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Book review

Denis J. Murphy (Ed.), Plant Lipids: Biology, Utilisation and Manipulation, Blackwell Publishing, 2005, £114.95, US$199.95, ISBN 1-4051-1904-7

The cover of this book shows it all. Thirty years ago, sunflowers were for flower arranging: now they represent a major cash crop and are the symbol of success for the drive in Europe to switch from animal-derived to plant-derived food oils.

It was in 1971 that Hitchcock and Nichols published the first real treatise on Plant Lipid Biochemistry. At that time, lipids were perceived by many as rather dull, inert compounds that accumulated in seeds or created a hydrophobic barrier by forming bilayer membranes. Thirty years on, this viewpoint has been totally revised, and many dynamic roles for lipids and their derivatives in cell function and regulation are recognised. As a postdoc in Durham, also about 30 years ago, Denis Murphy was already convinced that plant lipids were a very interesting and exciting group of products. His confidence paid off and now, as a renowned researcher in the field, he has edited this excellent volume, with the objective of summarising the current state-of-the-art of lipid research. Such an analysis has not been made in a single volume since the beginning of the 'molecular age', making it both timely and pertinent. The reputation of the Editor has ensured that each contribution has been prepared by a leader in the field.

The Editor's introductory chapter is full of interesting snippets of information, such as that the first internal combustion engines were made to run on peanut oil! With the current global level of consumption of mineral oils, the peanut and its friends may soon make a comeback. Denis reminds the reader how far advances in lipid research have depended on developments in analytical procedures: separation techniques, enzyme and gene isolation procedures, genetic modification and manipulation. The way that these have enhanced our understanding of – and frequently indicated increasing levels of complexity in – all areas of lipid biochemistry and exploitation runs as a common thread throughout the subsequent chapters. Nevertheless, it is not so long since the days when plant biochemists, as Denis quotes from Galliard and Mercer (1975), "*resorted to using only the term* Solanum tuberosum *when referring to the humble potato in the hope that the non-phytochemical majority might think it was the name of a micro-organism and thus be acceptable to the biochemical establishment*". Sadly, this situation has not improved as much as might be hoped, although this book will certainly help to show that plant lipid biochemistry research is up there with the best.

That studying plant lipids is not just a biochemist's playground is clear. The pioneering work of Downey's group on erucic acid in *Brassica napus* led to the foundation of a multimillion-dollar industry. Increasingly, plant lipids are being seen as a source of raw materials for the chemical industry, an interest likely to increase as petrol prices soar ever higher.

The contents of the book can be divided roughly into three parts: lipid biosynthesis, lipid exploitation and the role of lipids in metabolism. The book is not laid out in this way and in some places the rationale for the order of the chapters is not quite clear: chapters 4–6 seem to be in reverse order. Indeed, some cutting and pasting of sections of chapters – such as those in chapters 5 and 6 related to lipid degradation and turnover – might have improved continuity. But, such minor points aside, this volume provides a good read and is full of valuable comment and analysis.

The latest in fatty acid biosynthesis is comprehensively covered by John Harwood, in the most recent of his regular and invaluable reviews of this fundamental aspect of lipids in plants. Starting with a consideration of where the carbon actually comes from, he takes us through the different synthetic steps and shows how our understanding of the whole process has been enhanced by both three-dimensional structural studies of proteins and genetic analysis at the DNA level. Unfortunately, the chapter ends when the FAS complex has completed its task and the book lacks an equally detailed and authoritative discussion of the steps involved in introducing complexity (desaturation, oxygenation, epoxidation) into the chain. Free fatty acids do not accumulate in plants and where they go to is covered in chapters by Peter Dörman (membranes) and Randall Weselake (storage organs). The relative ease of isolating lipids from storage organs has tended to focus attention on the triacylglycerols but, as is evident, the membrane lipids of plants merit equal attention and represent a biochemically and functionally more diverse group. The difficulty of studying these processes, many of

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which take place in membranous non-aqueous environments, is somewhat understated by Weselake's phrase "*...the extent to which these reactions occur in different oilseeds and at different stages of seed development may be variable*". The relatively recent discovery of non-acyl-CoA-dependent (or acyl-CoA-independent: both are used) transacylation adds a further layer of complexity.

Of course, it is always satisfying to see biosynthesis and function discussed together, and a number of chapters, notably those on the plant cuticle, the oxylipins and the non-FAS lipids derived from the isopentenyl diphosphate pathway(s), effectively integrate these aspects. Pierre Beneveniste presents a succinct analysis of the current status of carotenoid and steroid biosynthesis in relation to parallel studies in mammals and micro-organisms. The other two chapters in this group emphasise the importance of the roles that lipids play in two very different aspects of plant physiology: protecting plants from water loss and providing part of the complex system by which plants fight against pathogens. Within the latter context, the special role of inositol-containing lipids in cell signalling is covered. All three of these 'function-orientated' chapters cover the pertinent aspects of biosynthesis and regulation, providing useful and informative analyses of our current knowledge.

Lipids do not act alone. Indeed, their hydrophobic nature requires that they be carefully monitored within the intracellular space. Interaction with proteins is frequently important, and this aspect is covered in the chapter on inositol-containing lipids and, more especially, in the chapter by Denis Murphy on the very specific proteins, the oleosins and caleosins, involved in the organisation of lipid-bodies and the movement of lipids, perhaps even in the long-distance transport of lipids within the phloem. The similarities drawn with fat metabolism in other groups of organisms are fascinating and make it hard to believe why it was ever considered that "*lipids were simply rather inert carbon stores*".

However diverse plants are at making a range of interesting and useful fatty acids, notably within a non-food role, we demand more. Looking at the remarkable structural diversity described by Sevim Erhan and Atanu Adhvaryu, it would appear that the currently available seed oils should suffice for future needs. Nevertheless, due to "management factors", it is considered more promising to genetically engineer current oilseed crops than to overcome the agronomic problems associated with many of the species producing these unusual products. Considering the difficulties of working with fatty acid enzymes, this is perhaps surprising, but the approach works to the benefit of the scientific community. As described in the chapter on fatty acid manipulation from David Hildebrand's group, considerable progress has already been made in both understanding the enzymology associated with the alteration of the basic palmitic or stearic acid unit and in the genetic engineering of oilseeds of unusual composition. The orientation of this approach towards non-food applications is likely to run into fewer problems with its acceptability.

Overall, this book is most acceptable and is an essential part of any library, private or public, that is concerned with plant products and plant metabolism. For both the specialist and the non-specialist, it provides a wealth of information and will constitute the first point of reference for many years to come. How long? Less, perhaps, than the 15 years since the last major update in the Stumpf and Conn *Biochemistry of Plants* series, but only due to the pace at which the subject is now advancing. The second edition will be eagerly awaited.

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