MINI REVIEW

Bio-diversity of Wild Mushrooms and their Future Perspectives

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Abstract

Mushrooms are ubiquitous and cosmopolitan in distribution covering tropics to poles and mountain tops to the deep oceans, and can colonize, multiply and survive in diversified habitats, *viz*., water, soil, air, litter, dung, foam, etc. Geographic location, climatic conditions, micro-habitat, substrate type, distribution of fauna, and flora are all important factors contributing to mushrooms distribution worldwide. Mushroom belongs to the group of organisms known as macrofungi under the phylum Ascomycotina and Basidiomycotina. The mushroom is the fleshy and spore-bearing organ of the fungi that is called as the fruiting body. Mushrooms are seasonal fungi, which occupy diverse niches in forest and territory ecosystems. They mostly occur during the rainy season, particularly in forests, where the dense canopy shade from trees provides a moist atmosphere and decomposing organic material such as leaf litter and favors the germination and growth mushrooms.

Keywords: Ascomycotina, Basidiomycotina, Biodiversity, Future Mushrooms, Perspective,

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Introduction

The galaxy of fungi with their natural beauty occupies a prime position in the biological world. Fungi are ubiquitous and cosmopolitan in distribution covering vast areas, ranging from tropics to poles, top of the mountain to the deepest base of the oceans, known to colonize, multiply and survive in diversified habitats as air, water, soil, dung, foam, litter, hair, textile, paint etc. Fungi are unique as most of them are attractive and play a significant role in the lives of humans besides their utilization in agriculture, medicine, food industry, textile, bioremediation, as biofertilizers, and geochemical cycling.

Mushrooms are seasonal fungi, which occupy diverse niches in nature within the forest ecosystem. Several types of edible mushrooms are cultivated on a large scale for commercial use and many more mushrooms grow wildly in nature, which has much nutritional and medicinal value. They occur during the season and also during spring when the snow melts. In the globe, biodiversity includes many species, the range of populations that make up a species, and the genetic diversity among individual life forms. Macrofungi are important economically due to their importance in food, medicine, biocontrol, chemical, biological, and other industries. Macrofungi are diverse in their food and medicine use, and several other species function as decomposers and form mycorrhizal associations (Meena, 2020). One-third of the fungal diversity of the globe exists in this country (Manoharachary *et al*., 2005). The number of fungi recorded in India exceeds 27,000 species. The number of genera reported worldwide, and that from fungi are considered the largest biotic community after insects (Sarbhoy *et al*., 1996). Senthilarasu reported 132 species in 60 genera belonging to Agaricales, Polyporales, and Russulales. Xylaria species grows on various substrates, especially on decorticated wood, dung, and nests of termites/ants (Senthilarasu and Kumaresan, 2016). Plant–fungus ratio is one of the important yardsticks to estimate the richness and diversity of fungi of a region (Hawksworth *et al.,* 1991,1995). On taxonomy and biodiversity of macrofungi (Agaricales) as they secure more importance as many macrofungi are getting extinct or facing the threat of extinction. The biodiversity of macrofungi is vital for ecosystem functioning and stability (Dwivedi, 2017) Plant-fungus ratio in the tropics has been predicted as 1: 33 against 1:6 in temperate regions. Many postulations have estimated the global fungal population between 0.5 and 9.9 million species (Cannon, 1997, 2002). Yet only a small fraction of total fungal wealth has been subjected to scientific scrutiny, and the new generations of mycologists have to unravel the unexplored and hidden wealth. The fungal population in India and the world are presented in Fig. 1.

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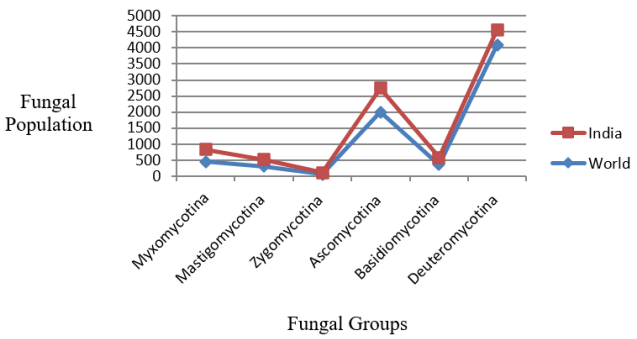

Fig. 1: Fungal population in world and in India

Mushroom belongs to the group of organisms known as macrofungi under the phylum Ascomycotina and Basidiomycotina. The mushroom is the fleshy and spore-bearing organ of the fungi that is called as the fruiting body. Mushrooms are seasonal fungi, which occupy diverse niches in forest and territory ecosystems. They mostly occur during the rainy season, particularly in forests, where the dense canopy shade from trees provides a moist atmosphere and decomposing organic material such as leaf litter, and favors the germination and growth of mushrooms.

