EDIBLE WILD MUSHROOMS OF ETHIOPIA: NEGLECTED NON-TIMBER FOREST PRODUCTS

SETAS SILVESTRES COMESTIBLES DE ETIOPÍA: PRODUCTOS FORESTALES NO MADEREROS MENOSPRECIADOS

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SUMMARY

This review summarizes existing ethnomycological work in Ethiopia. Although the literature to which we had access were scanty and limited in their scope, comprehensive issues such as the culture of collection and use of edible wild mushrooms in the country are summarized. In this review, moreover, a check list of available wild edible and medicinal mushrooms and their niches are also documented. The review reveals that wild mushrooms are the most neglected non-timber forest products (NTFPs). They are poorly studied and undocumented in Ethiopia as compared to other NTFPs and their importance for the livelihood of the local communities is also overlooked. Recognition of this resource is also hampered by the lack of taxonomic studies; most of the species are simply known locally by the shared common name "Enguday". Thus, this document can serve as baseline information and indicator for further studies to facilitate the wider use, promotion and conservation of wild mushrooms in Ethiopia.

Index words: Wild mushrooms, Enguday, ethnomycology, Non-timber forest products, Ethiopia.

RESUMEN

Este artículo resume los trabajos previos existentes sobre Etnomicología en Etiopía. Aunque los documentos a los que se ha tenido acceso son escasos y limitados en cuanto a sus objetivos, se presenta una valiosa y extraordinaria información sobre la recolección y consumo de hongos silvestres comestibles en el país. Además, se presenta un listado de los hongos utilizados por su valor comestible y medicinal, y se hace referencia a los ecosistemas en los que se recogen. Se ha observado que los hongos silvestres representan un valor reducido en comparación con otros recursos forestales no madereros (RFNM). Esto se debe en parte al desconocimiento taxonómico: todos los hongos reciben el mismo nombre local "Enguday". Este es un recurso muy poco estudiado si se compara con otros RFNMs, lo que hace que esté especialmente amenazado debido a los pocos estudios etnomicológicos llevados a cabo hasta el momento en el país. Por todo ello, pensamos que este estudio puede suponer un punto de partida fundamental para posteriores trabajos que contribuyan a un mayor conocimiento de este recurso en Etiopía, lo que conllevará una mayor promoción y conservación de los hongos silvestres comestibles y medicinales en el país.

Palabras clave: Hongos silvestres, Enguday, etnomicología, producto forestal no maderero, Etiopía

INTRODUCTION

Ethiopia encompasses a broad range of ecosystems, with great ranges of altitude, rainfall patterns and soil variability which contribute to the occurrence of different life forms both in flora and fauna (Bongers and Tenngkeit, 2010; Friis *et al.*, 2010). The existence of high variation in macro- and micro-climatic conditions has also contributed to the formation of diverse vegetation types in the country. Friis *et al.* (2010) classified the vegetation resources of Ethiopia into 12 types that range from Afro-alpine formations through dense high canopy montane forests to savanna, scrubland and deserts. An important feature of these vegetation types is their richness in valuable types of Non-Timber Forest Products (NTFPs) (Adilo, 2007; Seyoum, 2007; Sultan, 2009). The most important NTFPs include honey, bees-wax, bamboo, gum arabic, resin, coffee, spices, incense, and edible plant products like fruits, seeds, fodder, medicinal plants, mushrooms, as well as various extractives and flavorings (Asfaw and Tadesse, 2001; Lulekal *et al.*, 2011).

Wild mushrooms are parts of the livelihood of people in different parts of the world (Boa, 2004; Manoharachary *et al.*, 2005; Sarma *et al.*, 2010). They have long been collected as valuable NTFPs, generate cash income by market trade, and are used for local subsistence in food and traditional medicine (Boa, 2004; Chang and Lee, 2004; Mau *et al.*, 2004). This practices help rural people reduce vulnerability to poverty and strengthen their livelihoods through a reliable income and have turned ethnomycology into a discipline in different parts of the world (Boa, 2004). In Ethiopia, however, wild edible mushrooms are the most neglected NTFPs resources. Despite their importance, wild mushrooms have been given little attention, and they are less studied and rarely documented (Alemu, 2013; Muleta *et al.*, 2013). Then again, the justification behind forest resource

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management in the country has been primarily based on the production of wood products (Yemiru *et al.*, 2010). The values and roles of NTFPs like mushrooms have been neglected and all activities related to forest management are focused on maximizing wood products (Asfaw and Tadesse, 2001; Lulekal *et al.*, 2011; Melaku *et al.*, 2014).

