



BOOK REVIEW

Protein Phosphorylation in Plants. Edited by P. R. SHEWRY, N. G. HALFORD and R. HOOLEY (Proceedings of the Phytochemical Society of Europe, Vol. 39) Oxford Science Publications, 1996, 320, pp. £75. ISBN 019-857777X.

This volume is based on papers from a symposium held in September 1994. It is a measure of how far this area of research has advanced that there are 23 papers; it is also true that progress has continued unabated in the time since the symposium, so that the volume is rather out of date already. It is unfortunate that a more rapid method of publication is not used for monographs of this type; the gain in quality resulting from proper typesetting is offset by the loss in topicality.

The importance of reversible phosphorylation of proteins by protein kinases and phosphatases as a central control mechanism in eukaryotes is clearly illustrated in the initial survey chapter by D. G. Hardie; protein kinases account for 3% of all protein-coding genes in the nematode *Caenorhabditis elegans*. The rest of this chapter gives a concise account of the four main families of protein kinases, and outlines what is known about their functions, mainly from the study of organisms other than plants. It reflects the very rapid progress in molecular biology that has taken place, which has led to cloning and sequencing genes being relatively straightforward. Unfortunately, determining the biological roles of the products encoded by protein kinase and phosphatase genes is by no means as easy as identifying the genes themselves (as the rest of the volume shows).

The second section of the volume contains 10 papers on the role of protein phosphorylation in the control of plant metabolism. The first four papers deal with three central enzymes which control the partitioning of carbon and nitrogen in biological molecules in leaves, sucrose phosphate synthase, phosphoenolpyruvate carboxylase and nitrate reductase, all of which are subject to phosphorylation, which affects their activities. These chapters will act as a useful corrective to anyone rash enough to think that metabolic regulation of enzyme activities is a straightforward process, and is essentially fully understood. The complexity revealed in these papers is rather daunting, and there is an annoying failure in some places to attempt to draw conclusions and clarify the systems, so that the non-specialist reader will find it

difficult to see the wood for the trees. Of the remaining chapters, the one on pyruvate dehydrogenase is perhaps the best for the general reader to dip into.

Section III deals with the cell cycle and its control, which involves the reversible phosphorylation of proteins encoded by cell division cycle (*cdc*) genes. The first chapter in this section reviews the extensive body of knowledge on control of the cell cycle in yeast, and forms a useful introduction to what follows, although it would have been even more useful if better diagrams could have been provided. The author bravely admits that the complexity of this system is daunting, and it is clear that study of control of the cell cycle in plants is likely to lag behind yeasts (and animals). Are there features of cell division in plants that are different to other systems? This question is addressed to an extent in the following four chapters, but these have very much an air of 'work in progress', and mainly revolve around the cloning of plant homologues of yeast *cdc* genes. There are some very nice *in situ* hybridization experiments showing expression of cell cycle control genes in plant tissues, which are not well served by the rather grey photographs presented.

The final section contains seven chapters on signal transduction, in which protein phosphorylation/dephosphorylation plays a central role. Signal transduction in plants has been a *terra incognita* for many years, and it is encouraging to see that the systems which have been observed in other eukaryotes are now being characterized in plants. These chapters cover receptor-like kinases (although the receptors involved in recognition of fungal and bacterial pathogens are not covered), kinases with calmodulin-like domains that are putatively involved in the use of Ca^{2+} as a 'second messenger', other kinases and a protein phosphatase that may be involved in regulation by abscisic acid. Again, there is much of interest here, but readers looking for firm conclusions, or complete descriptions of signal transduction systems, as has been achieved in yeasts and higher animals, will be disappointed.

In conclusion, it is difficult to wholeheartedly recommend this volume to the phytochemical reader, who should look elsewhere for an introduction to the field of study; it is to postdoctoral and postgraduate researchers starting a project in this area that the volume will be of most use.

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