
Preface

Fungal biology deals with the study of fungi, including their growth and development, their genetic and biochemical characteristics, their taxonomy and genomics, and their use to humans. The current research focuses on mushrooms which may have hypoglycemic activity, anticancer activity, anti-pathogenic activity, and immune system-enhancing activity. A recent research has found that the oyster mushroom naturally contains the cholesterol-lowering drug, lovastatin, that mushrooms produce large amounts of vitamin D when exposed to UV light, and that certain fungi may be a future source of taxol. To date, penicillin, lovastatin, cyclosporine, griseofulvin, cephalosporin, ergometrine, and statins are the most famous pharmaceuticals which have been isolated from fungi.

Fungi are fundamental for life on earth in their roles as symbionts (e.g., in the form of mycorrhizae, insect symbionts, and lichens). Many fungi are able to break down complex organic biomolecules such as lignin, and pollutants such as xenobiotics, petroleum, and polycyclic aromatic hydrocarbons. By decomposing these molecules, fungi play a critical role in the global carbon cycle.

The kingdom fungi encompasses an enormous diversity of taxa with varied ecologies, life cycle strategies, and morphologies ranging from unicellular aquatic chytrids to large mushrooms. Little is, however, known about their true biodiversity, which has been estimated at 1.5 to 5 million species, with about 5% of these having been formally classified. Advances in molecular genetics have opened the way for DNA analysis to be incorporated into taxonomy, which has sometimes challenged the historical groupings based on morphology and other traits. Phylogenetic studies published in the last decade have helped reshape the classification within kingdom fungi, which is divided into one subkingdom, seven phyla, and ten subphyla.

The human use of fungi for food preparation or preservation and other purposes is extensive and has a long history. Mushroom farming and mushroom gathering are large industries in many countries. The study of the historical uses and sociological impact of fungi is known as ethnomycology. Because of the capacity of this group to produce an enormous range of natural products with antimicrobial or other biological activities, many species have long been used or are being developed for industrial production of antibiotics, vitamins, and anticancer and cholesterol-lowering drugs. More recently, methods have been developed for

genetic engineering of fungi, enabling metabolic engineering of fungal species. For example, genetic modification of yeast species, which are easy to grow at fast rates in large fermentation vessels, has opened the way for pharmaceutical production that are potentially more efficient than production by the original source organisms.

Several pivotal discoveries in biology have been made by researchers using fungi as model organisms, which grow and sexually reproduce rapidly in the laboratory. For example, the one gene–one enzyme hypothesis was formulated by scientists using the bread mold *Neurospora crassa* to test their biochemical theories. Other important model fungi are *Aspergillus nidulans* and the yeasts *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe*, each with a long history of use to investigate issues in eukaryotic cell biology and genetics, such as cell cycle regulation, chromatin structure, and gene regulation. Other fungal models have more recently emerged that address specific biological questions relevant to medicine, plant pathology, and industrial uses; examples include *Candida albicans*, a dimorphic, opportunistic human pathogen; *Magnaporthe grisea*, a plant pathogen; and *Pichia pastoris*, a yeast widely used for eukaryotic protein production. Fungi are used extensively to produce industrial chemicals such as citric, gluconic, lactic, and malic acids, and industrial enzymes such as lipases used in biological detergents, cellulases used for making cellulosic ethanol and stonewashed jeans, and amylases, invertases, proteases, and xylanases. Several fungi such as *Psilocybe* mushrooms (colloquially known as magic mushrooms) are ingested for their psychedellic properties, both recreationally and religiously.

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The book is an attempt in collating recent developments in fungi from various environments: their diversity and potential applications. We greatly appreciate the efforts of experts in contributing on various aspects of fungi. The opinions expressed by the authors are their own. We wish to thank all the contributors for readily accepting our invitation and Springer for publishing the book.

New Delhi, India
New Delhi, India
Bhopal, India

Tulasi Satyanarayana
Sunil K. Deshmukh
B. N. Johri

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