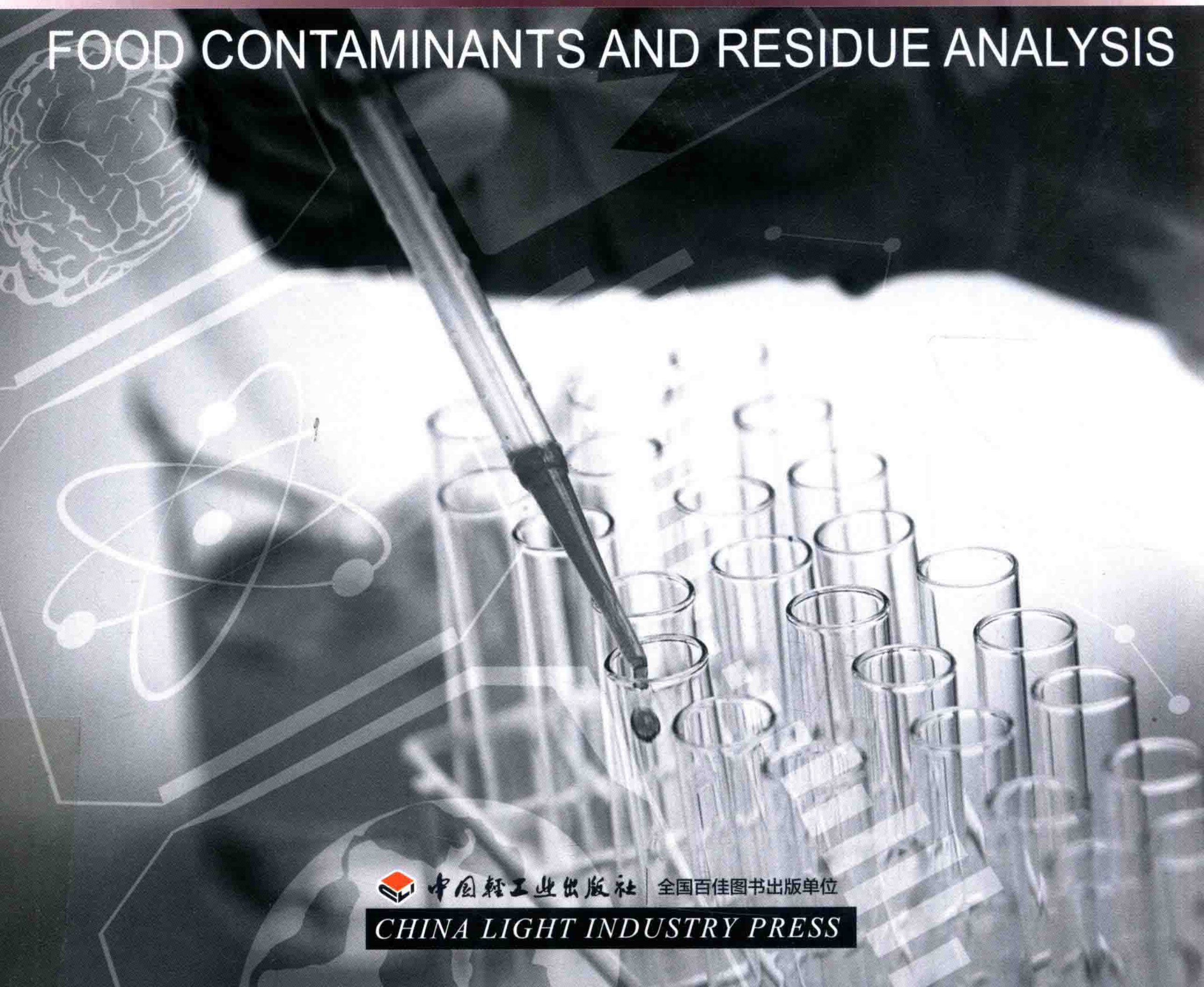
ELSEVIER
爱思唯尔

国外现代食品科技系列

食品污染物与残留分析

[西班牙] Yolanda Picó 主编　　吴永宁　苗虹　李敬光　主译

FOOD CONTAMINANTS AND RESIDUE ANALYSIS



中国轻工业出版社　全国百佳图书出版单位
CHINA LIGHT INDUSTRY PRESS

国外现代食品科技系列
《Wilson & Wilson's 综合分析化学》系列丛书

食品污染物与残留分析

[西班牙] YOLANDA PICÓ 主编

吴永宁 苗 虹 李敬光 主译

中国轻工业出版社

图书在版编目（CIP）数据

食品污染物与残留分析/（西）比科（Picó，Y.）主编；吴永宁，苗虹，李敬光主译. —北京：中国轻工业出版社，2017.2
（国外现代食品科技系列）
ISBN 978-7-5184-0766-8

Ⅰ.①食… Ⅱ.①比…②吴…③苗… Ⅲ.①食品污染—残留物分析
Ⅳ.①TS207.5

中国版本图书馆 CIP 数据核字（2015）第 294246 号

Food contaminants and residue analysis, 1st edition
Yolanda Picó
ISBN: 978-0-444-53019-6