The difference in the distribution of commonly observed mushroom fungal families over this location was compared with other locations in India.

Mushrooms and Other Macrofungi

Mushrooms occur in various shapes, sizes, and colors and have attracted naturalists' attention and are thus prized as drawings, paintings, sculptures, etc. Generally, they live as saprophytes; however, some are severe agents of wood decay. This group comprises largely fleshy fungi, including toadstools, bracket fungi, fairy clubs, puff balls, stinkhorns, earthstars, bird's nest fungi, and jelly fungi. Some fleshy fungi are notorious for being poisonous; however, most are harmless, and some are good to eat. Ample species of wild edible and medicinal mushrooms occur in all the biodiversity-rich regions during the rainy season. All types of mushrooms are essential in decomposition processes because of their ability to degrade cellulose and other plant polymers. Besides, they serve as nature's trash burners and soil replenishers and thus help in rejuvenating the ecosystem.

Though India has rich macrofungal biodiversity, most traditional knowledge about mushrooms comes from the far East countries like China, Japan, Korea, Russia, where mushrooms like *Ganoderma, Lentinus, Grifola,* and others have been collected and used since time immemorial (Ooi and Liu, 2000). India, in the top ten mega diversity sites, has innumerable mushroom species and their ethno mycological importance. Macrofungi are important economically due to their importance in food, medicine, biocontrol, chemical, biological and other industries. Macrofungi are diverse in their uses as food and medicine, and several other species function as decomposers and also form mycorrhizal associations (Meena, 2020).

Recent reports show a tradition of wild mushroom picking, their consumption, and sale in the market in countries like Mexico, Italy, Australia and many others (Sitta and Floriani, 2008). Mushrooms alone are represented by about 41,000 species, of which approximately 850 species are recorded from India (Deshmukh, 2004). Besides extensive surveys of the Himalayan region compiled by Lakhanpal (1996), records from Punjab, Kerala, and the Western Ghats were published last year (Atri *et al.,* 2000). The biodiversity survey was conducted to distribute untamed mushrooms, which naturally grow, in several localities, at different seasons. Twenty-four species of mushrooms belonging to 17 genera and 14 families were identified during the survey. The identified genera were *Amanita sp* (Fig. 2)., *Agaricus sp., Polypores sp.* (Figs. 4 and 5), *Armillaria sp., Coprinus sp., Cortinarius sp., Hebeloma sp., Mycena sp., Lepiota sp., Lycoperdon sp., Cyttaria* (Fig. 8) *Macrolepiotia sp., Daldinia sp., Tuber sp., Volvariella sp., Steccherinum sp., Hypholoma sp.* and *Coprinellus sp.* The collected specimens were deposited to SAU herbarium of mushroom flora (SHMF) (Rashid, 2016). Lakhanpal (1997) has recorded that in a survey conducted in the North-Western Himalayas during 1976–1987, 300 species of mushrooms and toadstools were recovered; of these, nearly 72 species in 15 fungal genera were observed to enter into mycorrhizal relationship with *Abies pindrow, Betula utilis*, *Cedrus deodara*, *Picea smithiana*, *Pinus roxburghii*, *Pinus wallichiana*, *Rhododendron arboreum, Quercus incana*, and *Quercus semicarpifolia.* As many as 24 fungal species were found to be associated with *Q. incana* alone. Mushrooms became attractive as functional foods and as a source of physiologically beneficial bioactive compounds. Various fleshy fungi are traditional food use collected from Vindhya forest region and other locations for his or her morphological characterization. The diversity of fleshy fungi in Vindhya forest of northern India was studied. Vindhya forest region is widespread for the diversity of the fleshy fungal population. Eight species of *Pleurotus*, two species of *Volvariella, Lentinus, Lycoperdon, Agaricus,* and one species of *Cococybe, Calocybe, Flammulina, Tricholoma, Auricularia, Hypomyces, Armillaria*, *Russula,* and *Ganoderma* were collected during the study (Yadav 2016). Deshmukh (2004) has compiled the folk medicine value of the Indian Basidiomycetes besides recording nearly 60 wild mushrooms, representing 54 species in 36 genera around Mumbai.

