

## Study of Ascomycetes and Basidiomycetes Fungi ( Macro) : A Review

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### ABSTRACT

The study mainly focused on the taxonomic study of fungi. Taxonomy is the science of naming, describing and classifying organisms and includes all plants, animals, and microorganisms of the world. Using morphological, behavioural, genetics and biochemical observation taxonomists identify, describe and arrange species into classification, including those that are new to science. Fungal taxonomy has been based on morphological development and physiological characteristics from which the current structure of species, genera and classes has emerged. The material and methods of specimens were collected using an axe, sharp knife, forceps, measuring tape, hand lens, books, labels, camera, papers and containers. Fresh specimens i.e, various stages of fruiting body development and fully grown bodies were collected in sterile polyethylene bag for further study in laboratory. The study helped us to give check list of the specimens, key were developed for identification helped to give the uses along with the local name used by people, find out some species were used as food and medicinal purpose. Finding a new records for state, country and world.

Keywords: Basidiomycetes ,Ascomycetes, Macrofungi, Taxonomy

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## I. INTRODUCTION

Taxonomy is the science of naming, describing and Classifying organisms and includes all plants, animals and microorganism of the world. Using morphological, behavioural, genetics and biochemical observation taxonomists identify, describe and arrange species into classification including those that are new to science. The term fungi was directly adopted from the

Latin word “fungus” (Simpson,1979). The scientific study of fungi is believed to have originated in 1836 with Miles Joseph Berkeley’s publication ( Ainsworth, 1976). Earlier taxonomists contemplated that fungi were closely related to plants based on their similar morphology, growth and habitat. Later ,it was realized that fungi are a separate kingdom, which diverged around one billion year ago( Baldauf & Palmer 1993, Bruns et al., 2006, Parfrey et al., 2011).

Around 1, 44,000 species of fungi have so far been formally described (Willis et al., 2018, Wijayawardene et al., 2020). But it has been estimated that there may be

2.2 to 3.8 million species ( Hawksworth & Lücking 2017) and there for the actual number is far from certain ( Hyde et al., 2020). Traditionally fungal species have been

distinguished by different approaches and concepts based on morphology, physiology, biochemistry or reactions to chemical tests. Fungal taxonomy is complicated by interspecific morphological and physiological characteristics from which the current structure of species, genera and classes has emerged.

About 80000 to 120000 species of fungi have been described to date although the total number of species is estimated at around 1.5 million ( Hawksworth, 2001; Kirk et al., 2001). This would render fungi one of the least explored biodiversity resources of our planet. Fungi are ancient, diverse and abundant. Fungi were once considered to be primitive members of the plant kingdom just slightly more advance than bacteria ( Carris et al., 2012). A fungus is any member of group of eukaryotic organisms that includes microorganisms such as yeasts and molds , as well as the more familiar mushroom with photosynthetic pigments being absent in fungi have a heterotrophic mode of nutrition. Some fungi obtain their nutrition from dead plants or animals and are called saprophytes. Some fungi infect a living host but kill host cell in order to obtain their nutrition there are called necrotrophs ( Carries et al., 2012). Fungi as agents of decay play an essential role in maintaining the earth's biosphere (Ainswarth,1976).

India is one of the mega biodiversity countries in the tropics with a very notable diverse fungal population. The group fungi are found to be distributed everywhere i.e., cosmopolitan. Based on their different characters they are divided in to different categories. Most macrofungi belong to Basidiomycota and Ascomycota (Mueller et al., 2007). Of the 1.5 million estimated fungal species in the world only 7.3%

( about 1,10,000 species) are macrofungi of which only 21,769 species of Ascomycota and Basidiomycota have been described ( about 20% of the estimated macrofungal species) ( Mueller et al., 2007).

Ascomycotina is the largest subdivision of the fungi encompassing 2700 genera and 28,500 species. Based on the published literature it is estimated that the Ascomycetes from approximately 40 to 45 % of the total fungi and this proportion is also true for Indian records ( Manoharachary et al., 2005).

Some are lower fungi and some are higher fungi. Among all fungi a group called Basidiomycota is one of the most interesting and advanced group of macroscopic fungi. The Basidiomycota contains about 30,000 species ( Kirk et al., 2001). The visual fungi of Basidiomycota include different groups like mushroom, puffballs, stinkhorns, bracket fungi, polypore, jelly fungi, boletus, chanterelles, earth stars, smuts and rusts etc.