However, if managed and conserved properly, mushrooms could potentially support the livelihoods of rural people as major sources of food, medicine, and means of cash. Interestingly, other studies in different part of the world indicated that wild mushrooms could play key roles in local economic developments. In some cases, they could generate even higher economic benefits than timber productions (Oria-de-Rueda *et al.*, 2008). Thus, this could help reconcile the social, economic and ecological values of the forests and could encourage the rural people to rationally manage and conserve forest resources in their locality.

Various ethnobotanical studies undertaken in Ethiopia have already revealed long lists of NTFPs, indicating their importance, contribution and use by rural communities (Lulekal *et al.*, 2011; Melaku *et al.*, 2014). However, reports on mushrooms rarely exist, and the available reports contain scanty and basic information about their existence and use at some community levels (Abate, 2014; Muleta *et al.*, 2013; Tuno, 2001). Efforts are needed to integrate wild mushrooms into the mainstream of NTFPs in the country to ensure their conservation and enhance their value in human welfare.

One strategy could be documentation and dissemination of information related to important edible and medicinal mushrooms and their ethnomycological uses to promote their added values, aside from subsistence, around the country. Therefore, this paper attempts to review and compile the diversity of wild edible and medicinal mushrooms in Ethiopia. Comprehensive information on the traditional practices regarding the use by certain ethnic tribes in the country was also documented through reviewing available information. Thus, this paper could serve as a baseline document for further research in Ethiopia.

MUSHROOM COLLECTION AND USE

Wild mushrooms have been utilized as important sources of food and medicine by rural communities that mostly depend on forests for their livelihoods. Such ethnomycological usage has been also traditional among the forest dweller communities in Ethiopia. The term "Enguday" or "Yejib tila" is commonly used by people to call wild edible mushrooms in the country. The literal meaning of "Yejib tila" is "shadow of the hyena" ("yejib": hyena and tila: "shadow") and implies wild mushrooms appear where hyenas cast shadows: wild mushrooms growth is somewhat mysterious (Abate, 2014). Although wild mushrooms have been used as food and traditional medicine sources (Asfaw and Tadesse, 2001; Semwal *et al.*, 2014), indigenous knowledge among different tribes has not been given significant attention. Additionally, the documented information on the collection, its use and list of valuable mushrooms, is limited. In this section, we summarize available ethnomycological notes to serve as a compressive reference and for further investigations.

Mushroom use as food

Available ethno-mycological literature provided a good illustration of certain ethnic groups use of wild mushrooms as a food source. For example, Tuno (2001) described the traditional use of wild mushrooms by the *Majangir* ethnic groups as a subsidiary food gathered from the natural forests in southern Ethiopia. Muleta *et al.* (2013) and Abate (2014) also documented the culture of hunting and traditional use of mushrooms by the *Kaffa* ethnic groups in the southwest part of the country. In both cases local wild mushrooms have a long history as part of their livelihood because of their nutritional value and good taste (Muleta *et al.*, 2013; Tuno, 2001). Those mushrooms collected from the forest are eaten fresh and efforts to preserve are not a widespread practice in either of the two ethnic groups.

Other important ethnomycological resources also come from Muleta *et al.* (2013) who indicated the existence of mushroom hunting cultural practices in the Bonga area in the southern region. In his research, Muleta *et al.* (2013) mentioned wild edible mushrooms are important sources of food supplement for rural communities, and the rural people preferred mushrooms primarily because of their unique flavor and texture. Mushrooms are used to make soup, salad and other traditional meals. The rare practice of mushroom drying and preservation existed among the local communities in the Bonga area (Muleta *et al.*, 2013).

A noticeable interest on wild mushrooms was also reported at the Benihsnagul Gumz region, western Ethiopia (Alemu *et al.*, 2012). In this region, the main tribal groups *i.e. Gumz* and *Berta* are practicing mushroom collection for subsistence, and they appreciate mushrooms as valuable food sources. They also use mushrooms as seasonal coping food, during food shortage periods, mainly in the rainy season when grain scarcity occurs (Alemu *et al.*, 2012).

