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Book Reviews[1]

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BIOTECHNOLOGY

The *Book Reviews* section of this part draws together reviews of four major reference works relevant to fungal biotechnology.

The Mycota: A comprehensive treatise on fungi as experimental systems for basic and applied research. Edited by Karl Esser. Springer-Verlag, Berlin.

II. Genetics and Biotechnology. Edited by Ulrich Kück. 2004. Pp. xxii + 434, figures 62 (6 in colour), tables 35. 2nd edn. ISBN 3 540 42770 8. Springer-Verlag, Berlin. Price: €199.95, US $259, £154.

Genetics and biotechnology has been one of the areas in which *The Mycota* has been strongest. In addition to Vol. II, Vols III (*Biochemistry and Molecular Biology*), X (*Industrial Applications*), XI (*Agricultural Applications*) and XII (*Human Fungal Pathogens*) in particular include genetic and biotechnological chapters. We live in an age where science is viewed with great urgency. This is a fast-moving area of science in which fungi have a high profile, and where reviews soon become dated. Vol. II first appeared in 1995 (review in *Mycological Research* **104** (5): 638–639, May 2001), and it is therefore not surprising that the Series Editor decided that a new edition should be prepared.

The same basic three section structure is retained: Nuclear and extracellular genetics; Molecular genetics; and Biotechnology. In the first section, the six chapters included are revisions of those in the first edition, with the same authors (some with fresh coauthors): these address the Genetics of *Neurospora*, Genetics of *Aspergillus*, Genetics of *Coprinus*, Electrophoretic karyotyping, The mitochondrial genetics of the budding yeast *Saccharomyces cerevisiae*, and the Mitochondrial genetics of *Neurospora*; the chapter on Fungal protoplasts in the first edition has been omitted.

The Molecular genetics section starts with a new and especially topical chapter, Functional genomics in fungi, a subject that hardly existed in 1995 but has come to the fore especially as a result of genome sequencing projects. This chapter summarizes the different techniques in use, and also has a table indicating applications; it will be a useful teaching aid as no similar review appears to be available, although I was concerned that the latest references to papers included were dated 2002. The next topics are updated chapters on Gene regulation in yeast, and Gene regulation in mycelial fungi (by the original authors but with fresh coauthors). Next is a particularly scholarly and new overview of Mobile genetic elements in mycelial fungi; this covers introns, plasmids, transposons and other mobile elements. Updated chapters on the Linear DNA plasmids and killer system of *Kluveromyces lactis*, and RNA viruses and killer genetics of *Saccharomyces* follow. Concluding the section is a new contribution, Molecular biology of fungal amino acid biosynthesis regulation. Three chapters in this section of the first edition have been dropped; these were on Genetic manipulation of fungi by transformation, Yeast retrotransposons, and Reverse transcriptase activities in mycelial fungi.

The Biotechnology section is rather a mixed bag, something that was perhaps inevitable bearing in mind the issue of overlaps with other volumes in the series. Three of the six chapters are updates (with some changes in coauthors): Biotechnical genetics of antibiotic biosynthesis, Molecular biology of cellulolytic fungi, and Lipids in fungal biotechnology. New chapters are: A platform for heterologous gene expression, Filamentous fungi as expression systems for heterologous proteins, and Wood degradation by brown-rot and white-rot fungi. Missing are contributions on the Biotechnology of lignin degradation, and Molecular strategies for *Agaricus* breeding.

The contributions are to a high standard, and the quality of production is excellent. More attention seems to have been paid to getting the scientific names correct in this volume than in some others, but it is still frustrating to see outdated names being accepted in some chapters, such as *Cephalosporium acremonium*, and *Nectria haematococca*. Overall, the strength of the volume is in the genetics, especially in the light of partially competing or overlapping volumes both within the series and without (see below). In view of the new chapters as well as the updates, this second edition is certainly something that libraries who have the first edition will seriously wish to consider purchasing. However, those wishing to buy a topical comprehenisive major reference work in this field also need to consider whether one or both of the two volumes edited by Dilip K. Arora (reviewed below) might better suit their requirements.

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Handbook of Fungal Biotechnology. Edited by Dilip K. Arora. 2004. 2nd edition. Pp. xii + 592. ISBN 0 8247 4018 1. [Mycology Series No. 20.] Marcel Dekker, New York. Price: US $225.

This is a most impressive large-format work, and a major leap forward from the first edition (Arora 1992), comprising

[1] This section is compiled by the Executive Editor, to whom books for consideration for coverage should be sent: David L. Hawksworth, The Yellow House, Calle Aguila 12, Colonia La Maliciosa, Mataelpino, ES-28492 Madrid, Spain. (tel/fax: [+34] 91 857 3640; e-mail: myconova@terra.es). Unsigned reviews and notices are by the Executive Editor.

