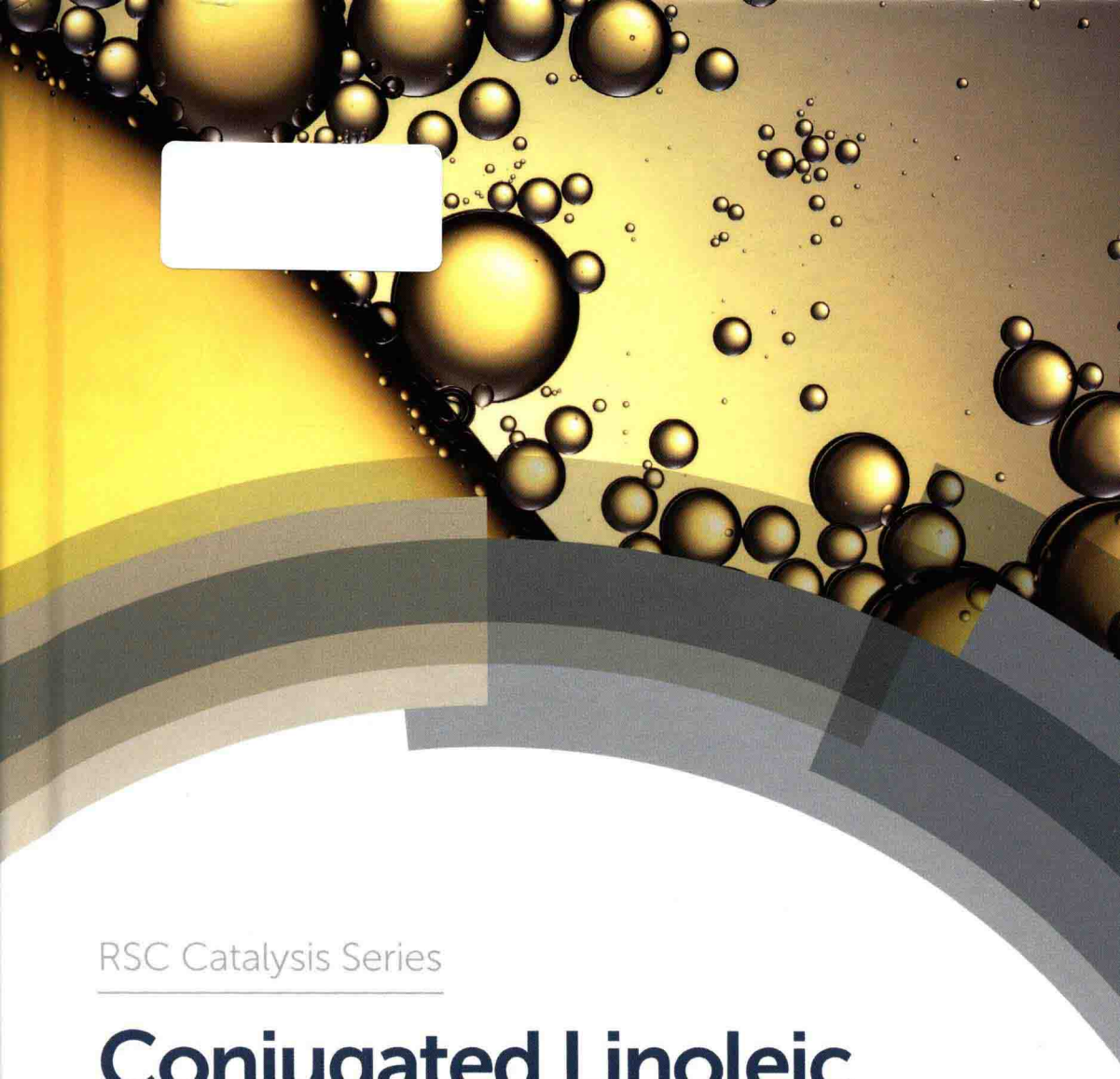

RSC Catalysis Series

Conjugated Linoleic Acids and Conjugated Vegetable Oils

Edited by Bert Sels and An Philippaerts

ROYAL SOCIETY OF CHEMISTRY

Conjugated Linoleic Acids and Conjugated Vegetable Oils

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Foreword: Exegi Monumentum Aere Perennius[†]

At the occasion of the appearance of the book *Conjugated Linoleic Acids and Conjugated Vegetable Oils*, edited by experts in heterogeneous catalysis, a few words clarifying and justifying the initiative might be of interest to the reader.