Wild mushroom fruiting and collection are restricted to the rainy season, mainly from June to September in Ethiopia. For some species like *Lentinus* sp., collection occurs during the dry season (Tuno, 2001). The most commonly used species, shown in Table 1, include *Agaricus arvensis*,

A. campestroides, *Laetiporus sulphureus*, *Termitomyces microcarpus*, *T. clypeatus*, *Lentinus* sp., *Schizophyllum commune* and *Dictyophora indusiata* (Abate, 2014, 2008; Muleta *et al.*, 2013; Tuno, 2001). Among these species, *L. sulphureus* and *S. commune* are well exploited and documented for their ethnomycological use in Ethiopia (Tuno, 2001). Habitat information for commonly used species was also noted (Table 1): they grow mainly in natural forests, grazing areas and termite mounds (Abate, 2014). However, taxonomic description and voucher collections of most of the species are lacking, indicating further work is needed in fungi taxonomy and classification. The information from the literature is very limited and does not reflect the wider cultural usage in the country. Thus, as there are numerous benefits that can be derived from traditional uses, further ethnomycological work is clearly needed to maximize the benefits from traditional knowledge and use of wild mushroom resources in Ethiopia.

Mushrooms as traditional medicine

Wild mushrooms are known to be rich sources of various bioactive substances (Lindequist *et al.*, 2005) and many of them have been reported to be used in folk medicine worldwide (Hobbs, 1995). Interestingly, traditional medicinal uses of mushrooms are reported by Abate (2014) from the *Kaffa* ethnic groups in southern Ethiopia. Among other species, *Laetiporus sulphureus* is reported to be commonly used for treating pain during childbirth, and its powder is usually preserved for long periods of time to use as drug during child delivery in Kaffa area (Abate, 2014).

The medicinal use of mushrooms, whose traditional knowledge for the practice is handed down generational lines via oral communications, has also been reported by Alemu *et al.* (2012) from the Benihsnagul Gumz region, western Ethiopia. In all cases, most of the knowledge on medicinal uses was found to be confined to elderly people of the village or handled secretly by traditional healers of the locality. They both are key informants for the identification of medicinal species since they use different mushrooms for their traditional medicinal practices (Abate, 2008). Consequently it is difficult to get list of species that have been used traditionally for medicinal purpose from any ordinary person (Abate, 2014). Thus, further documentation and ethnomedicinal uses study will be important for enhancing the understanding of indigenous knowledge systems and the list of species used in folk medicine in Ethiopia. List of species used for traditional medicinal purpose is provided (Table 1).

Mushrooms for market sale

Wild mushrooms are generally not among NTFPs for sale in Ethiopia. They are collected mostly for subsistence use (Yehuala, 2010). The major reason is that the season for wild mushroom growth is short and during this season everyone can collect from the wild for their own consumption. However, in some places wild edible mushrooms can provide additional income to households when sold in the markets. For example, in local markets of Bonga and Assosa, mushrooms are available occasionally in association with other vegetal products (Abate, 2014), which the local people sell to earn some income to supplement their household economy. The common species found fresh in local markets includes *Agaricus* sp., *Laetiporus* sp., and *Termitomyces* sp. (Abate, 2014). However, their market value is very low as the buyers are restricted among the local tribes, and many people were found to be quite ignorant about their edibility (Abate, 2014). Moreover, awareness to use mushrooms as a potential source of income in most rural part of the country is very low, and complete lists of species for the local markets is also lacking in all the literature. Traditional taboos such as considering collecting wild edible mushrooms as a sign of poverty also hinders wider mushroom utilization in a major part of the country, indicating that increasing awareness through collaborative efforts are essential to assist the nationwide efforts to combat food insecurity and ensure nutritional diversity in Ethiopia. List of species used for sale in some localities is presented in Table 1.

Gender and mushrooms

In Ethiopia, women are usually involved in collection of mushrooms and they recognize more fungi species than men. Children are also involved in the collection of some specific taxa like *Termitomyces* sp. (Abate, 2014; Alemu, 2013). Women have also basic knowledge of mushrooms in terms of habitats, niche, and associated substrates. They have also expertise to distinguish between edible and poisonous species. This might be because they are more often involved in preparing and cooking mushrooms than men. Although it differs from place to place, the most recognized ways used to classify mushrooms as edible and non-edible are the colors, shapes and the presence or absence of strong bad smell (Tuno, 2001). These all help for the successful collection of wild edible mushrooms in the locality. The traditional processing knowledge, including handling and cooking are also well known and handled by women (Abate, 2014; Muleta *et al.*, 2013).

Checklist of wild edible mushrooms

The majority of the rural population in Ethiopia is dependent on forest resources, either in the form of subsistence or as a cash income derived from NTFPs (Lulekal *et al.*, 2011). Although mushrooms are NTFPs,

Table 1. Summary of wild edible and medicinal mushrooms and their associated habitats in Ethiopia.

