The nutrition of a vegetative fungal colony can be viewed as a web of interconnected processes. In this volume, the author provides a mechanistic basis to the subject, focusing on processes at the plasma membrane, considering the modulating effects of the fungal wall and describing the fate of nutrients entering the fungus. The emphasis is physiological, but biochemical and molecular biological information has been drawn upon as appropriate to reflect the power of the multi-faceted approach and encourage such study further. A comprehensive review of what is known for the more commonly studied fungal species is complemented by information on other fungi to provide an indication of the diversity of nutritional processes that exist in the Fungal Kingdom.

THE PHYSIOLOGY OF FUNGAL NUTRITION

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Introduction

As far as I am aware, there has only been one other book about fungal nutrition. This contrasts very markedly with the large number of books devoted to the nutrition of higher plants. Here, we have a coherent field of study, well established through the need to understand how plant yield might be increased through the provision of inorganic nutrients. The economic benefits of an effective fertiliser regime for an agricultural or horticultural crop have been an important driving force for establishing plant nutrition as an identifiable discipline in plant physiology. But this identity for plant nutrition is aided in general germs by the fact that the higher plant has a specific organ, the root, for absorbing nutrients and the effectiveness of that organ can be determined by observable responses in other parts of the plant, such as change in shape and colour.

Fungal nutrition is clearly about what kinds and amounts of nutrients will support growth or bring about differentiation, whether it be secondary metabolism on reproductive structures. However, to focus on fungal nutrition thus described would be to produce recipes and little else. This book is about the nutrition of fungi as a web of processes, attempting to provide a mechanistic basis for the subject. For the most part fungi do not produce specialised organs of nutrition, nor, because of their great physiological plasticity, which is much greater than that of higher plants, can one observe in such a clear manner the consequences of changed nutrient conditions for the vegetative colony. Usually, any observable response, apart from a change in growth rate, is differentiation.

It should be apparent that nutrition of the vegetative colony is not easily defined as a topic. The fungus responds to a change in nutrient conditions homeostatically, with changes both qualitatively and quantitatively in a plethora of processes. My focus in this book is on how the fungus interfaces with the external medium, both in terms of acquiring

nutrients from it and of avoiding the deleterious effects of constituents within it that might be toxic to the fungus. So the emphasis of the volume is for the most part on processes at the plasma membrane as well as a consideration of the wall as a structure modulating the interactions between the external medium and the protoplasm of the fungus. Inevitably one cannot isolate processes occurring at the plasma membrane from other processes occurring within the protoplasm. Here, my decisions as to what or what not to include have been to a certain extent arbitrary. But as a rough rule, I have indicated how a nutrient once entering a fungus interacts with primary metabolism or might have its concentration regulated by internal processes.

In this volume, the external medium is essentially the non-living medium/substratum inhabited for the most part by saprotrophic fungi. I have resisted the temptation to consider parasitic fungi because of the complexity of the interactions between fungus and host but also because my assessment of present knowledge is that our *physiological* understanding of what may be occurring is somewhat limited. To introduce too much speculation would run counter to the general philosophy underlying the text, namely that the emphasis should be on the facts about any process under consideration. Although the book is very much concerned with saprotrophic fungi, I have included, where appropriate, information about parasitic fungi when they are grown in culture and mycorrhizal fungi when they are behaving saprotrophically.

One aim in writing this book has been to indicate for those processes coming within its preview the diversity that exists within the Fungal Kingdom. Mycological research is dominated by studies on *Saccharomyces cerevisiae* and to a lesser extent on *Aspergillus* sp., *Neurospora crassa*, *Penicillium* and *Schizosaccharomyces pombe*. One must not ignore the very important work on these fungi and I have attempted to give adequate coverage of the information relevant to this volume. However, wherever possible, I have tried to give a sensible picture of what is known for other fungi for three reasons. First, I believe it is important that we do not, without good reason, try to extrapolate from what we know about processes occurring in the above-named species to equivalent processes occurring in species in other parts of the Fungal Kingdom. Second, by referring to the little that is known for much less-studied species I hope to encourage more research on those species. Third, I am very anxious that we avoid more positively the tendency to see the fungi as a physiologically homogeneous group of organisms. Though species possess similar physiological features, there are nevertheless many striking

differences. A stumbling block often to the appreciation of those differences is our ignorance of what a fungus might be doing in its natural environment. The need to attempt to draw together physiology and ecology of fungi is a theme underlying the volume.

Essentially this book has been written for those involved in fungal physiology, as teachers or students, but particularly those are active in research. For that reason I have concentrated on known facts and eschewed speculation, unless it points up a clear line of research. I have almost punctiliously avoided referring to what might be occurring in other eukaryotic organisms to avoid clouding the readers' judgement as to what might be happening in fungi when present knowledge seems inadequate. While there is a considerable amount of information in the volume, I cannot claim that it is encyclopaedic. Nevertheless, in spite of the rate of advance of the subject, I hope the volume will be a useful source of information for some period for those with interests in fungal nutrition. For those areas where coverage has been to an extent superficial, I hope the literature to which I have referred will allow the reader to probe deeper.

Finally, though the major emphasis of the volume is physiological, biochemical and molecular biological information has been drawn upon wherever appropriate. Not one of those approaches can give more than a partial picture of what might be taking place in a particular process. I stress this, because today's emphasis on molecular biology, the undoubted power of which must be acknowledged, has tended to lead to much less reliance on other approaches, particularly the physiological. Wherever possible, I have tried to show the success of the multi-faceted approach to the study of fungal nutrition. If this volume encourages future research also to be more multi-faceted then I shall be pleased.

On a more personal note. I wish to thank Karen McGowan for her great skill in transferring my poor handwriting onto computer disc. Also, I am particularly grateful to Sandi Irvine of Cambridge University Press for her meticulous editing of the manuscript. Any mistakes that are still present are my responsibility! But an especial word of thanks is due to all those many fellow scientists who over the years so kindly responded to my many requests for reprints. Without them, my job in preparing the book would have been immeasurably harder.

David Jennings