At the beginning of the second millennium, at the Center of Surface Science and Catalysis, KU Leuven, a project was started on shape selective transformations of vegetable oils with (heterogeneous) zeolite-based catalysts. Stimulated initially by Albert J. Dijkstra,[1] the concept of essentially trans-free partial hydrogenation of fatty acid esters and edible vegetable oils with shape selective zeolites was developed. The editors of the present book on Conjugated Linoleic Acids (CLAs) were the driving force behind this research. Major scientific hurdles had to be overcome in order to achieve the prestigious goal. It took almost a decade developing an appropriate catalyst, namely a ZSM-5 zeolite with the Pt metal load fully incorporated in the zeolite crystalline lattice.[2] So, the intuition of A.J.D. was proven to be correct. Thank you Albert! This regioselective hardening of soy bean oil yielded nutritive almost trans-free shortenings with unprecedented physical properties.[3]

Meanwhile, Bert Sels accepted an academic chair at KU Leuven on 'Catalytic Conversion of Biomass and Bio-platform Molecules', while An Philippaerts made a major effort in accumulating postdoctoral expertise in the same area. Equipped with that catalyst design knowledge, it took only a minor leap to achieve hydrogen-free production of conjugated linoleic acids

[†]*Horace: I have erected a monument more lasting than bronze.*

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and esters using Ru totally encapsulated in the zeolite intracrystalline voids.[4] This was just another recent 'discovery' in the area of shape selective catalytic transformations of vegetable oils. Although it was realized at the initial discussion phase of this book project that the American Oil Chemists Society (AOCS) has been publishing overviews dealing with different aspects of CLAs on a regular basis, the last update being made in 2006,[5] it was decided that there was need for a textbook covering the topic from many different angles. Therefore, with the contribution of the experts at the basis of science and technology development in the area, the editors succeeded in less than 12 months in producing a textbook on all aspects of CLA science and technology. In my opinion, it will appeal not only to industrialists and researchers in this interdisciplinary field but also will attract the attention of the general public.

Pierre A. Jacobs
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Preface

Recent interest from academia, nutritionists, the paint and polymer industry, and the feed and food industry in conjugated linoleic acids (CLAs) and conjugated vegetable oils has grown spectacularly in the last few years. CLA isomers, either in their natural or synthetic forms, have not only been associated with different health effects but they are also interesting renewable compounds in the production of industrial products such as paints, inks and polymers.

Likewise, as a result of the interest in CLA, its literature has recently increased enormously and may come across as chaotic, especially due to the fact that often conflicting results have been published. Therefore, the objective of this book is to provide a comprehensive and up-to-date overview of all the various aspects of CLA, which will be easily understood by a wide variety of readers with some chemical background, both from industry as well as from academia.

This book is organized into six chapters, each chapter covering a key aspect of CLA that has been studied increasingly in recent years.

In Chapter 1, Shingfield and Wallace review the synthesis pathway of CLA in ruminants and humans. CLAs are naturally present in meats and milk products of ruminants, where they are synthesized by rumen bacteria during the biohydrogenation process. CLA can also be synthesized endogenously in tissues and the mammary gland in ruminants, and recent studies have shown that CLA can be synthesized endogenously in humans. As CLA has been associated with numerous positive health benefits, and CLA obtained from ruminants are the primary source of CLA in human nutrition, a lot of research has been conducted to increase the CLA content in milk and meats from ruminants. Chapter 1 provides a comprehensive evaluation of the most recent evidence on the biochemical, microbial, nutritional and physiological factors influencing the amount and distribution of CLA isomers formed.

