

Lipid Synthesis and Manufacture

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Edited by

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A series which presents the current state of the art in chosen areas of oil and fat chemistry, including its relevance to food technology. Written at professional and reference level, it is directed at chemists and technologists working in oil and fat processing, the food industry, the oleochemicals industry and the pharmaceutical industry, at analytical chemists and quality assurance personnel, and at lipid chemists in academic research laboratories. Each volume in the series provides an accessible source of information on the science and technology of a particular area.

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Preface

This book has been planned and written to be useful to scientists working in industrial and academic research laboratories. Synthesis, whether on a laboratory scale or on the scale of an industrial plant, is an important chemical activity, with new and revised procedures being developed continually. This book has been planned to offer a balance of topics, drawing on the authors best equipped to write in particular areas. Chapters on lipid synthesis appear in many books devoted to individual types of lipid, but there are few books devoted to lipid synthesis *per se*.

Several chapters are devoted to the synthesis and production of fatty acids and closely related derivatives. These are compounds with a single acyl/alkyl chain and are basic requirements for the synthesis of lipids with two or more acyl/alkyl chains. The chapters cover polyene acids, isotopically labelled acids, acids with conjugated unsaturation (many of which are used as pheromones), eicosanoids, derivatives for analysis, and some new chemistry associated with Δ -5 acids.

The synthesis of lipids with two or more acyl/alkyl chains is covered in the chapters on triacylglycerols, phospholipids, and sphingolipids. Together, these provide an authoritative account of the latest synthetic methods in these areas of lipid synthesis. They describe important routes to molecules required to further our knowledge of the roles of these compounds in health and disease. On a large scale, triacylglycerols of specific composition are being made by exploiting the various specificities of lipases. This new and exciting area of lipid activity is fully described and will be of interest to both academic and industrial scientists.

Areas more immediately of interest to those working in the food and oleochemical industries are covered in the chapters devoted to vitamin E, other natural antioxidants, sugar esters and ethers, and food surfactants. These are significant contributions, based on growing concern about the nature of our food and the demand for what is perceived to be natural.

A final chapter is devoted to the biosynthesis of fatty acids and lipids. Underlying all modern synthetic work is the desire to develop ever simpler methods which do not damage the environment. This leads to a demand for improved catalysts with higher efficiency and greater selectivity. Nature has already designed such pathways and it is good for synthetic chemists to be reminded of these.

This book should have something for all lipid scientists and technologists, including those involved in academic research and those working in oil and fat processing, the food industry, the oleochemicals industry and the pharmaceutical industry. Analytical chemists and quality assurance personnel will find much of relevance.

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F. D. Gunstone

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1 Polyene acids

Jean-Michel Vatèle

1.1 Introduction

Polyenoic fatty acids are widely distributed in the plant and animal kingdoms. Most of these acids have double bonds in the *Z* configuration arranged in a 1,4-skipped pattern of unsaturation. Also found in nature, but in much lower abundance, are fatty acids that have all or part of their unsaturation in a conjugated system with *Z* and/or *E* double bonds or in which double bonds are not entirely in a methylene-interrupted arrangement. Skipped polyunsaturated fatty acids possessing one or two *E* double bonds are formed during the heat treatment or hydrogenation of edible oils and represent a significant part of total dietary fatty acid intake. These compounds have emerged as an important group of fatty acids because of their possible physiological impact and their metabolites. As illustrated in Figure 1.1, polyunsaturated fatty acids possess a large variety of structural features and biological activities (Gunstone, 1994).

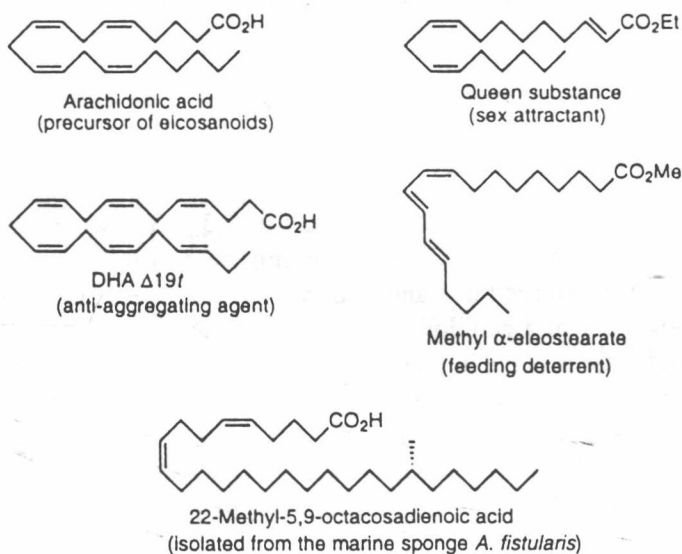


Figure 1.1 Examples of polyunsaturated fatty acids.

The first syntheses of oleic and linoleic acids, containing one and two double bonds appeared in the literature in 1934 (Noller and Bannerot) and 1950 (Raphael and Sondheimer), respectively. Methods for the synthesis of fatty acids: