

Preface to the Second Edition

Fungi are a major component of the microbial world with one lakh known species. They make an enormous contribution to our life. Yeasts, molds or both are important in the production of beverages (alcohol), foods (bread, blue cheeses), antibiotics (penicillin, griseofulvin, cephalosporin), enzymes (amylase, cellulase, protease, lipase), vitamins (B_2 , β -carotene), SCP (Quorn), organic acids (citric, gluconic, itaconic), growth hormones (gibberellins, zearalenone), pharmaceuticals (ergot alkaloids, recombinant proteins), mycoherbicides (DeVine, Collego BioMal), mycoinsecticides (Boverin, Green Muscle), mycofungicides (Rotstop, Soilgard, Binab T, Biofox C), and their direct consumption as edible fungi (e.g. white button mushroom, paddy straw mushroom, shiitake mushroom). Their role as decomposers of organic matter and in bioremediation is well documented. B.O. Dodge, an American mycologist, in 1939, stated that "We may be rest assured that as green plants and animals disappear one by one from the face of the globe some of the fungi will always be present to dispose of the last remains". On the other hand, many fungi are detrimental, inciting a large number of plant diseases and some causing human diseases, either directly (dermatomycoses, candidiasis, aspergillosis, cryptococcosis, sick-building syndrome) or through mycotoxins (aflatoxins, fumonisins, islanditoxin) and mushroom poisons (*Amanita phalloides*, *Gyromitra esculenta*), some others can be serious food contaminants (*Aspergillus*, *Penicillium*, *Cladosporium*, *Mucor*, *Rhizopus*) and the cause of wood rots (*Serpula lacrymans*, *Phlebiopsis gigantea*, *Armillaria mellea*).

Since the appearance of the First Edition of **An Introduction to Mycology** in 1990, several developments have taken place due to the application of modern research techniques and technological advancements. Much of the book has been extensively rewritten and contains most up-to-date information. All organisms studied by mycologists and lichens are incorporated. This book provides a broad introduction to the field of mycology, it explores the morphology, taxonomy, ecology, evolution, life cycle and commercial utilization of fungi. It deals with the role of fungi as pathogens of economically important plants and humans, their biotechnological applications emphasizing their role as saprotrophs and in bioremediation, their exploitation as biocontrol agents to control weeds, plant pathogens (diseases) and insect pests, and various industrial applications from production of foods, beverages, single-cell protein (SCP), enzymes, organic acids, oriental foods, to antibiotics. General topics such as heterothallism, parasexual cycle, sex hormones, physiological specialization, evolutionary tendencies and phylogeny of fungi are included. Their role in biodeterioration, spoilage of foods, as mycotoxins producer, and poisonous mushrooms are discussed at length.

Based on the molecular data, fungi are polyphyletic. Keeping in view the current literature, the three kingdoms of eukaryotes accepted here are: **Fungi**, **Chromista/Straminipila** and **Protozoa**. Chronology of chief milestones that fostered the development of mycology in addition to the notable contributions made by eminent Indian and foreign mycologists are included. Each chapter contains

review questions and objective type questions to test the knowledge and ingenuity of the readers. The aim of the book is to bring in all the recent information on fungi in one volume.

Based on students and teachers input and author's own experience of over four decades of PG teaching and research, the book has been written to cater to the needs of Honours, Postgraduate, Graduate students; research workers and teachers of Botany, Plant pathology, Microbiology, Biotechnology, Biochemistry, Food & Nutrition, Pharmacy, Environmental Science and B.Tech, in addition to the physician dealing with the mycoses. This is the one essential tool for all who work with or are interested in fungi (including lichens, slime molds and yeasts).

Views and suggestions from readers and users are welcome for improvement of this book in future editions.

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(Aspergillus, Penicillium, Cladosporium, Mucor, Rhizopus) and the cause of wood rot (Serpula)

Since the appearance of the First Edition of *An Introduction to Mycology* in 1960, several developments have taken place due to the application of modern research techniques and technological advances. Much of the book has been extensively rewritten and contains most up-to-date information. All organisms studied by mycologists and lichenists are incorporated. This book provides a broad introduction to the field of mycology; it explores the morphology, taxonomy, ecology, evolution, life cycle and commercial utilization of fungi. It deals with the role of fungi as pathogens of economically important plants and humans, their biotechnological applications emphasizing their role as saprophytes and as bioremediation, their exploitation as biocontrol agents to control weeds, plant pathogens (diseases) and insect pests, and various industrial applications from production of foods, beverages, single cell protein (SCP), enzymes, organic acids, animal foods, to antibiotics. General topics such as life cycle, sexual cycle, sex hormones, physiological specialization, evolutionary tendencies and physiology of fungi are included. Their role in biodegradation, spoilage of foods, as mycotoxin producers and poisonous mushrooms are discussed at length.

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Although there are several books on Mycology but none deals in single volume, the taxonomy, ecology, physiology, reproduction and economic importance in a comparative manner. The emphasis in biology has shifted from form to function and in the present book every effort has been made to bring in the latest information, scattered in literature at one single place in a concise and comprehensive manner. The literature in fungi is enormous and expanding very rapidly and many postgraduate students do not have time nor access to go to the originals. Efforts have, therefore, been made to bring in all the relevant and recent information in this book for the benefit of the students.