43 chapters and involving 81 authors from a wide range of countries. The chapters are grouped into four sections: Cell Biology, biochemical and molecular technologies; Commercial applications and biotechnological potential; Medical biotechnology; and Culture collections and biosafety. Agricultural, food, and environmental technology applications are excluded here and dealt with in a companion volume (see below). While that split might be somewhat frustrating, in the absence of this decision either there would have been a totally unwieldy volume, or one in which many of the topics were treated cursorily.

The Cell biology, biochemical and molecular technologies section is pragmatic and wide ranging, has 15 chapters, and includes topics dropped from or not treated in the equivalent volume of *The Mycota* (see above). It includes basic information on fungal cell biology and genetics, and methodologies from proptoplast isolation, transformations, and gene manipulations, to genome bioinformatics, DNA chips, microarrays, and signal transduction. It was especially good to see chapters encompassing fungal evolution and phylogenetics, and also covering some of the principles and statistical tests used in the latter (but not Mr Bayes).

The major section in the volume is Commercial applications and biotechnological potential, with 18 contributions. There are chapters on strain improvement in wine and brewing yeasts, solid-state fermentation, the production of fungal enzymes, bioactive polysaccharides, fungal lipids, modelling and optimizing biochemical product production systems, antibiotic production, and green fluorescent protein (GFP) technology.

The Medical Biotechnology section is relatively modest, occupying just 72 pages. Six chapters cover antifungal drugs, antitumor and immunomodulatory compounds, clinical and laboratory diagnosis (amazingly without a reference to de Hoog *et al*. 2000), candidiasis, immunization against fungal diseases, and fungal allergy. While these give a flavour of what is going on in medical mycology today, they are hardly a replacement for the more detailed reviews of medical mycology available in, for example, vol. XII of *The Mycota* (see *Mycological Research* **108** (4): 463–464, April 2004), Ajello & Hay (1998), and Breitenbach, Crameri & Lehrer (2002).

The final section on Culture collections and biosafety is especially welcome as these topics are too often glanced over. The benefits and risks related to genetically modified foods and mycoherbicides feature, and there is an overview of current developments in the complex and changing areas of access to genetic resources, intellectual property rights, and benefit-sharing. A chapter on safety categorization and safe handling of toxin producing fungi would have been a welcome addition here.

More attention to systematics throughout would have been useful, old concepts and misspellings irritate, such as '*Stramenopila*' for '*Straminipila*', continued use of the outdated class name '*Plectomycetes*', and the inevitable '*Cephalosporium acremonium*'. However, I was pleased to see *Magnaporthe grisea* live on (11 references) without any adoption of the 'correct' (until rejected) name *M. oryzae*, although this was perhaps by default.

Nevertheless, the Editor has clearly endeavoured to make the work as topical and comprehensive as possible, and the contributuions seem to have been painstakingly edited to attain the highest standards. Many chapters have references into 2001 and 2002, but I did not catch any from 2003; a situation understandable in view of the time the production of such a volume inevitably takes. Although rather expensive, the pricing is not out of line for a work of its size and complexity, and for libraries wanting a major reference work on the topic, this deserves to be the book of choice.

Ajello, L. & Hay, R. J. (eds) (1998) *Medical Mycology*. [Topley & Wilson's Microbiology and Microbial Infections Vol. 4.] Taylor & Francis, London.

Arora, D. K. (ed.) (1992) *Fungal Biotechnology*. [Handbook of Applied Mycology No. 4.] Marcel Dekker, New York.

Breitenbach, M., Crameri, R. & Lehrer, S. B. (eds) (2002) *Fungal Allergy and Pathogenicity*. [Chemical Immunology Vol. 81.] Karger, Basel.

de Hoog, G. S., Guarro, J., Gené, J. & Figueras, M. J. (2000) *Atlas of Clinical Fungi*. 2nd edn. Centraalbureau voor Schimmelcultures, Utrecht.

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Fungal Biotechnology in Agricultural, Food, and Environmental Applications. Edited by Dilip K. Arora. 2004. Pp. xii + 509. ISBN 0 8247 4770 4. [Mycology Series No. 21.] Marcel Dekker, New York. Price: US $195.

This is a companion volume to the new edition of the *Handbook of Fungal Biotechnology*), reviewed above. That a companion was needed reflects the enormous rise in interest in the use of fungi in the agricultural and environmental fields particularly that has taken place over the last 10–15 years. The book has 40 chapters involving 81 authors, and is divided into three sections reflecting the elements of its title.

