

## Short Communication

### Mushroom: Nature's Treasure in Ethiopia

**Kamal C. Semwal\***, Hayal Lemma, Anurag Dhyani, Gabru Equar and Solomon Amhare  
Department of Biology, College of Natural and Computational Sciences, Mekelle University,  
Mekelle, Ethiopia (\*semwalkamal@yahoo.com)

#### ABSTRACT

Mushroom is a form of fungus having distinct fruit body produced either above ground or below ground. It can be easily noticed in moist habitat in and around forest, grassland, on tree trunks due to their peculiar appearance. Present communication discusses important habit and habitats, medicinal and culinary uses, status of mushrooms in Ethiopia, and sustainable use for sustenance and food security.

**Keywords:** Mushroom, Fungus, Status, Tigray, Ethiopia.

#### 1. INTRODUCTION

Mushrooms are known to human beings since time immemorial and its use as food is as old as civilization. Their references are reported in various ancient treatises including Indian literature *Vedas* (Wassan, 1968). In China the cultivation of black ear mushroom (*Auricularia*) started about one thousand years ago (Chang, 1993). More than 2,000 species composed of 31 genera are identified to be edible from all over the world (Moore, 2005). According to Boa (2004), 1000 species are edible worldwide and in 80 countries fungi are collected for food necessities and sold to economic upliftment.

Mushrooms lack chlorophyll and unable to absorb carbon dioxide from atmosphere thus receives nutrients from other plants and known as saprophytes. They are different from plants in having different shapes, sizes and colour. Due to shape and form of gills it has been classified in different groups (Fig 1). Some mushrooms are mild to deadly poisonous and are known as toadstools. If it consumed accidentally, causes severe health problems and may leads to death. The deadly poisonous mushrooms belong to genus *Amanita* particularly *Amanita muscaria* (Fly Agaric), *Amanita virosa* (Destroying angel), and *Amanita phalloides* (Death cap). These contain endotoxins, i.e., Phallotoxins and Amatoxins. Phallotoxins causes abdominal pain, muscular cramping, renal failure followed by death. Amantoxin has also same effects with failure of liver,

damage in kidney, irritation in respiratory tract followed by shortness of breath and dizziness. Some other species viz. *Galerina autumnalis*, *Conocybe filaris* also produce same deadly toxins. Mushrooms are also known as Macrofungi, Macromycetes, Fleshy fungi and Toadstools, and considered as a key group in forest ecosystem maintenance. It decomposes leaf litter, dead wood, and ally of more than 95% plants as they form mycorrhizal association with tree roots. In this symbiotic relationship both are mutually benefited. Fungi receive energy, shelter, and tree absorbs vital nutrients from its mycelia. Mushrooms have a broad spectrum to serve as decomposer, waste management agent, bioremediation, pathogen, culinary, and have medicinal value.

Mushroom grows on a vast number of substrates and environmental conditions. It includes terrestrial (e.g., *Agaricus*, *Amanita*, *Russula*, *Tricholoma*, *Boletes*, *Cantharellus* etc), on cattle dung (*Coprinus*, *Paneolus*, *Psathyrella*, *Stropharia*), in moist conditions below ground (Truffles), on insects (*Cordyceps*), on tree trunks, known as lignicolous fungi (Species of *Ganoderma*, *Pluteus*, *Volvariella*, *Pleurotus*, *Bolbitius* and *Pholiota*), even on mushroom fruitbody (*Asterophora*).