List of taxa	Use	Origin	Referred sources
Agaricus arvensis Schaeff.	F, S	GA	Abate (2008); Alemu (2013); Muleta *et al.* (2013); Sitotaw *et al.* (2015a)
Agaricus campestroides Heinem & Gooss.-Font.	F, S	NF, GA	Abate (2014); Alemu (2013); Dejene *et al.* (2017), Sitotaw *et al.* (2015a); Woldegiorgis *et al.* (2014)
Agaricus subedulis Heinem.	F	NF	Dejene *et al.* (2017), (2016)
Agrocybe pediades (Fr.) Fayod	F	NF	Dejene *et al.*, 2016
Armillaria heimii Pegler.	FM	NF	Abate (2014), (2008); Dejene *et al.* (2016); Osarenkhoe *et al.* (2014)
Auricularia sp. Bull. ex Juss.	FM	NF	Abate (2008); Osarenkhoe *et al.* (2014); Woldegiorgis *et al.* (2014)
Calvatia rubroflava (Cragin) Lloyd	FM	NF	Dejene *et al.* (2016)
Coprinellus domesticus (Bolton) Vilgalys, Hopple & Jacq. Johnson.	F	NF	Dejene *et al.* (2017), (2016)
Coprinopsis nivea (Pers.) Redhead, Vilgalys & Moncalvo	F	NF	Dejene *et al.* (2016)
Coprinus pseudoplicatilis Voglino	F	NF	Abate (2014), (2008)
Hygrophoropsis aurantiaca (Wulfen) Maire.	F	NF	Dejene *et al.* (2017), (2016)
Hymenagaricus sp. Heinem.	F	NF	Dejene *et al.* (2017), (2016)
Laetiporus sulphureus (Bull.) Murrill	FM, S	NF	Alemu (2013); Dejene *et al.* (2016); Muleta *et al.*(2013); Osarenkhoe *et al.* (2014); Tuno (2001); Woldegiorgis *et al.* (2014)
Lentinus sp. Fr.	FM, S	NF	(Osarenkhoe *et al.*, 2014; Tuno, 2001)
Leucoagaricus holosericeus (J.J. Planer) M.M. Moser.	F	NF	Dejene *et al.* (2017), (2016)
Leucoagaricus leucothites (Vittad.) Wasser.	F	NF	Dejene *et al.* (2017), (2016)
Leucoagaricus rubrotinctus (Peck) Singer.	F	NF	Dejene *et al.* (2017), (2016)
Leucocoprinus birnbaumii (Corda) Singer.	F	NF	Dejene *et al.* (2016)
Leucocoprinus cepistipes (Sowerby) Pat.	F	NF	Dejene *et al.* (2017), (2016)
Lycoperdon sp. Pers.	F	NF	Dejene *et al.* (2016)
Macrolepiota sp. Singer	F	NF, GA	Abate (2008); Alemu (2013); Woldegiorgis *et al.* (2014)
Pholiota sp. (Fr.) P. Kumm.	F	NF	Abate (2014), (2008)
Schizophyllum commune Fr.	FM	NF	Alemu (2013); Osarenkhoe *et al.* (2014); Tuno (2001)
Suillus luteus (L.) Roussel	F	PT	Abate (2008); Semwal *et al.* (2014); Woldegiorgis *et al.* (2014)
Termitomyces aurantiacus (R. Heim) R. Heim	F	TM	Sitotaw *et al.* (2015b)
Termitomyces clypeatus R. Heim	F, S	TM	Alemu (2013); Muleta *et al.* (2013); Sitotaw *et al.* (2015b)
Termitomyces eurrhizus (Berk.) R. Heim	F	TM	Sitotaw *et al.* (2015b)
Termitomyces le-testui (Pat.) R. Heim	F	TM	Sitotaw *et al.* (2015b)
Termitomyces microcarpus (Berk. & Broome) R. Heim	FM, S	TM	Abate (2014); Alemu (2013); Muleta *et al.* (2013); Osarenkhoe *et al.* (2014)
Termitomyces robustus (Beeli) R. Heim	FM	TM	Osarenkhoe *et al.* (2014); Sitotaw *et al.* (2015b)
Termitomyces schimperi (Pat.) R. Heim	F	TM	Sitotaw *et al.* (2015b)
Tylopilus niger (Heinem. & Gooss.-Font.) Wolfe	F	PT	Dejene *et al.* (2017)
Vascellum sp. F. Smarda	F	GA	Abate (2014); Alemu (2013)

Note: GA: grazing area, NF: natural forest, TM: termite mounds and PT: plantation forest, F: food and FM: Food and Medicine, and S: For sale.

information on their diversity is hardly ever documented and the country remains mycologically unexplored (Sitotaw *et al.*, 2015b). So far, limited number of species with saprobic or ectomycorrhizal habits have been reported from different regions.