The variety and galaxy of fungi and their natural beauty occupy prime place in the biological world and India has been the cradle for such fungi. Only a fraction of total fungal wealth has been subjected to scientific scrutiny and mycologists have to unravel the unexplored and hidden wealth. One of 1.5 million of fungi only 50% are characterized until now. Unfortunately only around 5-10 % of fungi can be cultured artificially. Fungi are not only beautiful but play a significant role in the daily life of human beings besides their utilization in industry, agriculture, medicine, food industry, textile, bioremediation, natural cycling as biofertilizers and many other ways. Fungal biotechnology has become an integral part of the human welfare ( Manoharachary et al., 2005).

## II. METHODS AND MATERIAL

Extensive fieldwork was carried out in different forest regions with various climatic regimes like moist deciduous forest, dry deciduous forest, scrub forest, wet lands, arid and semi arid regions ( Nagadesi &

Arya, 2017). Most of the fleshy and grilled macro fungi were prevalent in the rainy time of the year as this time is favourable warm, relative humidity and sunshine which further more aids the macro fungi in the decomposition of dead organic tissue (Kokni et al., 2019). Sample were collected using an axe, sharp knife, forceps, measuring tape, hand lens, pens, books, labels, camera, papers and containers (Swapna et al., 2008). Fresh specimens i.e., various stages of fruiting body development and fully grown fruiting bodies were collected in sterile polyethylene bag for further study in laboratory (Patel et al., 2018). Morphological taxonomical characters were observed for both fresh and dried sample, macro observed under microscope (Patel et al., 2018). Sample were preserved by using the fresh method fresh sample were preserved in 2% and 4% of formaldehyde based on their appearance (Kokni et al., 2019).

### III. RESULTS AND DISCUSSION

Earlier, taxonomists contemplated that fungi were closely related to plants based on their similar morphology and growth habitat. Later it was realized that fungi are a separate kingdom which diverged around one billion years ago (Baldauf & Palmer, 1993; Bruns et al., 2006; Parfrey et al., 2011).

Bose and Bose (1940) 28 varieties of edible species including *Agaricus campestris*, *Cantharellus aurantiacus*, *Coprinopsis cibarius*, *Coprinus comatus*, *Lentinus subnudus*, *Termitomyces alburninosa*, *Termitomyces microcarpus* and *Volvariella terastius*, were identified from Bengal.

Ghosh and Pathak (1965) reported some species of genus *Macrolepiota* viz., *Macrolepiota procera*, *Macrolepiota rhacodes* and *Macrolepiota mastoidea* from Lucknow. Ghosh et al., (1967) Some edible species of order Agaricales were recorded including 3 species of *Volvariella*. The edibility of *Flemmulina velutipes* and *Volvariella bombycina* was also mentioned from Lucknow.

Gupta et al., (1974) Few species of *Calvatia* and *Lycoperdon* were identified from west Bengal. Kaul and Kachroo (1974) identified and described *Coprinus*, *Morchella*, *Pleurotus*, *Lycoperdon* and *Calvatia* Jammu and Kashmir. Jandaik and Kapoor (1975) identified the basidiomycetes fungi *Pleurotus sajorcaju* from North India.

The results of morphology based taxonomic studies are also important and used in other research areas such as fungal biochemistry, biotechnology,

bioremediation, physiology and plant pathology (Ali 1962, Hyde & Alcorn 1993, Ali shtayeh & Jamous 2000, de souza & Declerck 2003, Duong et al., 2008, Evidente et al., 2008, Hyde & Soyong 2008).

Traditionally fungal species have been distinguished by different approaches and concepts based on morphology, physiology, biochemistry or reactions to chemical tests (Senanayake et al., 2020).

Around 1,44,000 species of fungi have so far been formally described (Willis et al., 2018; Wijayawardene et al., 2020), but it has been estimated that there may be

2.2 to 3.8 million species (Hawksworth & Lucking, 2017) and therefore the actual number is far from certain (Hyde et al., 2020a).

A total of 3.086% macro fungi poisoning incidents in turkey were reported between 1970 and 1985 causing 90 deaths. There are been so such report to date concerning thrace (Stojchev et al., 1998).

Singer (1989) has reported 1320 species belonging to 129 genera under Agaricales. Besides extensive survey of the Himalayan region are compiled by (Lakhanpal, 1997). Atri et al., (2000) has done taxonomic studies of agarics from Punjab plains. Pradeep et al., (1998) worked on the diversity of mushroom from Western Ghats.

Barua et al., (1998) came up with the Wild edible mushrooms of Meghalaya. Venkateshwarlu et al., (1999) studied the volatile flavour components of 3 edible mushrooms.

