

## Books

# Plant secondary metabolism

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By *David S. Seigler*

ix + 759 pages. Dordrecht, The Netherlands: Kluwer Academic Publishers, 1998. £313.00 h/b. ISBN 0 412 01981 7.

Plant secondary metabolism is an immense subject, dealing as it does with metabolites with a bewildering diversity of chemical structures. These days, books covering such wide-ranging topics are usually multi-authored, and assembled under the supervision of one or more editors. It is therefore remarkable to find a book on secondary metabolism in plants written by a single author. It is also a pleasure to note that the book is even-handed in its treatment of the different classes of compound: the author's research expertise with cyanogenic glycosides, for example, has not seduced him into writing in more detail about these compounds than about any other metabolites.

More than this, the author deserves our congratulations for producing such a comprehensive and authoritative book single-handedly. I say single-handedly since the author has clearly written the book himself: he does, however, acknowledge the assistance of a number of students who have researched particular topics for him and he has also, wisely, sought the expert comments of distinguished workers in fields that lie on the fringes of his own expertise. In this way, he has ensured that the book is accurate as well as comprehensive.

The book covers a prodigious amount of ground. There are 37 chapters, dealing with the following chemical classes: fatty acids; acetylenic compounds; plant waxes; polyketides; quinones; compounds derived from the shikimic acid pathway; phenylpropanoids; coumarins; 2-pyrones, stilbenes, dihydrophenanthrenes and xanthenes; flavonoids; tannins; nonprotein amino acids; peptides; carbohydrates; cyanogenic glycosides and cyanolipids; terpenes (9 chapters); alkaloids (11 chapters).

The chapters are of similar format. The compounds are introduced, their structures are shown and their biosynthetic origins explained. Their distribution within the plant kingdom is explored and their biological activity is discussed. Any medical or other commercial application of the compounds is also mentioned. Each chapter concludes with a list of references. Accordingly, each stands largely on its own and, for workers new to that particular area, forms an excellent introduction to a particular class of compound. The reference list can then be used as a springboard to the primary literature.

The first chapter provides a general introduction to the field. In it, the author explains the concept of secondary metabolites but soon progresses to address the question that most people who have had any contact with these compounds end up having to deal with sooner or later, namely, 'Why do plants produce secondary compounds?'. Of course, such an enquiry risks accusations of teleology but this particular question has been asked too many times to be ignored and, quite rightly, the author deals with the issue head on. Unfortunately, he does not come to any clear conclusions in this chapter, raising concepts only to shoot them down. However, he does give a general overview of potential roles for these compounds, such as the waste-product hypothesis, the idea that secondary metabolites have internal functions (for example in metabolic regulation), that they are produced to deal with transient metabolic imbalances or that, by interacting with other organisms, secondary metabolites increase the competitiveness of the host plant. In fact, the truth is that it is unwise to attempt to come up with any general role for these metabolites: almost certainly, different compounds have different functions and some might have no specific significance at all, although, presumably, also no 'cost' disadvantage to the organisms that produce them. In the author's defence, the idea that no overarching role can be ascribed to secondary compounds comes across much more clearly in the individual chapters, though it is worth stating that, even within a single class of compound, individual metabolites might have different functions.

Much more important than arguments over the functions of secondary metabolites, however, is the fact that, by studying these compounds in plants, biochemists are now investigating how organisms interact with each other. We are all accustomed to seeing metabolic maps showing the biochemical pathways that operate within a living organism. On the assumption that most of these internal metabolic pathways are now pretty well understood, it is appropriate that biochemists are now turning to the chemical interactions that take place between rather than within organisms, investigating phenomena such as parasitism and symbiosis, plant pathology, predation, pollination, seed dispersal and environmental competitiveness. In stressing such aspects of current research, this book avoids the obvious trap of being simply a list of structures and metabolic pathways: the chemistry is set in a clear biological context.

Although I am full of praise for this book, I do have one criticism. This relates to the loss of my youth. Any lingering fantasy that, despite advancing years, I still do not need to wear glasses for reading has been cruelly shattered. The typeface in the text is very small (about 7 point, I estimate) and even smaller in the figure legends and index. This might not be a problem to readers with younger eyes than mine but it struck me as a bit of a shame in an otherwise excellently produced book, especially as

there is a generous margin at the bottom of each page of which part could have been sacrificed in order to support a slightly larger typeface.

However, I do not wish to conclude on a carping note. This book is a valuable addition to my personal library and I have no hesitation in recommending it to anyone involved in the practice or teaching of plant biochemistry or plant ecology. Although it is not really a book for reading from cover to cover, it is a valuable reference work and is easy to use as such. In this context, therefore, I would also suggest that any modern department of biological sciences, chemistry, agriculture or medicine would be remiss not to have a copy in its library.