## 2. IMPORTANT USES OF MUSHROOM

Many mushrooms treated as medicine in different ethnic cultures of the world. These are used to prevent heart attacks, cancer and tumors (Chang, 1995; Liu and Chang, 1995). It contains chemical compounds which are responsible to cure viral infection, bacterial, fungal diseases, decrease blood cholesterol etc. *Ganoderma* (*Lingzi*), known as a magic herbal medicine in traditional Chinese medicine (TCM), with no side effects, even after consuming for a long time. It increases body healing ability, and provide a long life (anti aging and vitality). *Ganoderma lucidum* (*Reishi*) has different bioactive molecules which have Anti-cancer activity, Anti-HIV, Anti-heart attack (Cholesterol lowering), Hypoglycemic (Anti-diabetes) and Anti-oxidant (AHP, 2006; Willard, 1990). *G. lucidum*, *Lentinus edodes* (*Shiitake*), *Inonotus obliquus* (*Chaga*) have been collected and used for hundreds of years in Korea, China, Japan, and eastern Russia (Ying et al., 1987; Hobbs, 1995, 2000; Wasser and Weis, 1997a&b, 1999; Stamets, 2000). Another

highly prized medicinal mushroom is Caterpillar fungus (*Cordyceps*), which helps in improving body immunity, reduce stress, helps in relieving nervous tension and mild anxiety (Jiang and Gao, 1995). In a nutshell, mushroom intake is a promise to human body to keep it healthier and live longer.

Apart these mushrooms are highly valued for their rich characteristic flavour and potent nutritional properties. Mushrooms possess various types of dietary supplements. They have low carbohydrate and fat content, even devoid of starch. Hence, recommended as food for diabetics and high cholesterol patients. Due to its delicacy makes it one of the most preferred options of food in big hotels throughout the world (Mshigeni and Chang, 2000). Mushrooms are low in calorific value but rank very high for their vitamins, minerals and protein contents (Beetz and Greer, 1999). Owing to these rich contents, the mushrooms are being recognized universally as complement food. Their protein have 60-70% digestibility and contain all the essential amino acids such as Lysine required by adult human beings, rich in vitamins viz. Vitamin B12, C, D, and K and minerals potassium, calcium, phosphorous, copper and iron. These vitamins are well retained during cooking, canning, drying and freezing.

### **3. ROLE OF MUSHROOMS IN FORESTS AND ECOSYSTEMS**

Mushrooms along with some bacteria are valued for their quality to degrade lignin, organic matter on forest floor (Antonella et al., 2013; Osono and Takeda, 2002). “Lignin” is a polymer found in trees tissues, responsible for strength, keep trees upright in high winds and gravity, hard to breakdown. Mushroom secretes extracellular enzymes and acids which break down lignin, cellulose and hemicellulose into simpler molecules, then utilized for their growth and metabolism, consequently as humus, rich in nutrients. The current scenarios of modern developments i.e. agricultural sectors, food processing industries, establishment of new cities etc are producing solid wastes or some byproducts or garbage. These are produced through the agricultural activities, (wheat straw, rice straw, banana straw, corn stalk, sorghum stalk, teff stalk, cotton waste, sugarcane bagasse, soybean husk, and coffee and tea waste), forest and food processing industries etc. These organic solid wastes are a kind of biomass, degrade very slowly.

Careless disposal of solid wastes leads to environmental pollution. Mushrooms have the capability to transform these all wastes into valuable nutrient and nutraceutical resources. The nutrient and nutraceutical resources are stored in fruit body and used for food and medicinal purposes, which prevent us from health hazards. Due to this property mushrooms are considered as environment friendly components of the earth. They play another important vital role in forest health and ecosystem. They form mycorrhizal association with tree roots, particularly the members of family Amanitaceae, Russulaceae, Boletaceae, and Cantharellaceae. In this mutual association, the host plant gain more mineral nutrients (Nitrogen, Phosphorus, and Potassium), increases tolerance to stresses and the fungi receive carbon compounds from the tree and optimized environment to grow and survive well. However, every species is specific to form mycorrhizal association with a particular species of tree roots and some others are open to associate with a vast number of trees i.e *Amanita hemibapha*, and *Russula cyanoxantha* form with Oaks and Pine trees. Various types of mycorrhizal association have been classified based on mycelia attachment with roots. In the forest mostly ectomycorrhizal type of association occurs, in which the mycelia forms a mantle around the roots. The root infected with fungal mycelium colonization can be differentiate on the basis of thickness and dichotomously branched shape.