Nidiry (2001) recorded the structure fungi toxicity relationships of 14 volatile flavour constituents of the edible mushrooms *Agaricus bisporus* and *Pleurotus florida*. Rai and Ahlawat (2002) put forward the Biotechnological approaches of edible fungi. Das et al., (2002) gave the study of 70 wild edible mushroom as forest products for livelihood generation.

Tsukamoto et al., (2002) studied those at various non pseudomonas bacteria capable of detoxifying aflatoxin were also associated with fruit bodies of wild Agaricales fungi, waiting for further studied on their symbiotic or parasitic roles.

Mahamulkar et al.,(2003) came up with the study of order Tremellales. Mainly gave (36 species belonging to 14 genera, out of which 8 genera were new record for India). Patil et al.,(2003) collected 9 species of jelly and fleshy fungi from Maharashtra.

Deshmukh (2004) has compiled the folk medicine value of the Indian basidiomycetes besides recording nearly 60 wild mushroom representing 54 species in 36 genera around Mumbai.

Arya (2004) reported the 7 species of wood deteriorating fungi are *Phallus impudicus* L., *Cyanthus striatus* ( Schw.) de Toni, *Trametes cingulata* Fr., *Trametes varians* van der Biji, *Lenzites sterioides* ( Fr.) Ryv., *Ganoderma lucidum* ( Fr.) Karsten and *Phellinus nilgheriensis* ( Mont.) Cunn. The *Trametes varians* and *Lenzites sterioides* are new reported to India.

Upadhyay and Kaur (2004) studied 4 light spored Agarics viz., *Hygrotrama microsporum*, *Lactarius indigo*, *Pluteus punctipes*, *Tricholomopsis crocoba* from Himachal Pradesh, India. Adhikari et al., (2005) studied the Ethnomycological knowledge on uses of 24 wild mushrooms in western and central Nepal.

Riviere et al., (2006) gave the Spatial distribution of ectomycorrhizal Basidiomycete *Russula subsect. foetentinae* populations in a primary dipterocarp rainforest. Ajith et al., (2007) done research work on Indian medicinal mushrooms as a source of antioxidant and antitumor agents.

Swapna et al., ( 2008) has reported total of 778 species of macro fungi belonging to 43 families , 101 genera were enumerated of which 242 species were identified to genus level and 73 were identified to species level.

Swapna et al., (2008) has investigated in moist deciduous forest total 280 genera belonging to 41 families and 19 order were recorded of which 87.5% belongs to Basidiomycetes, 11.4% Ascomycetes, 1.1% Myxomycetes with single family and 68% of the total families were found to be distributed with less than 5 genera.

Kaewa & Rai (2010) has observed 153 species of mushroom were identified and keyed of 47 genera belonging to 26 families of these species of the genus *Agaricus* were found to be more abundant compared to other collected mushroom species.

Pala et al., (2011) has surveyed different places of Hirpora wildlife sanctuary, 14 Ectomycorrhizal macro fungal species belonging to genera *Amanita* and *Russula* were collected and identified.

Nagadesi & Arya., (2012) showed 30 species of wood deteriorating fungi belonging to Ascomycetes and Basidiomycetes fungi reported from Ratanmahal wildlife sanctuary Gujarat , India.

Chandulal et al., ( 2013) has been surveyed several number of mushrooms were collected and identified 18 genera belonging to 12 families and 2 classes.

Tapwal et al., (2013) has observed 30 macro fungal species representing 26 genera belonging to 17 families were collected from the study area, maximum six genera assignable to family Polyporaceae, five genera to Russulaceae, three genera to Agaricaceae, two genera to Ganodermataceae and Cantharellaceae .

Enow, Egbe et al., (2013) has reported 177 species in 83 genera were collected the subphylum Basidiomycotina had 163 species, while Ascomycetes had 14 species , 134 species in 67 genera in the raining seasons, 89 species in 46 genera in early dry seasons.

Kunjada et al., (2014) provided the medicinal and antimicrobial role of the Oystere culinary medicinal mushroom *Pleurotus ostreatus* ( higher

Basidiomycetes) cultivated on banana agrowastes in India.

Nagadesi & Arya (2015) observed 30 species of wood deteriorating fungi belonging to Ascomycetes and Basidiomycetes fungi reported from Ratanmahal wildlife sanctuary Gujarat, India.

Nagadesi & Arya (2015) has observed that wood decay fungi associated with Tamarind indica belonged 4 Basidiomycotina, 4 Ascomycotina and 6 Deuteromycotina fungi.