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As CLA has been associated with health-promoting properties, there is a lot of interest in enriching feed and food ingredients with CLA. In Chapter 2, the use of CLA in animal feed is discussed by Everaert, Koppenol and Buyse. This chapter provides a comprehensive review of literature concerning various outcomes of dietary CLA supplementation in livestock, *i.e.* ruminants (diary and meat-type), pigs, poultry (laying and meat-type), and some fish species. The effects covered comprise zootechnical and reproductive performance, CLA enrichment and fatty acid profile in tissues and animal products, and immune status. Chapter 3 by Park and Wu assesses the diverse health benefits of CLA in humans. In this chapter the current knowledge of the influence of CLA on body fat regulation, cancer and cardiovascular diseases prevention, modulation of immune and inflammatory responses, and benefits on bone health is reviewed. Also the potential health concerns of CLA supplementation are considered. Finally, biological activities of CLA metabolites and other conjugated fatty acids are discussed.

The bioactivity of CLA was only first reported in the 1980s. Since then, there has been growing interest in CLA for feed and food applications. However, CLA has been used since the early 1930s in chemical applications, mainly as drying oil used, for instance, in paints, glues and inks. For these applications CLA is produced on a commercial scale via either homogeneous base-catalysed isomerisation of vegetable oils enriched in linoleic acid or via dehydration of castor oil. Nowadays, conjugated vegetable oils are largely used as building blocks for the synthesis of various bio-based thermosetting materials for applications in the automobile and construction industries. These topics, relating to the industrial production of CLA and conjugated vegetable oils and their chemical use, are covered in Chapter 4 by Quirino.

Due to the increasing interest in CLA and conjugated vegetable oils, many studies arose describing new synthesis procedures of CLA and conjugated vegetable oils, aiming at higher yields of total CLA isomers or even of very specific CLA isomers. The recent advances in the production of CLA and conjugated vegetable oils are presented in Chapters 5 and 6. Chapter 5 focuses on the microbial and enzymatic production of conjugated fatty acids. Ogawa, Takeuchi and Kishino clearly describe the use of a bioprocess for the production of CLA with high isomer-selectivity, which has a high potential for medicinal and nutraceutical purposes. Besides the microbial and enzymatic production of CLA, a great deal of research has also been focused on the production of CLA and conjugated vegetable oils via metal catalysis. The use of metal catalysts, both homogeneous and heterogeneous, is tackled in Chapter 6 by Belkacemi, Chorfa and Hamoudi. It is clearly illustrated that it is nowadays possible to produce both CLA and its derivates as conjugated vegetable oils via homogeneous and heterogeneous metal catalysts with appealing CLA yields and productivities.

The analysis of different conjugated fatty acids isomers, usually in a complex matrix containing plenty of other non-conjugated fatty acids, is very challenging. In Chapter 7, Kramer, Fardin-Kia, Aldai, Mossoba and

Delmonte give a clear overview of the various analytical techniques available, focusing especially on gas and high pressure liquid chromatography. The benefits and limitations of different GC and HPLC columns are evaluated. Nevertheless, up to now it is not possible to analyse all the possible geometric and positional isomers of fatty acids in one single analysis. Therefore, the authors propose various combinations of methods in order to analyse as many conjugated and non-conjugated fatty acids as possible.

Finally, we would like to acknowledge our colleagues throughout the world who, through their research on conjugated fatty acids, contributed to this book. We wish in particular to thank all the contributing authors, for their enthusiasm and efforts in providing a comprehensive and up-to-date overview of the CLA topic in their expertise field and making this book an indispensable reference work for everybody who is interested in conjugated fatty acids and oils and their applications. Lastly, we would like to thank the editorial staff of the Royal Chemical Society, for their collaboration and the final editing.

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