#### 4. MUSHROOMS IN ETHIOPIA

In Ethiopia mushroom locally called as *Angudai* in Amharic and *Kintishara* in Tigrinya language. Mushroom has been used as food by the Majangir tribe and Wacha inhabitants in southwestern Ethiopia (Tuno, 2001; Teferi et al., 2013). Cultivation and exploration of mushrooms in Ethiopia has been reported scarcely. Although, mushroom cultivation has been started a decade ago with the trial made with Oyster mushroom (*Pleurotus ostreatus*) followed by button mushroom, *Agaricus* sp. and Shitakke mushroom, *Lentinus* sp. (Abate, 1995, 1998a&b). There are still some gaps in training and awareness programs of technology transfer to the farmers or local populace regarding mushroom utilization and cultivation (Teferi et al., 2013). To fill these gaps an initiative in the form of mushroom cultivation training has been jointly organized by the Mekelle University and Tigray Science & Technology Agency, Ethiopia

during 6 - 8<sup>th</sup> April, 2014,. The training was followed by a delicious lunch to develop the taste of mushroom food among teachers and students, who can play a vital role to disseminate the utility, benefits, cultivation and conservation of mushroom among local populace and farmers.



Figure 1. Different types of gills (hymenium) in mushrooms to categories in groups- A). Polypore; B). *Boletes* having honey comb pores; C). *Lacatarius*- gills emitting milk on bruising; E). Agarics gills; F). Decurrent, biforked gills in *Cantharellus*; and G). Tooth like hymenium in *Sarcodon*.

Furthermore, other African countries i.e Camroon and Benin started to generate the local income through mushroom cultivation (Djik et al., 2003). So, there is scope to establish industries of different mushroom species cultivation in Ethiopia. DXN, a leading company of preparing different kinds of *Ganoderma* products has taken an initiative to establish mushroom farm near Lake Shala (region??) with the initial investment of 285 million Ethiopian Birr to cash the business opportunity in Ethiopia. It will certainly help to generate job opportunity to the local peoples and they may start their own business to fulfill the rising demand of *Ganoderma* product in the world.

There is a wide scope to study wild mushroom taxonomy and ecological diversity in Ethiopia. Few reports suggest its potential to have a wide variety of mycoflora. Hjortstam and Ryvardeen (1996) identified fifteen species of Corticiaceae including *Diplomitoporus rimosus* and *Physisporinus rivulosus* as new report to Africa and *Mycoacia brunneofusca*, *Vuilleminia obducens* are described as new species to the world. *Agaricus campestris* reported by Abate (1999); *Dictyophora indusiata*, *Schizophyllum commune* and *Lentinus* sp. reported by Tuno (2001); four by Decock et al. (2005), including two new species of *Fomitiporia* to the world; three by Teferi et al. (2013), namely *Termitomyces clypeatus*, *T. microcarpus* and *Laetiporus sulphureus*; seven taxa, viz. *Trametes versicolor*, *Gyromitra* sp. *Pycnoporus* sp. *Agaricus avensis* *A. campestris*, *Schizophyllum commune*, and *Clitocybe nuda*, by Fekadu (2013), and recent study on mushroom collections and identification from Gondar (Kamal, unpublished) highlights the potential of the forests to grow wild mushrooms in Ethiopia.