Almost half of the chapters (18) are in the Agricultural biotechnology section. These cover approaches in plant protection, techniques (metabolite profiling and metabolomics, isozyme analysis, molecular methods of identification, and molecular markers), the control of mycotoxigenic fungi, the use of entomopathogens, ergot alkaloids, plant growth promotion and disease suppression, mycoherbicides, biofungicides, the biocontrol of fungal and nematode diseases, and the use of arbuscular mycorrhizal fungi as biofertilisers. There are some gaps and areas that really merited strengthening here. There is no mention of the new and exciting technologies using mycorrhizas that are developing, and the problems of identification and risk assessment related to host specificity and species concepts in plant pathogens are not addressed in earnest. Further, there is no equivalent to the safety aspects in the *Handbook*; I would have welcomed an overview of quarantine legislation and requirements and discussion of the risks posed by the introduction of fungi from one region to another at the strain as well as at the specific level.

The Food and feeds section is especially useful as it draws together threads from generally disparate subject areas. The 12 chapters included embrace fermented foodstuffs, edible fungi, mycoprotein, wine fermentation, yeasts in the dairy industry, flavours and aromas, antifungal food additives, molecular detection of fungal contaminants, spoilage fungi, and mycotoxins. However, I found many of the treatments rather brief, scarcely doing justice to their importance – not least in the case of the edible mushroom industry and the advanced breeding techniques now in vogue. Further, for a reference work of this type, I would have expected something on the medical benefits of eating fungi (i.e. fungi as nutriceuticals).

The concluding Environmental biotechnology section has ten chapters, which address cellulose degradation, wood decay in forest ecosystems (a useful ecologically interesting summary,

but applications?), the biodegradation of lignocelluloses, biomineralization of heavy metals (with a table listing 'fungus' and 'yeast' as different categories equivalent to 'alga' and 'bacterium'!), decolourization and degradation of industrial wastes and dyes, the bioconversion of distillery waste, the biodegradation of hydrocarbons, azo dyes and explosives, and the restoration of mycorrhizas in disturbed arid ecosystems. I was surprised not to see contributions on topics such as the biodeterioration of stonework and building materials, and the concentration and translocation of radionuclides.

In summary, an impressive collection of reviews which will provide useful starting points for access into the topics addressed, but not an in-depth overview of all that might be expected to be found in a work with its title. Nevertheless, this is a reference work that deserves to be on the shelves of agricultural and food technology libraries alongside the *Handbook*, where I am sure it will be especially popular amongst students preparing essays.

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Handbook of Secondary Fungal Metabolites. Edited by Richard J. Cole, Milbra A. Schweikert & Bruce B. Jarvis. Sept. 2003. 3 vols. Pp. 2544. ISBN 0 12 179460 1. Academic Press, Amsterdam. Price: £195.

I was amused to discover just how big this set was when it was delivered. It certainly puts to bed any suggestion that interest in fungal secondary metabolites is in decline. The volumes will contribute immensely to the budding field of metabolomics, and this review allows me to introduce a new term, 'secondary-metabolomics'. The latter differs from the original concept, which appears to be currently used for primary metabolites as expressed by genomes (i.e. 'primary-metabolomics'). This concept can be expanded into secondary metabolism with all the complexity that entails *via* the 'biotechnologist's central dogma'.

Originally, I thought there would be little comment I could give except unbridled praise. The books follows the format of the excellent Cole & Cox (1981), except that the references are listed after each compound, rather than clustered together, which I am not convinced is an advantage. The original book had the additional (minor) benefit of being able to refer to a compound as toxic if it was listed. This is no-longer the case, and for that information it is necessary to look up the activity data provided for each compound.

The handbook is divided into three volumes, and the placement of metabolites within them is based on chemical relationships, except for some miscellaneous sections. Volumes I, II, and III cite 494, 399, and 398 (total 1291) molecular weights respectively in the index, which I assume relates directly to the number of separate compounds considered. However, this is tempered by multiple entries for some compounds because of modifications of the basic structure. For example, cytochalasins have 26 entries in the index and ganoderic acid even more. The fungi covered range from yeasts to basidiomycetes, with *Saccharomyces* and *Ganoderma* respectively being especially well represented.

A definition of what the authors meant by 'secondary' fungal metabolites would have been interesting, and might have helped explain their choice of what to include. For example, I cannot accept ergosterol as a secondary metabolite, and so it should not really have been included, nor indeed perhaps the whole section on sterols. Most lipids are clearly separated from secondary metabolites (Paterson 1998), for reasons which are fairly obvious.

