MORPHOLOGICAL ASPECTS OF FUNGAL DIMORPHISM

Marcel Borgers
Dept of Morphology, Life Sciences
Janssen Research Foundation
2340 Beerse, Belgium

ABSTRACT

From a purely structural point of view, the term dimorphism is very restrictive for the various fungi that are dealt with in this symposium. Polymorphism would be more accurate. Ultrastructural features of the following fungal organisms are presented: Candida albicans, Pityrosporum ovale, Histoplasma capsulatum, Paracoccidioides brasiliensis, Sporothrix schenckii and Coccidioides immitis. The detailed ultrastructure of these fungi is documented by transmission/scanning electron microscopy, with standard preparation procedures and auxiliary techniques, such as enzyme cytochemistry and immunocytochemistry.

This multidisciplinary approach to morphology aims at describing differences in the number and composition of subcellular organelles between the various fungi and between different morphogenetic forms of the same organism. Particular attention is given to several constituents, namely the cell wall, plasmalemma and its derived structures, nucleus, central vacuolar system, mitochondria, peroxisomes, and cytosol. Environmental (in vivo) and culture (in vitro) conditions as determinants for morphology and morphogenetic transition include growth inhibitory interventions, interactions with host defence cells, composition of nutrients, temperature, pH, etc.

The relation between pathogenicity and morphologic adaptation of fungi is intriguing. The structural changes that accompany the expression of invasiveness or the inhibition thereof are seen primarily at the level of the cell periphery and consist of alterations in the density and thickness of the cell wall, altered patterns of the plasmalemma-cytoskeletal complex, changes in subplasmalemmal membranes, and differences in the directional movements of subcellular organelles.

Although an important number of morphological aspects of polymorphism have been identified, many remain enigmatic. With the advent of new morphologically oriented, molecular biological markers, these aspects can be tackled more adequately in future research.
INTRODUCTION

Descriptive fungal cytology has, for many years, struggled with the problem of adequate permeation of chemical fixatives through the cell wall and plasmalemma. This is especially true for species such as *Candida albicans* and *Pityrosporum ovale*.

The slow permeation of chemical fixatives into the cytoplasm has posed a serious problem for the morphological identification of internal organelles of these species. Potassium permanganate, a commonly employed fixative, revealed the membranous components fairly well but failed to display ribosomes and the various nuclear and nucleolar substructures. Moreover, this fixative cannot be used for the preservation of cells for enzyme cytochemistry. With a modification of the conventional preparation procedures, this has been largely solved by glutaraldehyde fixation, which makes all subcellular organelles fairly visible and yet enzymes retain their activity. The detailed substructure of the cell walls are also well displayed with this methodology. A more recently developed approach, microwave-assisted fixation of fungi, has proved to have enormous advantages over classical fixation because of its rapid immobilization of structures and enhanced permeation of fixatives. The changes in distribution, size and shape of subcellular organelles that accompany morphologic transition in several dimorphic species have been described. In addition, marker enzymes for the various subcellular organelles have been identified, which may aid the understanding of inter-organelle relationships that are not obvious from morphological examination alone.

The species and their different morphological forms that are dealt with in this paper are *C. albicans*, *P. ovale*, *Coccidioides immitis*, *Paracoccidioides brasiliensis* and *Sporothrix schenckii*.

CANDIDA ALBICANS

*C. albicans* is polymorphic and grows as a multipolarly budding yeast, as a pseudohypha of elongated yeast-like cells, and as a true septate hypha (Fig. 1). Both the true hypha and pseudohypha may regenerate the yeast phase by producing clusters of yeast-like blastoconidia. Morphogenetic and ultrastructural aspects have been reported extensively.

![Fig. 1 C. albicans. SEM pictures of surface morphology of yeast (a) and branching mycelial (b) phase cells.](image-url)