Rajput et al., compiled the first checklist on the basis of their own field survey and available literature on the fungal diversity of the state and reported 334 species.

Koyani et al., (2015) and Vasava et al., (2016-17) documented the distribution and diversity of the family Xylariaceae, Myxomycetes and Agariaceae there for

study aimed to report the status and diversity of Polyporaceae from Gujarat state on the basis of our own fieldwork and available literature.

Zhang et al., (2015) estimated 1662 taxa as Chinese macro fungal resource (1020 edible, 692 medicinal and 480 poisonous species) although more and more edible species have been successfully artificially cultivated year by year only about 50 species are commonly used for commercial production.

Nagadesi & Arya (2016) discovered 69 species of lignicolous macro fungi belonging to Ascomycetes and Basidiomycetes fungi 15 families and 30 genera reported from Gujarat, India.

Koyani et al., (2016) intensive surveyed in all 33 districts of Gujarat including hilly regions, plains of different climatic regimes and agricultural lands was carried out total 19 species were found to be of Xylariaceae.

Nagadesi & Arya (2017) collected 11 Xylariaceous fungi were identified in which 6 belong to Daldinia 4 belong to Xylaria and 1 belongs to Hypoxylon of Xylariaceae.

Hawksworth & Lücking (2017) estimated majority in the phyla Ascomycetes and Basidiomycetes but it is estimated that the vast majority over 90% of fungal species are currently unknown to science and that the total number is somewhere between 2.2 and 3.8 million.

Patel et al., (2018) has documented occurrence of *Cyathus stercoreus* for the first time from Gujarat state and its pure culture was successfully established on PDA medium and maintained at 4°C for further study.

Debnath et al., (2018) reported 5 mushrooms were collected from Jampui hills of Tripura, north-east India and identification of detail they grow and their distribution along with the key features.

Patel et al., (2018) gave the one of the stinkhorn, a unique and the most beautiful fungi popularly known as cage fungi from different forest (Ahwa, Dangs, Dharampur, Wilson hill, Shoolpaneshwar and Vasanda) of Gujarat state.

Vasava et al., (2018) has enlisted 37 species belonging to 20 genera of the family Polyporaceae on the basis of available literature and our own collections from different biogeographic region of Gujarat.

Wu, Fung et al., (2019) discovered 277 species could be treated as "Gold Mushroom", including *Agaricus bisporus*, *Armillaria ostoyae*, *Auricularia heimues*, *Flammulina filiformis*, *Naematelia aurantialba*, *Tremella fuciformis* so on that have been cultivated artificially and widely available for sale for year.

Kokni et al., (2019) studied 71 species belonging to 33 genera of 19 families from Basidiomycetes in Dediapada forest division, Agaricaceae is most dominant family with 7 genera and 23 species followed by Psathyrellaceae with 7 genera and 11 species, Marasmiceae 6 species, Lyophyllaceae 5 species and others are less than 2 species.

Kokni et al., (2019) discovered 45 species belonging to 27 genera of 12 different families, dominant genus was *Ganoderma* (7), *Trametes* (5), *Microporus* (4), *Lentinus* (3), *Polyporus*, *Lenzites*, *Hericium* (2).

Kokni et al., (2019) reported 75 species of Basidiomycetes fungi belonging to 40 genera of 23 families that was found, Agaricaceae is most dominant family with 9 genus and 23 species followed by Marasmiaceae 8 species, Lyophyllaceae 5 species and others are less than 3 species.

Fungorum (2020) investigated fungal kingdom is significantly less well studied than the plant kingdom, currently 1,48,000 species of fungi are recognized.

Boonmee et al., (2021) has contributed 125 taxa from 4 phyla, 10 classes, 31 orders, 69 families, 92 genera and 3 genera incertae sedis are treated, demonstrating worldwide and geographic distribution.

Boonmee et al., (2021) has gave the 3 new genera, 69 new species, one new combination, one reference specimen and 51 new record on new genera, *Cylindrotorula*, *Scolecoteotia* and *Xenovaginatispora* are introduced based on distinct phylogenetic lineages and unique morphologies.

Sakib et al., (2022) observed effect of different strains on yield and yield attributing parameters of paddy straw mushroom *Volvariella volvacea* is presented.

Kumar et al., (2022) analyzed the spatial variations in the concentrations of potentially toxic elements (PTE) in *Agaricus bisporus* mushroom samples collected from different location in Uttarakhand state, India.

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