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# Biochemistry of plant secondary metabolism

## **Biochemistry of plant secondary metabolism (Annual Plant Reviews, Volume 2)**

*Ed by Michael Wink*

xii + 358 pages. Sheffield, UK: Sheffield Academic Publishers, 1999. £85.00 h/b. ISBN 1 84127 007 5. As the number of secondary plant metabolites identified has increased, the previously held belief that they are just waste products or functionless molecules has been replaced by the realization that they perform significant roles, for example as signal or defence molecules. This book seeks to provide a comprehensive survey of the biochemistry of secondary metabolites and its integration into the physiology and ecology of plants. In compiling the book the editor has assembled an impressive list of contributors with established expertise in this field.

The opening chapter, authored by the editor, provides a broad introduction of the biochemistry, role and biotechnology of secondary metabolites. This conveys a good appreciation of the breadth and variety of molecular structures involved, while indicating the comparatively few synthetic pathways for these compounds. The factors involved in regulating the transport, storage and turnover of the secondary metabolites are explained, with an interesting inclusion of a consideration of the energetic costs of secondary metabolism to the plant. An allusion to the bioactivity and consequent biotechnological potential of secondary metabolites completes the chapter.

The succeeding four chapters deal in depth with aspects of specific groups of secondary metabolites. The first covers the biochemistry and physiology of alkaloids and

betalains. After a brief overview this chapter concentrates on the most recent data in a few areas, obtaining a good balance; not assuming too much prior knowledge but rapidly taking the reader into detailed specifics. Compared with many other reviews of these particular metabolites, this chapter manages to contain sufficient detail of molecular structures, which by their nature are initially visually intimidating, without repelling the reader. Yet it still provides an interesting commentary and several thought-provoking discussions, for example, the future production of chemotherapeutic, taxol, the sites of synthesis and means of translocation of, alkaloids.

There follows a chapter on the biosynthesis of cyanogenic glycosides, glycosinolates and nonprotein amino acids. General properties of cyanogenic glucosides are detailed, ranging from the effects of HCN inside the plant cell and cassava-derived cyanide in humans, to the biosynthetic production of the glycosides and their function in herbivore deterrence. A similar treatment of glucosinolates, including the process of mustard-oil formation, ensues; this is perhaps less compelling in its interest to the reader than the review of cyanogenic glycosides, possibly because of the larger number of unanswered questions. The remaining segment on non-protein amino acids (NPAA) covers the range and basic origins of these compounds, together with the unanswered questions, but perhaps the paucity of recent references on NPAAs reflects either less interest in or less progress in research on these compounds.

By contrast, the topics in the next chapter, the phenylpropanoids and related compounds, are amongst the most investigated in respect to their biosynthetic pathways in plants. This chapter, a laudably seamless composition by three authors, reviews the phenylpropanoid pathway and the diversity of coumarins, lignans, tannins, flavonoids, anthocyanins and isoflavonoids. This is a well constructed survey, containing much recent detail of the biochemistry and molecular biology of the enzymes involved but it only gives brief hints as to the diverse roles of these compounds.

The last of the chapters on the specific compound groups deals with terpenoids. To a graduate biochemist such as myself, undergraduate knowledge of plant secondary metabolites was to a large extent restricted to terpenoid compounds. Thus from a personal perspective this chapter is the most satisfying, indicating the great diversity of terpenoid structures and the recent elucidation of various aspects; for example, the resolution of the long-standing controversy of the subcellular location of hydroxymethyl glutaryl CoA reductase, by a combination of classical and modern molecular techniques. The number of very recent references cited testifies to the burgeoning interest in these compounds, with biosynthesis now well understood but functions less so. A good illustration is the sterols, where most enzymes have now been studied in depth, and there are indications that steroid glycosylation takes place at various stages and is not necessarily the terminal step as had been previously thought.

The final chapter discusses chemotaxonomy in relation to the molecular phylogeny of plants. At first sight this seems a little incongruous in a text concerned primarily with the structural diversity, biosynthesis and function of secondary metabolites. However, the reader is soon

beguiled by an account of the increasing use, in the last quarter of a century, of small molecules for chemical taxonomy and the author of this chapter manages to make this both information-rich and interesting. This is perhaps the primary characteristic of this text overall. In a topic which easily lends itself to extreme treatments, with either a comprehensive catalogue of detail which is valuable as reference material but not for reading cover to cover, or with an interesting treatment of concepts but lacking substance in key areas, this text has managed a fine balance of readability, interest retention and detailed information. This reflects well on the co-ordinating efforts of the editor

and the compositional skills of the authors of chapters, providing a treatise that will be of value and be comprehensible to the novice first venturing into secondary metabolites, and also to the more experienced researcher keen to appraise recent developments in this field.

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