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1. Introduction

In different regions of Africa, the people's diet depends partially on edible products from wild animals, plants, or mushrooms, motivated not only by the high cost of living but also by the profusion of such products in local environment (Soro et al., 2019). In addition to being appreciated for their high nutritional value, rich in proteins, carbohydrates, elements (phosphorous, potassium, calcium, copper, magnesium, iron, zinc), vitamins, and lower fat amounts, these non-timber forest products (NTFPs) are the basis of various dietary, ethnic, cultural, religious, and medicinal considerations, depending on ethnic groups. Despite the rich biodiversity of the African continent, this remains largely unexplored resulting in a poor food contribution to the often malnourished populations (Yongabi et al., 2004).

Thus, the aim of this review is to gather information on the wild mushroom species used in Central and Southern Africa and their main uses, with a focus on food and medicinal species.

2. Mushroom diversity in African forests and importance of their use by rural communities

Most studies on edible mushrooms in Tropical Africa are pioneering and current inventories are generally quite incomplete (de Kesel et al., 2017). In many regions of Central Africa (Figure 1), edible mushrooms are known only by their vernacular names.

Most vernacular names have only usage. However, several of them are also used in different geographic areas. Some of these include "ochui vió" in Gabon, "ubwaba" in Burundi, "bowa" in Malawi, "ubuyoga" in Tanzania, "mbowa, ubuaba" or "uhwa" in Zambia; "boua" in the Central African Republic and the Democratic Republic of Congo, and "tortulho" in Angola (Buyck B., 1994; Harkonen, 1995; Malaisse, Kesel, N'gasse, & Lognay, 2008; Ndong et al., 2010; Pegler & Pearce, 1980).



Figure 1. Wild edible mushrooms main distribution in African countries. Source: (Degreef & de Kesel, 2017).

3. Collection of wild African mushrooms and traditional differentiating tools between edible and toxic mushrooms

Harvesting wild mushrooms for personal consumption is a risky activity, as the correct identification of the species is essential for their conscious and safe consumption (Machado-Gonçalves et al., 2018).



➤ Despite its nutritional and medicinal assets, wild mushrooms may contain high concentrations of potentially toxic elements (PTEs), such as toxic metals, rare earth elements (REEs), and radionuclides, which may be transferred to the human food chain throughout its consumption.

➤ The accumulation of toxic metals (arsenic, cadmium and lead) by mushrooms is independent of whether the species is edible or not. However, it depends on soil quality parameters and the nature of the environment.

➤ Human exposure to toxicity occurs primarily through consumption of mushrooms and their products and, to a lesser extent, indirectly through ingestion of edible insects and mushroom-eating wild animals.

➤ Long-term monitoring studies are needed in Africa

6. References

Barros, L., Pereira, C., & Ferreira, I. C. F. R. (2013). Optimized Analysis of Organic Acids in Edible Mushrooms from Portugal by Ultra Fast Liquid Chromatography and Photodiode Array Detection. *Food Analytical Methods*, 6, 309–316.

Buyck B. (1994). *UBWOBA: Edible mushrooms from western Burundi*. (Issue 34, p. 123). Publ. Agricole.

de Kesel, A. de, Kasongo, B., & Degreef, J. (2017). Edible mushrooms from Haut-Katanga. *RD Congo AbcTaxa*, 17, 1–290.

Degreef, J., & de Kesel, A. (2017). *Annotated database of edible fungi from tropical Africa*. Wwww.EFTA-Online.Org – Accessed On 02/17/2022.

Harkonen, M. (1995). *An ethnomycological approach to Tanzanian species of Amanita*. <http://repository.costechn.or.tz/handle/123456789/11878>

Leal, A. R., Barros, L., Barreira, J. C. M., Sousa, M. J., Martins, A., Santos-Buelga, C., & Ferreira, I. C. F. R. (2013). Portuguese wild mushrooms at the "pharma-nutrition" interface: Nutritional characterization and antioxidant properties. *Food Research International*, 50(1).

