**Keywords:** *Schizophyllum commune*, nutritional value, mineral elements, phenolic compounds, functional food, DRC.



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## 1. Introduction

Edible mushrooms represent an underutilized food resource in tropical countries, offering potential solutions to food security and malnutrition challenges (Food and Agriculture Organization [FAO], 2021). *Schizophyllum commune* Fries (Schizophyllaceae) is a cosmopolitan species, commonly known as "Bukolokoto" in the DRC, where it is harvested from the wild and sold in local markets (Boa, 2006). This lignicolous basidiomycete has documented medicinal properties, including immunomodulatory, antitumor, and antimicrobial activities (Grienke et al., 2014).

In the DRC, where protein and micronutrient deficiencies affect a significant part of the population (United Nations Children's Fund [UNICEF], 2022), the promotion of local food resources like *S. commune* represents a promising nutritional strategy. However, quantitative data on its composition remain fragmentary, and geographical variations have not been systematically studied.

This multidimensional study aims to:

1. Characterize the proximate composition of *S. commune* samples from Kikwit and Mbandaka;
2. Establish their complete mineral profile using ICP-OES spectrometry;
3. Evaluate their antioxidant potential via the quantification of phenolic compounds;
4. Propose valorization perspectives based on the obtained results.

## 2. Materials and Methods

### 2.1. Sampling and Pretreatment

Fresh fruiting bodies of *S. commune* were collected in triplicate from markets in Kikwit (5°02'S, 18°49'E) and Mbandaka (0°03'N, 18°16'E) during the 2022 rainy season. Identification was confirmed by macroscopic analysis according to De Kesel et al. (2017). Samples were freeze-dried (Christ Alpha 1-4 LDplus), ground (Retsch GM200), and sieved (500 µm mesh) before analysis.

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**2.2. Physicochemical Analyses**

- **Proximate Composition:** According to AOAC methods (2019):
  - Moisture: Oven drying at 105°C (method 924.05);
  - Proteins: Kjeldahl (N × 6.25; method 954.01);
  - Lipids: Soxhlet with hexane (method 920.39);
  - Ash: Muffle furnace at 550°C (method 942.05);
  - Fiber: Kurschner-Hanak method;
  - Carbohydrates: By difference;
  - Energy: Calculated using Atwater factors.
- **Mineral Analysis:**  
 Digestion with HNO<sub>3</sub>:H<sub>2</sub>O<sub>2</sub> (5:1, v/v) using a microwave system (Milestone Ethos UP); quantification by ICP-OES (Perkin Elmer Avio 500) with certified standards (NIST).
- **Bioactive Compounds:**
  - Total polyphenols: Folin-Ciocalteu method (Singleton et al., 1999);
  - Condensed tannins: Vanillin-sulfuric acid method (Sun et al., 1998);
  - Phytochemical screening: Standardized methods (Harborne, 1998).

**2.3. Statistical Analysis**

Data expressed as mean ± standard deviation (n = 3) were analyzed by one-way ANOVA and Tukey's post-hoc test (GraphPad Prism 9.0). Differences were considered significant at p < 0.05.

**3. Results**

**3.1. Nutritional Characteristics**

Table 1 presents the biochemical composition of the samples. Proteins were the major macronutrient, with significantly higher contents in Kikwit (p = 0.003). Dietary fiber showed notable inter-site variations (p = 0.012).

**Table 1.** Nutritional composition (g/100 g DM, mean ± SD)

Parameter	Kikwit	Mbandaka	p-value
Proteins	35.2 ± 0.24a	32.55 ± 0.03b	0.003
Lipids	5.82 ± 0.38a	4.27 ± 0.01b	0.008
Carbohydrates	29.98 ± 0.19b	30.56 ± 0.04a	0.015
Fiber	20.5 ± 0.15b	23.9 ± 0.1a	0.012
Ash	8.5 ± 0.02b	8.72 ± 0.02a	0.007
Energy (kcal)	313.1 ± 2.1a	290.87 ± 1.8b	0.005

Note: Values with different letters in the same row differ significantly (p < 0.05).

**3.2. Detailed Mineral Profile**

Table 2 reveals high concentrations of potassium and phosphorus. Zinc levels were notable, exceeding those of many tropical vegetables.