## 5. SUSTAINABLE USE OF MUSHROOMS

In the world mushrooms are considered as delicious and nutraceutical food for the human health still could not disseminated or properly advertised in Ethiopia (Teferi et al., 2013). However, south Asian and orient countries are facing overexploitation of medicinal and edible mushrooms. They are concerned about their sustainably use. The domestication trials, ectomycorrhizal colonization with tree seedlings and forest protection will improve the opportunity to cultivate and collection of wild edible and medicinal mushrooms. In medicinal mushroom *Ganoderma*,

*Lentinus Tricholoma (Matsutake)* and edible mushroom Button (*Agaricus*), Oyster (*Pleurotus*), Paddy straw (*Volvariella*), Milky mushroom (*Calocybe*) are the examples of sustainable use throughout the world. The Morel mushroom (*Morchella*), Caterpillar fungi (*Cordyceps*) are other edible and medicinal fungi still could not grown artificially, overexploited in the world, therefore government laws should be formulated to restrict their collection from wild and probably it could be a step towards conservation of wild mushrooms and its sustainable exploitation.

## 6. CONCLUSION

Mushrooms play a vital role in human life due to various benefits. The mushroom cultivation practices can raise the economy of country and can enhance food security with sustainable use of natural resources. Use of wild mushroom by ethnic groups in Ethiopia suggests its importance from ancient time. Dire need of community awareness for cultivation and promotion of wild mushroom is suggested. On the other hand Ethiopia has a varied topography with different climatic zones, especially southwestern part with having a wet forest land. These habitats are rich in mushroom biodiversity. To our knowledge exploration of wild mushroom from the region is a few. It constrained mycologist to survey, collect, identify, document and further domesticate mushrooms which may be responsible for treating some life saving drugs in future.

## 7. REFERENCE

- Abate, D. 1995. Cultivation of the oyster mushroom in traditional brick pots, *Mycologist*, **9**:179-181.
- Abate, D. 1998a. Cultivation of the oyster mushroom, *The International Journal of Small-scale Food Processing*, **23**:20-21.
- Abate, D. 1998b. Mushroom Cultivation: A Practical Approach. Berhanena Selam Printing Enterprise, Addis Ababa, 218p.
- Abate, D. 1999. *Agaricus campestris* in upland Ethiopia. *Mycologist*, **13**: 28.
- American Herbal Pharmacopoeia. 2006. Reishi Mushroom *Ganoderma lucidum* Standards of Analysis, Quality Control, and Therapeutics. In: Anonymous. American Herbal

- Pharmacopoeia and Therapeutic Compendium. American Herbal Pharmacopoeia: Scotts Valley, CA, USA: 10-12
- Antonella A., Valeria, T & Giovanna, C.V. 2013. The Bioremediation Potential of Different Ecophysiological Groups of Fungi. *In*: E.M. Goltapeh, Y.R. Danesh and A. Varma (eds.), *Fungi as Bioremediators*, Soil Biology 32, Springer-Verlag Berlin Heidelberg, pp. 29-49 (doi: 10.1007/978-3-642-33811-3\_2).
- Beetz, Alice & Lane Greer. 1999. Mushroom Cultivation and Marketing Horticulture production Guide, appropriate technology transfer for Rural Areas, Fayetteville, 24p.
- Boa, E. 2004. Wild edible fungi: a global overview of their use and importance to people. Non-Wood Forest Products, No. 17, FAO, Forestry Department, Rome, Italy, 148p.
- Chang, S.T. 1993. Mushroom biology: the impact on mushroom production and mushroom products. *In*: S.T. Chang., J.A. Bushwell and S.W. Chin (eds.). *Mushroom biology and mushroom products*. Hong Kong: The Chinese University Press, 261p.
- Chang, S.T. 1995. *Ganoderma*- The leader in production and technology of mushroom nutraceuticals. Proceedings of 6th Int symposium on Recent Advances in *Ganoderma lucidum* Research (B.K. Kim, I.H. Kim and Y.s. Kim (eds.)), The pharmaceutical Society of Korea, Seoul, Korea, pp. 43-52.
- Decock, C., Bitew, A & Castillo, G. 2005. *Fomitiporia tenuis* and *Fomitiporia aethiopica* (Basidiomycetes, Hymenozymetales), two undescribed species from Ethiopian Highlands: taxonomy and phylogeny. *Mycologia*, **97**:124-132 (doi:10.3852/mycologia.97.1.121).
- Dijk, H. Onguene, N.A & Kuyper T.W. 2003. Knowledge and Utilization of Edible Mushrooms by Local Populations of the Rain Forest of South Cameroon. *Ambio*, **32**: 19-23.
- Fekadu Alemu, 2013. Assessment of Wild Mushrooms and Wood Decaying Fungi in Dilla University, Main Campus, Ethiopia. *Int. J. Advanced Research*, **1(8)**: 458-467.
- Hjortstam, K & Ryvarde, L. 1996. New and interesting wood-inhabiting fungi (Basidiomycotina-Aphyllphorales) from Ethiopia, *Mycotaxon*, **60**:181-190.
- Hobbs, C. 1995. Medicinal mushrooms: an exploration of tradition, healing and culture. Botanica



