

Lipid Analysis

ISOLATION, SEPARATION, IDENTIFICATION AND
LIPIDOMIC ANALYSIS

Fourth Edition

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Preface

The first edition of this book appeared in 1973 when gas chromatography and thin-layer chromatography were the main techniques available to lipid analysts. Indeed, lipid analysts were at the forefront in the development of these techniques. The main spectroscopic techniques available were infrared and ultraviolet spectrophotometry, while nuclear magnetic resonance spectroscopy and mass spectrometry were new techniques just becoming established in the wealthier laboratories. With successive editions, high-performance liquid chromatography became a significant part of the text and mass spectrometry, especially with electron-impact ionization, assumed greater importance. There were also remarkable improvements in many of the older chromatographic techniques. Now, this fourth edition has become necessary because of the pace of developments in mass spectrometry of intact lipids, which has given recognition of lipid analysis and 'lipidomics' as a distinct science. This has been defined briefly as: "The analysis of lipids on the systems-level scale together with their interacting factors".

The new influence of mass spectrometry is due mainly to the development of novel types of instruments and techniques, especially electrospray ionization (ESI) and matrix-assisted laser desorption/ionization (MALDI). We place most emphasis on the former in this book. It is enabling structural characterization of different lipid classes and the identification of novel lipids and their molecular species. Liquid chromatography coupled with mass spectrometry is vital for the analysis of new lipids or of minor lipid species in complex mixtures. 'Shotgun' lipidomics with electrospray ionization and tandem mass spectrometry permits characterization and quantification of intact multiple lipid classes and their molecular species at the mass level of low femtomole per mg of cellular protein in cell types or tissue samples, by direct infusion into the instrument. A vast amount of information is obtainable on the spatial and temporal alterations in the content and composition of different lipid species in selected systems, which can be processed by bioinformatics to provide mechanistic insights into cellular functions.

To include this new material it has been necessary to reduce substantially the amount of space devoted to the older chromatographic procedures in comparison to the third edition, although we trust nothing vital has been omitted. Owners of the third edition, who rely mainly on chromatographic techniques may therefore

wish to hold onto it. Gas chromatography and high-performance liquid chromatography will be major tools for lipid analysts for the foreseeable future, and they remain at the core of this fourth edition. Nor is thin-layer chromatography neglected; it may be 'low-tech' but it works. As with previous editions, we hope that this one will be found on the laboratory bench, not on the library shelf.

We do not discuss steroids (other than cholesterol and plant sterols), prostanoids and eicosanoids, plant oxylipins, carotenoids and terpenes, fat-soluble vitamins, or petroleum products here. These topics would require several more volumes of this size, and we leave them to others that are better qualified.

We would like to make a sincere apology to many excellent lipid analysts. At the outset, we decided that we did not want to produce an encyclopaedic compendium. To keep the number of references cited within reasonable bounds, we have tried to pick out the more important current papers and review articles on each topic, frequently ignoring the historic precedent. This means that we may give the impression of unfairly neglecting much first class work. Please forgive us if your publications fall into this category, as we recognise that we build on the substantial foundations provided by others.

Please note that many of the solvents and reagents mentioned in this book have the potential to do harm to the operator and other laboratory personnel if used carelessly, and we trust that readers following our recommendations will take appropriate precautions at all times.

WWC is grateful to Professor Peter Gregory and the Council of the Scottish Crop Research Institute and to the Scottish Executive Rural Affairs Department for providing the facilities and encouragement that made this book possible. XH is grateful to his colleagues for their constructive comments and enthusiastic support during his writing.

William W. Christie
Xianlin Han

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