Machado-Gonçalves, L., Tavares-Santos, A., Santos-Costa, F., Soares-Diniz, R., Câmara-de Carvalho-Galvão, L., Martins-de Sousa, E., & Beninni-Paschoal, M. A. (2018). Effects of Terminalia catappa Linn. Extract on Candida albicans biofilms developed on denture acrylic resin discs. *Journal of Clinical and Experimental Dentistry*, 10(7). <https://doi.org/10.4314/jced.54776>

Martins, F. (2004). *Cogumelos. Património Natural Transmontano* (Vol. 1).

Mdachi, S. J. M., Nkunya, M. H. H., Nyigo, V. A., & Urusa, I. T. (2004). Amino acid composition of some Tanzanian wild mushrooms. *Food Chemistry*, 86(2). <https://doi.org/10.1016/j.foodchem.2003.08.030>

Malaisse, F., de Kesel, A., N'gasse, G., et al. (2008). Diversité des champignons consommés par les pygmées Bofi de la Lobaye (République centrafricaine). *Geocotop.Be*, 32, 1–8.

Ndong, H., & Degreef, J. (2010). Diversity of species of Cantharellus, Lentinus and Termitomyces consumed by the pygmies of North Gabon. In Royal Botanic Gardens (Ed.), *Systematics and conservation of African plants. Proceedings of the 18th AETFAT Congress, Yaoundé, Cameroon* (pp. 133–141).

Oyetayo, O. v. (2011). Medicinal uses of mushrooms in Nigeria: Towards full and sustainable exploitation. *African Journal of Traditional, Complementary and Alternative Medicines*, 8(3). <https://doi.org/10.4314/ajtam.v8i3.65289>

Pegler, D. N., & Pearce, G. D. (1980). The Edible Mushrooms of Zambia. *Kew Bulletin*, 35(3).

Rahi, D., & Malik, D. (2016). Diversity of mushrooms and their metabolites of nutraceutical and therapeutic significance. *Journal of Mycology*. <https://doi.org/10.1155/2016/7654123>

Soro, B., Abdoulaye Koné, Golo, Patricia Louyounan Vanié-Léabo, L., Konaté, S., Bakayoko, A., & Koné, D. (2019). Phytogeographical and sociolinguistic patterns of the diversity, distribution, and uses of wild mushrooms in Côte d'Ivoire, West Africa. *Journal of Ethnobiology and Ethnomedicine*, 15(5).

Tibuhwa, D. D. (2012). Folk taxonomy and use of mushrooms in communities around Ngorongoro and Serengeti National Park, Tanzania. *Journal of Ethnobiology and Ethnomedicine*, 8. <https://doi.org/10.1186/1746-4269-8-36>

Yongabi, K., Agho, M., & Carrera, D. (2004). Ethnomycological studies on wild mushrooms in Cameroon, Central Africa. *Micologia Aplicada*, 16(2), 34–36.

In Africa, the greatest risks of human exposure to mushroom toxicity may be due to:

1. The widespread consumption of mushrooms from various ferrous and highly mineralized substrates such as streamers and dumps;
2. Inadequate and poorly enforced environmental health and food safety regulations and policies;
3. Lack of environmental and human health monitoring data and well-equipped health facilities to facilitate early detection and treatment of human health effects;
4. Potential synergistic interactions between PTEs in mushrooms and other human food products and health stressors such as a high burden of human disease and infections;

However, the ethnomycological identification of toxic mushrooms is doubtful, as it is common to identify edible species, among others considered toxic by local populations.

4. Nutritional and medicinal features of wild edible mushrooms from Africa

Mushrooms are appreciated worldwide for their nutritional properties and pharmacological value, as they are considered important sources of bioactive compounds. Mushrooms are characterized by low energy levels and high amounts of minerals, essential amino acids, vitamins and fiber (Leal et al., 2013). Edible mushrooms are also a good source of protein and carbohydrates, with a low lipid content, which makes them a suitable food to be incorporated into low-calorie diets (Barros et al., 2013). The fruiting bodies of fresh mushrooms are rich in various carbohydrates that include glucose, chitin, glycogen, glucon and fiber (Rahi & Malik, 2016). Mushrooms are also rich sources of essential macro and micronutrients, being cofactors of numerous enzymes (Rahi & Malik, 2016).

In addition to their valuable nutritional properties, mushrooms also have medicinal assets. Some of which have been presented in Table 1. In Angola, although the consumption of wild mushrooms is widespread, there is practically no information on the species used their properties.

