

sources of edible oils, much of which is not readily accessible elsewhere. The wide range of crops being assessed as oil sources, microbial lipids and the rapid advances in biotechnological techniques for modifying oil crops are well reviewed. Amongst the many references, a good proportion are from the 1990s, including at least one from 1993, and the topical nature of the contributions makes the book particularly valuable.

The obvious errors in this book are few and far between, but the chemical structure of cholesterol is wrong, and Shukla describes linolenic acid (C 18:3 n-6) as one of the major polyunsaturated fatty acids of plant lipids, whereas it should of course be C 18:3 n-3.

The discussions of nutritional aspects of oils are rather brief overviews. The section on regeneration of used oils does not mention the effects of extended use on tocopherol levels and this should be an important consideration in the useful life of an oil. Antioxidants other than vitamin E are not discussed. However, despite these limitations the main sections in the book are very well written by eminent contributors.

This book is highly recommended for scientists and technologists interested in potential sources of edible oils and the methods currently being investigated for developing alternative oils or oils with modified composition.

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Recent Developments in Flavor and Fragrance Chemistry. Proceedings of the 3rd International Haarmann and Reimer Symposium. Edited by R. Hopp & K. Mori. VCH, Weinheim, Germany, 1993.

It is a common reaction when reading conference proceedings to be thankful that one has not expended vast sums on the registration fee in order to attend. This is not the case with the present volume. The conference must have been absolutely fascinating and the obvious charms of Kyoto (Japan) would have provided a considerable bonus.

The proceedings take the form of sixteen sections, with eight contributions from the sponsor (Haarmann and Reimer) and eight from academic scientists. It is further subdivided into eight chapters on fragrance chemistry and four chapters each on flavour chemistry and biochemistry. The perfumery section begins with an excellent and very timely account from Noyori on the use of BINAP-transition metal complexes as catalysts in the industrial production of terpenes. Asymmetric hydrogenation and isomerisations are described en route to (R)-citronellal (1500 tons per year!), (-)-isopulegol (1100 tons per year!) and (-)-menthol (9 tons per year) amongst others. It is pleasing to see synthetic elegance alongside industrial practicality.

The second chapter, by Hopp, should really have come first, because it provides a fascinating account of the history of Haarmann and Reimer from 1874 to the present. This allows the reader to compare the early

synthesis of vanillin from the cambial sap of fir trees (5000 trees provided 20 kg of coniferin and from this 7 kg of vanillin) with the recently devised biotransformation of eugenol to vanillin) with the recently devised biotransformation of eugenol to vanillin. Along the way, the random synthesis of 10 000 potential perfumery chemicals was accomplished, and a range of interesting products are discussed. Pelzer *et al.* then describe another facet of the modern perfumery industry in their use of computer modelling to identify the basic structures necessary for a lily of the valley fragrance. Their modelling allowed a rationalisation of existing floral compounds, and suggested the synthesis of many new ones. Several rather more exotic structures have been isolated, identified and synthesised by Weyerstahl and coworkers, and these three chapters provide a valuable insight into the strategies and techniques employed by the scientists at Haarmann and Reimer.

Mori then provides another timely review of his extensive use of enzymes (lipases, Bakers' yeast, etc.) in the synthesis of floral compounds, insect pheromones, juvenile hormones, etc. At one point he shows a pictorial summary of 15 diverse structures that have all been obtained from the achiral compound 2,2-dimethylcyclohexan-1,3-dione following stereoselective reduction using Bakers' yeast. The perfumery section concludes with three chapters on various aspects of isolation procedures, analysis and formulation, including an interesting insight into the evolution and composition of several well-known brands of perfume.

The section on flavour chemistry commences, perhaps predictably, with a review of the Maillard reaction (Tressl *et al.*), in which details are given of some model studies of the reaction between 1-¹³C-glucose and various amino acids, especially cysteine and proline. The other three chapters in this section all involve heterocyclic compounds (mainly furans, thiophenes and other oxygen and sulphur heterocycles) that are produced during cooking. P. Werkhoff describes the isolation and characterisation of flavour compounds from cooked or roasted beef, pork and chicken, whilst M. Guntert *et al.* discuss the results of model studies in which thiamine was heated in the presence of various amino acids to produce compounds with a typically meaty flavour. Finally, H.-J. Bertram *et al.* describes their synthesis of alkylmercaptofurans and thiophenes.

The biochemistry section commences with a review by Croteau on the biosynthesis of the thujane system, a topic near to this reviewer's heart, since I studied the biosynthesis of thujone some 25 years ago. This article is mainly concerned with very recent experiments to determine the stereospecificity of the key stages catalysed by the enzymes sabinene cyclase and sabinene hydrate cyclase. A very useful summary of the present state of knowledge concerning signal transduction in the olfactory system is provided by Reid, and Williams *et al.* show how certain flavours appear during processing due to the hydrolysis of glycosides of monoterpenes, norisoprenoids and shikimate metabolites. Finally, Gatfield & Sommer describe the biotransformation of

ricinoleic acid to gamma-decalactone (and various intermediates) using the yeast *Candida albicans*. The organoleptic qualities of the various products are discussed.

Overall, the book contains a wonderful mélange of chemistry and biochemistry related to odiferous and flavour chemicals. It is beautifully produced on high

quality paper, and will be essential reading for all those engaged in the flavour and fragrance industries. However, it will be a shame if the book is not more widely read, since the science is both good and of general interest.

John Mann