Chapter 4

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Fungi

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When Flora's lovelier tribes give place, the Mushroom's scorned but curious race, bestood the moist autumnal earth; a quick but perishable birth, inlaid with many a brilliant dye, of Nature's high-wrought tapestry.

Bishop Mant

Fungi are a diverse group of multicellular organisms with an incredible array of vegetative and reproductive morphologies and diverse life cycles. They are more abundant, on a mass basis, in soils than any other group of microorganisms; their biomass ranges from 500 to 5,000 wet kg ha^{-1} (Metting, 1993). Fungi inhabit almost any niche containing organic substrates, so that they are active participants in ecosystems as degraders of organic matter, agents of disease, beneficial symbionts, agents of soil aggregation, and an important food source for humans and many other organisms. In many cases, they are a vital component of ecosystem function and vitality. Humans depend considerably on fungi for metabolic by-products in food additives and medicines. At least 70,000 species have been described, but at least 20 times that number are estimated to exist worldwide (Hawksworth, 1991).

Fungal Cell Structure

Unlike prokaryotic bacteria discussed in Chapter 3, fungal organisms are eukaryotic. The multitude of membrane-bound organelles present in each cell (Fig. 4–1) are similar to those of insects, plants, and animals, but with some important differences. The membrane surrounding the nucleus constricts during formation of two daughter nuclei, whereas it degenerates and reforms in plant and animal cells. Within the nucleus is a predominantly protein structure called a nuceolus that may persist, become dis-

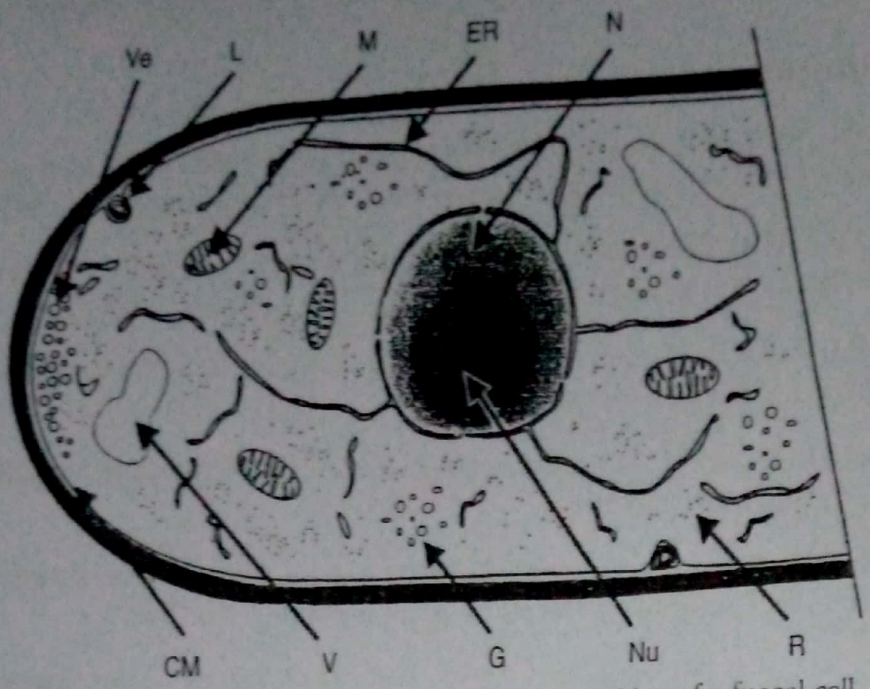

Figure 4–1 General structure and organellar composition of a fungal cell at the apex of a hypha. ER = endoplasmic reticulum, G = glycogen granules, L = lomasome, M = mitochondrion (plural, mitochondria), N = nucleus, Nu = nucleolus, CM = cytoplasmic membrane, R = ribosomes, V = vacuole, Ve = vesicles.

persed within a nucleus or be discharged into the cell cytoplasm. Vacuoles in the cell cytoplasm also usually are smaller than those in plant cells. The network of endoplasmic reticulum is not as extensive, and it has fewer connections with the cytoplasmic membrane compared to that in plants and animals. An extensive membrane system generates many secretory vesicles that substitute for Golgi bodies found in other eukaryotic organisms. These vesicles are uniquely important in filamentous fungi for cellular function and growth because they transport structural and enzymatic molecules to active metabolic regions. These occur at the tips of tubular strands or filaments called **hyphae** (singular, hypha) that elongate and branch indefinitely.

Even though fungi do not contain chlorophyll and thus cannot carry out photosynthesis, they have been considered plantlike because they have cell walls, are generally nonmotile, and reproduce by means of **spores** (microscopic parts that resemble seeds in functioning as vehicles of dissemination and formation of new individuals, but they lack embryos). Accordingly, Latin binomial names of fungi are based on the Botanical Code of Nomenclature. However, other morphological characters and new molecular evidence suggest that fungi are more closely related to animals. We now believe that they originated about one billion years ago as a group equal in rank to plants and animals. Table 4–1 summarizes properties unique to fungi as well as those shared with plants, animals, or both.

Growth and Reproduction, with Reference to Taxonomy

Fungi can be single-celled, but the majority are multicellular organisms with a filamentous vegetative body. In contrast to the relative simplicity of the vegetative body, reproductive structures include various kinds of single-celled spores produced alone or in visible and complex fruiting bodies. Diverse reproductive structures produced