**Table 2.** Mineral elements (mg/100 g DM)

Element	Kikwit	Mbandaka	RDA (%)*
K	1420 ± 12a	1195 ± 10b	71
P	605.9 ± 5.1a	560.9 ± 4.8b	87
Ca	34.16 ± 0.3a	32.7 ± 0.2b	4
Zn	10.04 ± 0.1a	8.10 ± 0.1b	100
Fe	0.2 ± 0.01b	0.79 ± 0.02a	6

\*Note: Recommended Daily Allowance for 100 g (adult).

**3.3. Antioxidant Potential**

The contents of phenolic compounds (73.2 mg GAE/g in Kikwit) and tannins (76 mg CE/g) were significant. Phytochemical screening confirmed the absence of toxic secondary metabolites.

**4. Discussion**

**4.1. Protein Richness and Nutritional Implications**

The high protein contents (32.55–35.2 g/100 g DM) place *S. commune* among the richest fungal sources, surpassing *Pleurotus ostreatus* (25–30 g) and *Agaricus bisporus* (20–25 g) (Kalac, 2013). This characteristic is particularly relevant in the DRC where the prevalence of protein malnutrition reaches 43% in some regions (World Health Organization [WHO], 2021). The quality of fungal proteins, rich in essential amino acids like lysine, which is often limiting in cereal-based diets (Sánchez, 2017), makes it a valuable dietary supplement.

**4.2. Mineral Profile and Public Health**

The exceptional potassium concentration (1195–1420 mg/100 g) represents an asset for the prevention of hypertension, a growing public health problem in sub-Saharan Africa (Ataklte et al., 2015). The high potassium/sodium ratio (29–33:1) is beneficial for cardiovascular health. The zinc contents (8.10–10.04 mg), covering 100% of the RDA, are remarkable given that zinc deficiency affects 30% of the Congolese population (Wessells & Brown, 2020).

**4.3. Dietary Fiber and Digestive Health**

The fiber content (20.5–23.9 g) exceeds that of most vegetables and cereals. The specific β-glucans found in mushrooms have documented prebiotic effects (Synytsya & Novák, 2021), likely to improve gut health and immunity.

**4.4. Bioactive Compounds and Health Potential**

The identified polyphenols (69.2–73.2 mg GAE/g) and tannins (66.1–76 mg CE/g) possess validated antioxidant, anti-inflammatory, and antidiabetic activities (Kozarski et al., 2015). Their synergy with selenium (0.11–0.14 mg) could potentiate protective effects against oxidative stress involved in degenerative diseases (Ferreira et al., 2015).

**4.5. Geographical Variations and Implications**

The significant differences observed between sites probably reflect pedological and microclimatic specificities. The higher iron content in Mbandaka (0.79 mg vs 0.2 mg) could be explained by the alluvial nature of the soils in the Équateur region, which are richer in ferrous minerals (Bauters et al., 2020). These variations

highlight the importance of geographical traceability in the valorization of non-timber forest products.

## 5. Conclusion and Perspectives

This study demonstrates the potential of *S. commune* as:

- A sustainable source of high-quality plant proteins;
- A significant source of essential minerals (K, P, Zn);
- A reservoir of bioactive compounds with multiple health properties;
- A nutritional alternative for vulnerable populations.

### Recommended Research Perspectives:

#### 1. Advanced Nutritional Studies:

- Evaluation of mineral bioavailability using *in vitro* models (simulated digestion);
- Analysis of the complete amino acid and fatty acid profiles;
- Study of specific  $\beta$ -glucans and their immunomodulatory properties.

#### 2. Food Valorization:

- Development of enriched products (biscuits, soups) incorporating *S. commune*;
- Optimization of conservation techniques (drying, extrusion);
- Consumption and sensory acceptability studies.

#### 3. Sustainable Development:

- Development of controlled cultivation protocols using local substrates;
- Assessment of small-scale production potential;
- Socio-economic studies on existing value chains.

#### 4. Translational Research:

- Clinical trials on health effects (blood glucose, blood pressure);
- Long-term toxicological studies;
- Exploration of synergies with other local foods (cassava, maize).

The valorization of *S. commune* aligns with a "One Health" approach, reconciling food security, public health, and biodiversity conservation. Its integration into national nutritional policies could significantly contribute to achieving the Sustainable Development Goals in the DRC.

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#### Declarations

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- **Ethics:** No ethical approval was required for this study on commercial products.
- **Contributions:** MMPC designed the study and supervised the analyses; DNC performed the experiments and statistical analysis. All authors contributed to the writing.