Another wild fungus as *Lycoperdon, sp* (Fig. 3), *Cortinarius* (Fig. 4), *Pleurotus sp* (Fig. 7) Kombucha (also tea mushroom, tea fungus, or *Manchurian mushroom* when referring to the culture; Latin name *Medusomyces gisevii* (Jayabalan, 2014 (Fig. 9), Witches' Butter (*Dacrymyces palmatus*) (Fig. 11), *Calostoma sp*

Fig. 2: Fly Agaric mushroom (*Amanita* sp.)

Fig. 3: Spiky mushroom (*Lycoperdon* sp)

Fig. 4:. Purple mushroom (*Cortinarius* sp)

Fig. 5: Bracket fungus (*Polypores* sp)

Fig. 6: Fungi in the snow (*Polypores* sp)

Fig. 7: Pink mushroom (*Pleurotus* sp)

Fig. 8: Indian bread fungi, (*Cyttaria* sp)

Fig. 9: The "Kombucha Mushroom" Elixir of Life (*Medusomyces gisevii*)

Fig. 10: Scarlet elf cap (*Sarcoscypha coccinean*)

Fig. 11: Witches' butter (*Dacrymyces palmatus*)

Fig. 12: Stalked puffballs (*Calostoma* sp)

(Stalked puffballs) (Fig. 12) (Reed 1910) *Lysurus periphragmoides*, commonly known as the stalked lattice stinkhorn or chambered stinkhorn, is a species of fungus in the stinkhorn family. (Fig. 13) are reported (Dring, 1980).

Conservation of Fungus

It is generally accepted that only about 7% of fungi have been discovered till now. Fungi are neglected organisms, and they are not well protected, but like animals and plants, they are endangered by human activities. Although the 1992 Convention on Biological Diversity extends protection to all organisms, it is worded in terms of "animals, plants and microorganisms" and fungi do not fit well into these categories. Now fungal biodiversity and conservation topics have been overlooked. As a result, countries which signed the Convention have almost universally overlooked fungi in preparing their biodiversity conservation plans: fungi are truly the orphans of Rio (Minter, 2010).

Threats to fungi throughout the globe are of concern since they are beautiful and play a significant role in human welfare. Moore *et al*. (2001) have suggested the following steps for fungal conservation:

Conservation of habitats

(i) *In-situ*: conservation of non-mycological reserves/ ecological niches,
(ii) *Ex-situ*: conservation, especially for saprotrophic species growing in culture.

Preservation

The selection of preservation techniques for fungi not only depends upon the success of the method but also upon the use of the organism, time, facilities, and resources available. Long-term stability is considered together with the required availability of the culture without delay.

A collector may select a continuous growth method that is to be backed up.

(a) Mineral oil storage is a simple method of storage that retains the viability of fungi for many years but places strain under selective pressure because of the special conditions of storage.
(b) Water storage technique may allow growth depending upon the method adopted. The procedure is to cut agar plugs from the edges of actively growing cultures and placing them in sterile distilled water in screw cap bottles.

The nutrients available in the agar will allow growth until oxygen is depleted in the storage container.

(c) Soil storage involves inoculation of spores or mycelium suspended in sterile distilled water into sterile soil of approximately 20% moisture content. This method of storage can retain viability for 10 to 20 years.
(d) Silica gel storage methods are suitable methods for fungal spores that remain viable for periods up to and over 20 years.
(e) Freeze-drying entails freezing of the organism and its desiccation by the sublimation of ice under reduced pressure.
(f) Cryopreservation is the method of storage at ultra-low temperatures, which is the most successful method for retaining both the viability and characteristics of fungi.

Fig. 13: Stalked lattice stinkhorn (*Lysurus periphragmoides*)

On the one hand, the world of fungi provides a fascinating and almost endless source of biological diversity, which is a rich source for exploitation. On the other, studies of fungal distribution and mapping are challenging tasks due to the lack of sufficient taxonomic knowledge and lack of knowledge of mycologists worldwide.

Conclusion

Macrofungi plays a vital role in maintaining the ecosystem; they have high nutritional, medicinal potentials and help in the biodegradation and recycling of organic matter. Identifying unknown wild macrofungi opens a new way for researchers and pharmaceuticals to exploit them for food, medicines, and other bio-prospects to attempt its commercial cultivation.

References

Atri, N. S., Kaur, A. and Saini, S. S. (2000).Taxonomic studies on Agaricus from Punjab plains. Indian J. Mushroom. 18: 6-14.

