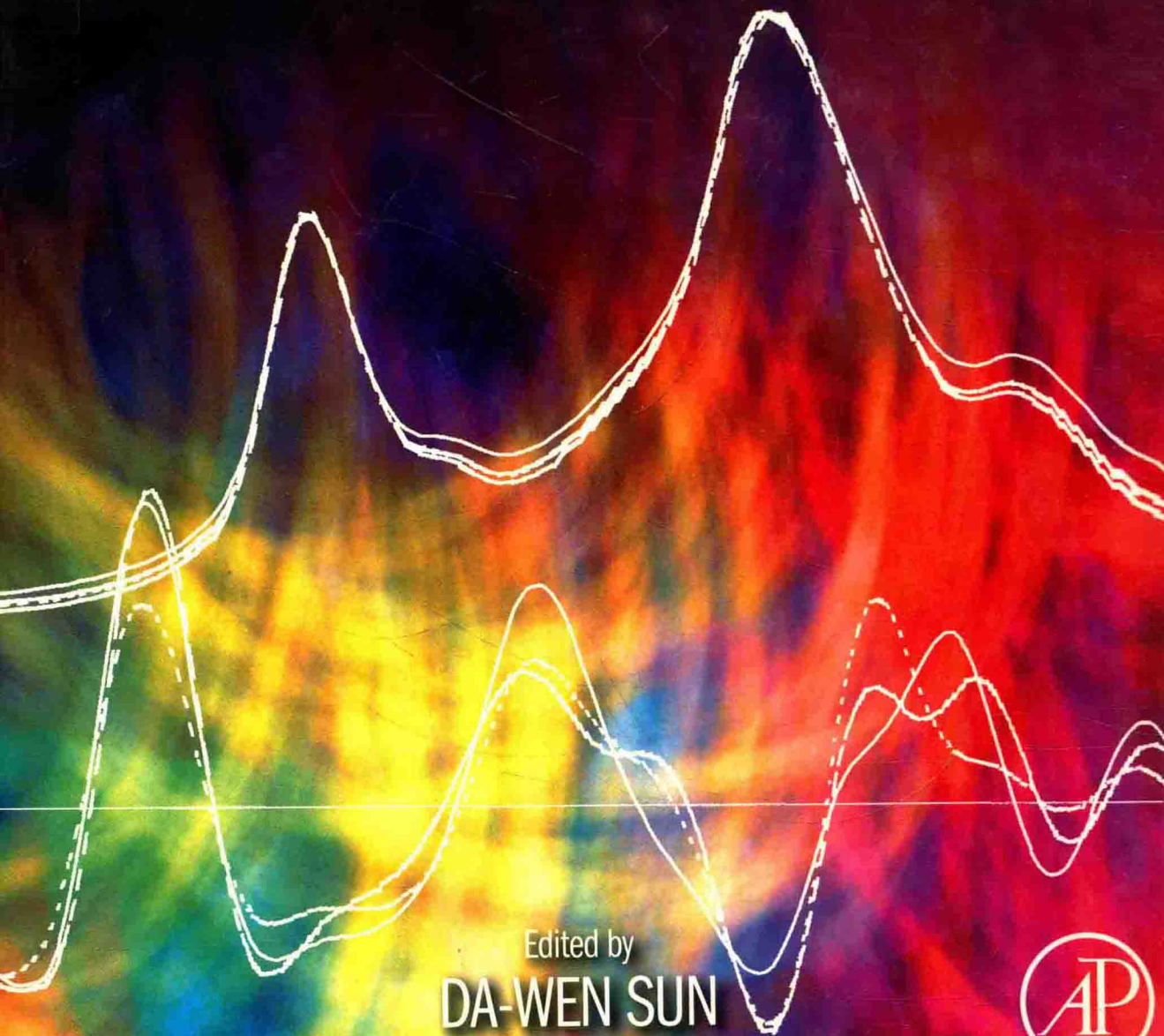


INFRARED SPECTROSCOPY —FOR FOOD QUALITY— ANALYSIS AND CONTROL



Edited by
DA-WEN SUN



Infrared Spectroscopy for Food Quality Analysis and Control

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INFRARED SPECTROSCOPY FOR FOOD QUALITY ANALYSIS AND CONTROL

Infrared Spectroscopy for Food Quality Analysis and Control

Edited by
J. M. H. VAN DUYN
and
J. A. J. VAN DER KAM

Analysis
of foodstuffs
using infrared spectroscopy and
chemometrics. This book is a
practical guide to the use of
infrared spectroscopy and
chemometrics in food analysis.