It is difficult to explain why the most important fungal secondary metabolite, penicillin is not included. Neither are the more important cephalosporins, which contain nitrogen derived from amino acids (only cephalosporin P_1 is given). Most of the main mycotoxins are included, but why not zearalenone? Further, brevianamide A is not treated, while brevianamides C, D, and F are; this is as surely a secondary metabolite, and one demonstrated to have insecticidal activity (Paterson *et al*. 1990).

Attention was drawn in this issue (*Mycological Research* **108** (6): 596–597, June 2004) to a publication with excellent analytical data on 474 fungal metabolites (Nielsen & Smedsgaard 2003). It is disappointing that earlier analytical papers are not referred to in the handbook. Such compilations have the advantage of using the same methods to analyse hundreds of compounds, and are surely should have been worth including for that reason. Somebody, at some stage, needs to cross-reference the data in the *Handbook* with that given in these types of publications. Related to this, I wonder if the references could have been updated; in the first volume the most recent I found was 1997, but in the third volume's miscellaneous section there was at least one from 2002.

In conclusion, this is an extensive, well-presented set which would grace library or personal shelves. The cover has colourful pictures of various fungi, together with chemical structures of some of the metabolites, serving to remind readers that we are dealing with biological systems. However, there appears to have been little or no attempt to use the 'currently accepted' names. I can understand the difficulties of doing this, but it does mean that users need to be on their guard. The publication is obviously one for reference, and in view of its size the price is extremely reasonable.

Cole, R. J. & Cox, R. H. (1981) *Handbook of Toxic Fungal Metabolites*. Academic Press, New York.

Nielsen, K. F. & Smedsgaard, J. (2003) Fungal metabolite screening: database of 474 mycotoxins and fungal metabolites for dereplication by standardized liquid chromatography-UV-mass spectrometry methodology. *Journal of Chromatography A* **1002**: 111–136.

Paterson, R. R. M. (1998) Chemotaxonomy of filamentous fungi by unsaponifiable lipids. In *Chemical Fungal Taxonomy* (P. D. Bridge & J. C. Frisvad, eds): 183–218. [Handbook of Applied Mycology Vol. 6.] Marcel Dekker, New York.

Paterson, R. R. M., Simmonds, M. J., Kemmelmeier, C. & Blaney, W. (1990) Effects of brevianamide A, and its photolysis product brevianamide D, and ochratoxin A from two *Penicillium* strains on the insect pests *Spodoptera frugiperda* and *Heliothis verescans*. *Mycological Research* **94**: 538–542.

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RUST FUNGI

The Rust Fungi of the British Isles: A guide to identification by their plant hosts. By D[ouglas] M. Henderson. 2004. Pp. 35. British Mycological Society, Kew. ISBN 0 9527704 9 0. Price: Not indicated.

This booklet is an adjunct to Douglas Henderson's *Checklist of the Rust Fungi of the British Isles* published in 2000

(see *Mycological Research* **105** (3): 384, March 2001). The families, and genera within them, are arranged alphabetically, and under each genus the rusts and stages present on particular plant species are mentioned. In some cases details of spore dimensions and ornamentation are given, but only where this is necessary to differentiate rusts growing on the same host. Additions and corrections to the 2000 checklist are also included as an appendix. The booklet will be of particular value to field mycologists both as a guide to hosts to search for rusts on, and as a short-cut in making identifications.

Production of secondary metabolites often occurs after fungal growth has ceased as a result of nutrient limitations but with an excess carbon source available, making it possible to manipulate their formation. It is intriguing that some endophytic fungi are capable of producing secondary metabolites previously known from plants. Noteworthy examples include production of two clinically important anticancer drugs, paclitaxel (TaxolÂ®) and camptothecin, by Taxomyces andreanae and Nothapodytes foetida, respectively, and a synthetic precursor of an anticancer drug, podophyllotoxin, by Phialocephala Fungi have the capability to produce a tremendous number of so-called secondary metabolites, which possess a multitude of functions, e.g., communication signals during coexistence with other microorganisms, virulence factors during pathogenic interactions with plants and animals, and in medical applications.Â This review aims to depict the complexity of all the regulatory elements involved in controlling the expression of secondary metabolite gene clusters, ranging from epigenetic control and signal transduction pathways to global and specific transcriptional regulators.Â
Fungi/pathogenicity*. Gene Expression Regulation, Fungal. Plants/microbiology. Secondary Metabolism*. Signal Transduction. Virulence Factors/genetics.