Cannon, P. F. (1997).Strategies for rapid assessment of fungal diversity. Biodiversity Conserv. 6: 669-680.

Cannon, P. F. and Simmons, C. M. (2002). Diversity and host preference of leaf endophytic fungi in the Iwokrama Forest Reserve, Guyana. Mycologia, 94: 210-220.

Deshmukh, S.K. (2004). Biodiversity of tropical basidiomycetes as sources of novel secondary metabolites. In Microbiology and Biotechnology for Sustainable Development (ed. P.C. Jain,), CBS Publishers and Distributors, New Delhi, 121-140.

Dring DM. (1980). "Contributions towards a rational arrangement of the Clathraceae". *Kew Bulletin*. **35**(1):1–96. doi:10.2307/4117008.JSTOR4117008.

Dwivedi, S, Singh S, Chauhan U.K, Tiwari M.K.(2017) Biodiversity studies on macro fungi with special reference to order agaricales: Indian scenario. Journal of Bacteriology & Mycology.; 5: 420-423.

Hawksworth, D. L., Kirk, P. M., Sutton, B. C. and Pegler, D. N. (1995). Dictionary of the Fungi, CAB Intl., pp. 616.

Hawksworth, D.L. (1991). The fungal dimension of biodiversity: magnitude, significance, and conservation. Mycological Research. 95: 641–655.

https://en.wikipedia.org/wiki/Lysurus_periphr periphragmoides

Jayabalan, Rasu 2014). "A Review on Kombucha Tea—Microbiology, Composition, Fermentation, Beneficial Effects, Toxicity, and Tea Fungus". *Comprehensive Reviews in Food Science and Food Safety*. 13 (4): 538–550. doi:10.1111/1541-4337.12073. PMID 33412713.

Lakhanpal, T. N. (1996). Mushrooms of Indian Boletaceae. Vol. I. Studies in Cryptogamic Botany (ed. Mukherji, K. G.), APH Publishing Corporation, Delhi.pp. 35-56.

Lakhanpal, T. N. (1997).Diversity of mushroom mycoflora in the North-West Himalaya. In Recent Researches in Ecology, Environment and Pollution (eds Sati, S. C., Saxena, J. and Dubey, R. C.), Today and Tomorrow's Printers and Publishers, New Delhi. pp. 35–68.

Manoharachary, C.S., Singh, K.R., Adholeya, A., Suryanarayanan, T.S., Rawat. and Johri, B.N. (2005). Fungal biodiversity: distribution, conservation and prospecting of fungi from India. Curr Sci.89: 58-71.

Meena B., Sivakumar V. and Praneetha S. (2020) Prospects of biodiversity and distribution of mushroom fungi in India GSC Biological and Pharmaceutical Sciences, 2020;13(1):078-085: https://doi.org/10.30574/gscbps.2020.13.1.0329

Minter DW (2010) Conservation of fungi: the orphans of the Rio De Janeiro Convention. In: The First International Conference on Basic and applied Mycology 9–11 March 2010, Assiut, Egypt: 22-23.

Ooi, V. E. and Liu, F. (2000). Immunomodulation and anticancer activity of polysaccharide–protein complexes. Curr. Med. Chem.7, 715–729.

Rashid, S.N., Aminuzzaman, F.M., Islam, M.R., Rahaman, M., Rumainul, M.I. (2016) Biodiversity and distribution of wild mushrooms in the southern region of Bangladesh. Journal of Advances in Biology & Biotechnology.6; 9: 1- 25.

Reed HS. (1910). "A note on two species of the genus *Calostoma*". *The Plant World*. 13 (10): 246–248. JSTOR 43476817.

Sarbhoy, A.K., Agarwal, D.K. and Varshney, J.L. (1996). Fungi of India 1982-1992. CBS Publishers and Distributors, New Delhi.

Senthilarasu G, and Kumaresan V. (2016) Diversity of agaric mycota of Western Ghats of Karnataka, India. Current Research in Environmental & Applied Mycology.; 6:75-101.

Sitta, N. and Floriani, M. (2008). Nationalization and globalization trends in the wild mushroom commerce of Italy with emphasis on Porcini (Boletus edulis and allied species). Econ Bot. 62:307-322.

Yadav, M.K, Chandra, R, and Dhakad, P,K.(2016) Biodiversity of edible mushrooms in Vindhya forest of northern India. Indian Journal of Agricultural Sciences;86:1070–1075.