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About the Editor



Born in Southern China, Professor Da-Wen Sun is a world authority in food engineering research and education. His main research activities include cooling, drying and refrigeration processes and systems, the quality and safety of food products, bioprocess simulation and optimization, and computer vision technology. In particular, his innovative studies on the vacuum cooling of cooked meats, pizza quality inspection by computer vision, and edible films for shelf-life extension of fruit and vegetables have been widely reported in the national and international

media. Results of his work have been published in over 180 peer-reviewed journal papers and more than 200 conference papers.

He received a first-class BSc Honors and MSc in Mechanical Engineering and a PhD in Chemical Engineering in China before working in various universities in Europe. He became the first Chinese national to be permanently employed in an Irish University when he was appointed College Lecturer at the National University of Ireland, Dublin (University College Dublin) in 1995; he was then continuously promoted in the shortest possible time to Senior Lecturer, Associate Professor and full Professor. Dr Sun is now Professor of Food and Biosystems Engineering and Director of the Food Refrigeration and Computerized Food Technology Research Group in University College Dublin.

As a leading educator in food engineering, Professor Sun has significantly contributed to the field of food engineering. He has trained many PhD students, who have made their own contributions to the industry and academia. He has also given lectures on advances in food engineering on a regular basis in academic institutions internationally, and delivered keynote speeches at international conferences. As a recognized authority in food engineering, he has been conferred adjunct/visiting/consulting professorships by ten top universities in China, including Zhejiang University, Shanghai

Jiaotong University, Harbin Institute of Technology, China Agricultural University, South China University of Technology, Jiangnan University. In recognition of his significant contribution to food engineering worldwide, and for his outstanding leadership in the field, the International Commission of Agricultural Engineering (CIGR) awarded him the CIGR Merit Award in 2000 and again in 2006; the Institution of Mechanical Engineers (IMechE) based in the UK named him "Food Engineer of the Year 2004", in 2008 he was awarded CIGR Recognition Award in recognition of his distinguished achievements as top one percent of Agricultural Engineering scientists around the world.

He is a Fellow of the Institution of Agricultural Engineers. He has also received numerous awards for teaching and research excellence, including the President's Research Fellowship, and has twice received the President's Research Award of University College Dublin. He is a member of CIGR Executive Board and Honorary Vice-President of CIGR, Editor-in-Chief of *Food and Bioprocess Technology – an International Journal* (Springer), Series Editor of the "Contemporary Food Engineering" book series (CRC Press/Taylor & Francis), former Editor of *Journal of Food Engineering* (Elsevier), and editorial board member for *Journal of Food Engineering* (Elsevier), *Journal of Food Process Engineering* (Blackwell), *Sensing and Instrumentation for Food Quality and Safety* (Springer) and *Czech Journal of Food Sciences*. He is also a Chartered Engineer registered in the UK Engineering Council.

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Preface

Infrared (IR) spectroscopy deals with the infrared part of the electromagnetic spectrum, it measures the absorption of different IR frequencies by a sample positioned in the path of an IR beam. Currently, infrared spectroscopy is one of the most common spectroscopic techniques used by the industry. With the rapid development in infrared spectroscopic instrumentation software and hardware, the application of this technique has expanded into many areas of food research. Infrared spectroscopy has become a powerful, fast and non-destructive tool for food quality analysis and control.

In order to reflect this trend of rapid technology development, it is appropriate to publish *Infrared Spectroscopy for Food Quality Analysis and Control*. The book is divided into two parts. Part I deals with principles and instruments including theory, data treatment techniques and infrared spectroscopy instruments. Part II covers its applications in quality analysis and control for various foods, for example, meat and meat products, fish and related products, vegetables, fruits, dairy products and cereals.

Infrared Spectroscopy for Food Quality Analysis and Control is written by international peers who have both academic and professional credentials, highlighting the truly international nature of the work. It aims to provide the engineer and technologist working in research, development, and operations in the food industry with critical and readily accessible information on the art and science of infrared spectroscopy technology. The book should also serve as an essential reference source to undergraduate and postgraduate students and researchers in universities and research institutions.

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Fundamentals and Instruments

PART

I

Principles of Infrared Spectroscopy

Éric Dufour

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Introduction

The development of rapid analytical methods for food products relies mainly upon two approaches: the use of physical properties of substrates as an information supply and the automation of chemical methods. Most rapid analytical methods based on the physical properties of food products are spectroscopic methods. Spectroscopy can be split into two large groups (Wilson, 1994): photonic spectroscopy, which is based on the study of the interaction of an electromagnetic wave with matter, and particle spectroscopy. The first group comprises spectroscopic methods exhibiting an analytical potential for rapid control. The second group is represented by mass spectrometry and derived methods.

All the spectroscopic methods, except mass spectrometry, can be classified according to the energy involved during measurement. Electromagnetic radiation, of which visible light forms a tiny part, exists as waves that are propagated from a source and move in a straight line if they are not reflected or refracted. The undulatory phenomenon is a magnetic field associated with an electric one. The speed of the electromagnetic wave