The most important published reports on list of mushrooms in Ethiopia comes from the work of Abate (2014), (2008); Alemu (2013) and Muleta *et al.* (2013) from natural forests in the highlands of the country. Some specific *Agaricus* species were reported by Abate (1999) and Sitotaw *et al.* (2015a) from the Afro-montane forest regions in central Ethiopia. Moreover, Tuno (2001) also reported few edible mushrooms from the moist Afro-montane forest systems in the southwest part of the country. Most recently, Sitotaw *et al.* (2015b) described seven edible *Termitomyces* species in the western lowland part, where the *Combretum - Terminalia* woodland vegetations are dominant. A compilation of the wild edible or medicinal mushrooms and their associated habitats reported from Ethiopia are presented (Table 1). Up-to-date fungal taxa names and authors' names were obtained from Mycobank database (http://www.mycobank.org).

Some other researchers also have reported the potential availability of wild edible mushrooms in plantation forest systems from Ethiopia (Megersa *et al.*, 2017; Semwal *et al.*, 2014). They highlight the existence of valuable genera such as *Suillus, Lactarius, Lepista* and *Cantharellus*. In a similar way, a survey report of NTFPs from the *Combretum–Terminalia* woodland vegetations in Western Ethiopia reflected wider availability of edible mushrooms (Alemu *et al.*, 2012). However, this report lacks field observations that justify the claims, and the species mentioned here are not properly identified. Almost all the species lack scientific names, underlining the fact that the majority of wild mushrooms in Ethiopia remain unnamed or await scientific description.

More recently, our research team reported a total of 26 wild edible mushrooms from natural and exotic forest plantations in southern Ethiopia (Dejene *et al.*, 2017, 2016). Most species are not known by the local communities, and their edibility was assessed from other countries experiences. Interestingly, we found some edible mycorrhizal mushroom in non-native tree plantation forests. A list of the species reported are presented (Table 1), and photographs of some of the wild edible mushrooms collected are illustrated (Figure 1).

CONCLUSIONS

By and large, the reviewed literature showed wild mushroom gathering as accessible food source, and in traditional medicine their use is a common practice in Ethiopia; wild mushrooms also have economic importance to local people in some localities. However, all the available ethnomycological notes focused on specific areas such as the west and southwest parts of the country, and most of the country still remains unexplored. This indicates that the information contained is inadequate and does not convey the full ethnomycological picture of the country, as Ethiopia is characterized by many communities that might have long histories of wild mushroom usage with wider traditional knowledge in the culture. Thus, we encourage more research and documentation to reveal the human-mushroom relationships in depth in the country.

On the other hand, the reviewed literature did highlight the potential existence of wild edible and medicinal mushrooms in Ethiopia. More interestingly, some lists of common species used in the country have been indicated even though many species and their diverse uses remain unidentified, undescribed, and undocumented. This indicates that wild mushrooms have suffered many years of neglect and some of the species might face extinction as their habitats are being altered in the country. Consequently, mushroom resources in Ethiopia remained under-represented in the literature. Thus, further studies are needed for effective and potential utilization of wild mushrooms, as well as wild mushroom conservation in the country.

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Figure 1. Pictures of some wild edible mushrooms in Ethiopian forests: (A) *Agaricus campestroides*, (B) *Agaricus subedulis*, (C) *Agrocybe pediades*, (D) *Armillaria heimii*, (E) *Calvatia rubroflava*, (F) *Coprinellus domesticus*, (G) *Coprinopsis nivea*, (H) *Coprinus pseudoplicatilis*, (I) *Hygrophoropsis aurantiaca*, (J) *Hymenagaricus fuscobrunneus*, (K) *Leucoagaricus holosericeus*, (L) *Leucoagaricus leucothites*, (M) *Leucoagaricus rubrotinctus*, (N) *Leucocoprinus birnbaumii*, (O) *Leucocoprinus cepistipes*, (P) *Lycoperdon perlatum* and (Q) *Tylopilus niger* (Photos by Tatek, 2015).

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