The subject material has been presented into twelve chapters and deals with morphology, taxonomy, life cycles and classifications of various groups of fungi belonging to Myxomycota, Eumycota (Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina) and also includes the symptoms, disease cycle and control measures of various fungal pathogens responsible for causing diseases of national and international importance. Although Ainsworth's system of classification has mainly been followed, however, in the light of the recent information, the latest classifications proposed by various mycologists after Ainsworth, have been incorporated at various places. Important fungal classifications have been given in a tabular form to give a comparative idea about the classification proposed by different mycologists. Keys to the families and genera have been given wherever found necessary.

First chapter is devoted to introduction and various systems of classification that includes definition, thallus organization, modification of the hyphal structure, dimorphism, cell structure, cell wall composition, nuclear division, nutrition, hyphal growth, reproduction (vegetative, asexual and sexual), sexual compatibility, heterokaryosis, parasexual cycle, life cycles and status and classification of fungi proposed by various mycologists from time to time.

The chapter on historical introduction to mycology deals with the early development of the subject of Mycology, the discovery of microscope and the printing and its impact on the development of science and the subject of Mycology. The outstanding contributions of some important workers like Micheli, Linnaeus, Fries, Buller, Prevost, Tillet, Berkeley, Kuhn, de Bary, Woronin, Flemming and others have been discussed. This chapter also includes detailed note on the development of the subject of Mycology in India.

The Myxomycota have been traditionally classified with the inclusion of Plasmodiophoromycetes here in contrast to Alexopoulos and Mims (1979). The life cycle of *Dictyostelium discoideum* has been discussed in detail and so also the various types of sporophore development in the Myxomycetes. The phylogeny of the group is an additional feature.

The chapter 4 deals with zoosporic fungi illustrated with various types of life cycles and zoospore types. Graphic life cycles have also been given. Important plant pathogens have been discussed in detail. The recent information on the life cycles has been incorporated.

The chapter 5 incorporates information on the discovery of heterothallism, the economic importance and mycorrhizal forms and representative genera have been discussed in details including the genus *Saksena* and its medical and phylogenetic importance.

The chapter 6 includes the information on the evolutionary tendencies in lower fungi, evolution of the asexual apparatus from a sporangium to 'conidium' in the Zygomycotina.

The chapter 7 discusses the subdivision Ascomycotina in detail. The special features are the description of various types of fructifications and hamathecium (sterile tissues of ascocarp), ascus, dehiscence mechanisms of ascus and the discharge of ascospores, various types of centra and importance of it in the classification of various groups, a comparative classification of the Ascomycotina proposed by various workers since Nannfeldt (1932). The important fungal pathogens and the diseases caused by them have been described in detail. *Neurospora* genetics, the *Claviceps* alkaloids, and the discussion on the degeneration of sexual apparatus in the group has been discussed at length.

The chapter 8 deals with the septum, the basidium, the basidiocarps, life cycle pattern, compatibility, Buller phenomenon and the detailed classification of the group. Physiological specialization, axenic culturing, epidemiology and phylogeny of rusts, important smuts and important criteria used in the classification of Aphyllophorales have been discussed in a concise manner. Sexuality in Basidiomycetes has been discussed in detail.

Chapter 9 is on Deuteromycotina deals with various types of asexual reproductive structures, the parasexual cycle, the conidiogenesis and its impact on the classification. Classification proposed by various workers have been given in a comparative manner, various types of spores and conidial ontogeny have been discussed in detail. Important plant and human animal fungal pathogens, including predacious fungi, have been discussed.

Chapter 10 discusses heterothalism in lower fungi ('Phycomycetes'), Ascomycetes; Basidiomycetes; sex hormones in fungi; physiological (biological) specialization; and phylogeny of the fungi. Biochemical basis of evolutionary interrelationships have also been discussed.

Chapter 11 on the ecology, economic importance of fungi and fungi in biotechnology deals with role of saprophytes in nature: return of carbon dioxide to the atmosphere; humus formation; types of organic compound decomposed, cellulose structure and its decomposition; hemicellulose decomposition; pectic materials decomposition; decomposition of lignin, biodeterioration of cellulosic and non-cellulosic materials of economic importance: biodeterioration of wood, paper, textiles, leather, optical equipment, electrical equipment, plastics fuels, paint and paint films, food spoilage; fungi as parasites of plants; fungal diseases of man and animals; entomogenous fungi; fungi parasitic on other fungi and lichens; fungi as allergens; poisonous fungi; fungi in medicine; transformation of steroids; vitamins from fungi; industrial enzyme production from fungi; production of organic acids; fungi in fermentation and food processing: tempeh, shoyu or soya sauce, miso or soya cheese, soya milk, tofu and sufu, ragi, ang-kak, lao-chao, hamanatto, ontjom, proteins from fungi, fungi in cheese production, fungi in biological assay and fungi in biological control.

Its last chapter deals with fungi as symbionts of photobionts, plants and insects. Lichens have been discussed in detail including their structure, classification, synthesis, reproduction and economic importance; fungi as partner of plants (mycorrhizal fungi) and fungi as insect symbionts have been discussed in detail.

In the end various appendices, important text and reference books, important mycological journals, important fungal culture collection centers, fungal mounting media and common culture media for fungi have been given.

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