Table 1. Traditional medicinal uses of some wild mushrooms from Africa

Scientific name	Common/Local name	Country	Medicinal use	Source
<i>Auricularia auricular</i>	-	Nigeria	Treatment of hemorrhoids and hemoptysis	(Oyetayo, 2011)
<i>Auricularia polytricha</i>	-	Côte d'Ivoire	Peptic ulcer and hypertension	(Soro et al., 2019)
<i>Calvatia cyathiformis</i>	-	Nigeria	Treatment of leucorrhea, bareness, and hiccups	(Oyetayo, 2011)
<i>Daldinia concentrica</i>	-	Côte d'Ivoire, Nigeria	Hernia, stomachache, pediatrics (stomachache), reduction of big navel of newborn babies, invigoration of kidney's activity; Treatment of stomach ulcer and upset, skin disease, and whooping cough and prevention of excessive growth of fetus to ease the delivery;	(Oyetayo, 2011; Soro et al., 2019)
<i>Ganoderma spp</i>	Ubuyoga	Tanzania	Treatment of sick cow	(Mdachi et al., 2004)
<i>Ganoderma sp.</i>	-	Côte d'Ivoire	Pediatrics (whet newborn appetite)	(Soro et al., 2019)
<i>Ganoderma resinaceum</i>	-	Nigeria	Lowering blood sugar level and protecting liver cells	(Oyetayo, 2011)
<i>Ganoderma applanatum</i>	-	Nigeria	Antioxidant and used for lowering blood sugar level, as well as antihypertensive	(Oyetayo, 2011)
<i>Ganoderma lucidum</i>	-	Côte d'Ivoire, Nigeria, Cameroon	Stomachache, make giving birth easier, use as antibiotic after giving birth, hemorrhoid, healing wound, rheumatism, insecticide, Treatment of arthritis and neoplasia; Traditional medicine to treat skin infections, boils, abscesses, and tumors. It is also used as a component in other medicinal preparations	(Oyetayo, 2011; Soro et al., 2019; Yongabi et al., 2004)
<i>Lentinus tuber-regium</i>	-	Côte d'Ivoire	Pediatric, burn's wound	(Soro et al., 2019)
<i>Lentinus squarrosulus</i>	-	Nigeria	Treatment of mumps and heart diseases	(Oyetayo, 2011)
<i>Penicillium griseofulvum</i>	-	South Africa, Argelia, Kenya	Antibiotic and antifungal	(Martins, 2004)
<i>Pleurotus tuber-rigium</i>	-	Nigeria	Treatment of headache, cold, fever, stomachache, and constipation	(Oyetayo, 2011)
<i>Polyporu officinalis</i>	-	Nigeria	Treatment of hernia, cough, and catarrh	(Oyetayo, 2011)
<i>Termitomyces microcarpus</i>	Ubuyoga	Nigeria, Tanzania	Treatment of gonorrhoea, Health promoter and inducer of breast lactation	(Oyetayo, 2011; Tibuhwa, 2012)
<i>Termitomyces microcarpus</i>	-	Nigeria	Treatment of gonorrhoea	(Oyetayo, 2011)
<i>Schizophyllum commune</i>	-	Nigeria	Treatment of diabetes	(Oyetayo, 2011)
<i>Vovariealla volvaceae</i>	-	Côte d'Ivoire, Nigeria	Fat removal, Antibiotic and antineoplastic	(Oyetayo, 2011; Soro et al., 2019)

5. Conclusion and future perspectives

Although highly biodiverse, the Central African forest has much of its resources still underexploited or relatively unknown. The limitation of the safe use of mushrooms from this and other regions by their communities is guided by the scarcity of studies that allow validating their nutritional and medicinal properties, since mushrooms are good alternatives for the suppression of protein deficiency in the daily diet of these populations and a source of bioactive compounds useful for the formulation of functional products with added value. Therefore, the documentation of ethnomycological information is useful to confirm, or even correct the identification of specimens and conservation of these natural resources with potential for cultivation, to increase and improve consumption. However, it is crucial to carry out further studies on African mushrooms not only from the identification point of view, but also in terms of nutritional, chemical and bioactive characterization to enrich the existing database.



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