- Press, Santa Cruz, California, 252p.
- Hobbs, C. 2000. Medicinal value of *Lentinus edodes* (Berk.) Sing. (Agaricomycetidae). A literature review. *Int J Med Mushrooms*, **2**:287–302.
- Jiang, J.C & Gao, Y.F. 1995. Summary of treatment of 37 chronic renal dysfunction patients with Jin Shui Bao. *J. Admin. Trad. Chin. Med.*, **5**: 23–24.
- Liu, F., Ooi, V.E & Chang, S.T. 1995. Anti-tumor components of the culture filtrates from *Tricholoma* sp. *World J. Microbiol. Biotechnol.*, **11**:486–490.
- Moore, D. 2005. Principles of mushroom developmental biology. *Inter. J. Med. Mushrooms*, **7**:79-101.
- Mshigeni, K.E & Chang, S.T. 2000. A guide to successful Mushroom Farming: With Emphasis on Technologies Appropriate and Accessible to Africa's rural and peri-Urban Communities. University of Namibia, Windhoek, Namibia, 34p.
- Osono, T & Takeda, H. 2002. Comparison of litter decomposing ability among diverse fungi in a cool temperate deciduous forest in Japan. *Mycologia*, **94**:421–427.
- Stamets, P. 2000. Growing gourmet and medicinal mushrooms, 3rd edition. Ten Speed Press, Berkeley, California, pp. 10-11.
- Teferi Yenealem, Muleta, D & Woyessa, D. 2013. Mushroom consumption habits of Wacha Kebele resident, southwestern Ethiopia. *Global Research Journal of Agricultural and Biological Sciences*, **4**(1): 6-66.
- Tuno, N. 2001. Mushroom utilization by the Majangir, an Ethiopian tribe. *The Mycologist*, **15**: 78-79.
- Wasser, S.P & Weis, A.L.1997a. Shiitake mushrooms [*Lentinus edodes* (Berk.)Sing.]. In: E. Nevo (ed.) Medicinal mushrooms. Peledfus, Haifa, Israel, pp. 6.
- Wasser, S.P & Weis, A.L. 1997b. Reishi mushroom [*Ganoderma lucidum* (Curt.: Fr.) P.Karst.]. In: E. Nevo (ed.) Medicinal mushrooms. Peledfus, Haifa, Israel, pp. 39.
- Wasser, S.P & Weis, A.L.1999. Medicinal properties of substances occurring in Higher Basidiomycetes mushrooms: current perspectives. *Int. J. Med. Mushrooms*, **1**:31–62.
- Wasson, R.G. 1968, Soma: Divine Mushroom of Immortality. Harcourt, Brace Jovanovich, Inc.:

Los Angeles, CA, USA, pp. 80-92.

Willard, T. 1990. Reishi Mushroom: Herb of Spiritual Potency and Medical Wonder.

Washington, DC: Sylvan Press, 167p .

Ying J., Mao X., Ma, Q., Zong, Y & Wen, H. 1987. Icons of medicinal fungi from China.

Science Press, Beijing, 575p.