策划编辑：李亦兵
责任编辑：李亦兵　钟　雨　　责任终审：张乃柬　　封面设计：锋尚设计
版式设计：宋振全　　责任校对：晋　洁　　责任监印：张　可

出版发行：中国轻工业出版社（北京东长安街 6 号，邮编：100740）
印　　刷：三河市万龙印装有限公司
经　　销：各地新华书店
版　　次：2017 年 2 月第 1 版第 1 次印刷
开　　本：787×1092　1/16　印张：45
字　　数：1030 千字
书　　号：ISBN 978-7-5184-0766-8　定价：120.00 元
著作权合同登记　图字：01-2010-2389
邮购电话：010-65241695　传真：65128352
发行电话：010-85119835　85119793　传真：85113293
网　　址：http://www.chlip.com.cn
Email：club@chlip.com.cn
如发现图书残缺请直接与我社邮购联系调换
090475K1X101ZYW

本书翻译人员名单

主　　译：

吴永宁　苗　虹　李敬光

译　　者：

赵云峰　杨　欣　尚晓虹　张　磊　周萍萍　李筱薇
陈达炜　高　洁　王雨昕　鲁　杰　王　丹　周　爽
范　赛　骆鹏杰　刘　卿　杨立新　李　珊　韩　璐
李瑞丰　郭斐斐　刘印平　李　鹏　张晨光　李　娜
李莹莹　施致雄　高颐雄　周　蕊　岳　兵　苗宏健
杨　杰

译 者 序

食品安全是事关民生、经济发展和政治稳定的重大公共卫生问题，中共十八届五中全会关于“十三五”规划的建议中要求制定食品安全战略和“十三五”食品安全规划，《“健康中国 2030”计划》将食品安全保障作为重要手段予以规划。由于食品在全球范围内流通，我国餐桌上来源于国际进口支付的食品已经占到 1/5，因此我国的食品安全也是全球的公共卫生问题。我国食品安全的监督管理已经进入风险治理阶段，自 2009 年颁布的《中华人民共和国食品安全法》规定实施国家食品安全风险监测制度、风险评估制度和统一的食品安全国家标准制度，到 2015 年修订颁布的《中华人民共和国食品安全法》规定国家建立食品安全全程追溯制度，实施这些制度均以食品污染物与残留的先进检测技术为基础。

本书由 Yolanda Picó 主编，是 Elsevier 出版集团出版的当代分析化学领域的《Wilson & Wilson’s 综合分析化学》系列丛书之一，是食品安全领域有关污染物与残留分析的权威书籍。本书涉及了食品中污染物和残留分析的众多方面，包括食品污染物与残留检测的目的和重要性，并以这一领域分析工作中所面临的诸多挑战作为开篇，随后介绍了欧盟及美国与本领域相关的法规。本书共 22 章，前三章是食品分析的总体层面；第四章到第八章介绍样品处理技术、色谱 - 质谱方法、毛细管电泳和免疫化学方法；第九章到第二十二章是包括各个热点污染物与残留的分析技术，讨论了从农、兽药残留到真菌毒素、二噁英和多氯联苯、多环芳烃、亚硝基化合物、杂环胺、丙烯酰胺、氨基甲酸乙酯、食品包装材料迁移等众多污染物与残留，涵盖物理化学性质、分析方法及在食品中的污染现状和未来的发展趋势。

本书覆盖了食品残留分析中所能遇到的大多数问题，卫生部食品安全风险评估重点实验室（国家食品安全风险评估中心）有关成员对于本书进行了翻译，可作为该领域新进人才和专业食品实验室人员的参考用书。

国家食品安全风险评估中心

技术总师

吴永宁

2016 年 11 月

编　撰　人

Wendy C. Andersen
US FDA, Animal Drugs Research Center, Denver Fed Ctr, Lakewood, CO 80225, *USA*

Jean-Philippe Antignac
LABERCA-Ecole Nationale Vétérinaire de Nantes, Route de Gachet, BP 50707, *F* – 44307 *Nantes Cedex* 3, *France*

Ioannis S. Arvanitoyannis
University of Thessaly, School of Agricultural Sciences, Fytokou Str., 38446 *Nea Ionia Magnesias, Volos, Greece*

Damià Barceló
Department of Environmental Chemistry, IIQAB – CSIC, Jordi Girona 18, 08034 *Barcelona, Spain*

Carlo Brera
Istituto Superiore di Sanità, Centro Nazionale per la Qualità degli Alimenti e per i Rischi Alimentari, Reparto OGM e Xenobiotici di origine fungina, Viale Regina Elena, 299, 00161 *Rome, Italy*

Sergio Caroli
Instituto Superiore di Sanita, Viale Regina Elena, 299, 00151 *Rome, Italy*

Leon Coulier
Analytical Research Department, TNO Quality of Life, Utrechtseweg 48, 3700 *AJ Zeist, The Netherlands*

Adrian Covaci
Toxicological Centre, Department of Pharmaceutical Sciences, University of Antwerp, Universiteitsplein 1, 2610 *Wilrijk, Belgium and Ecophysiology, Biochemistry and Toxicology Group, Department of Biology, University of Antwerp, Groenenborgerlaan* 171, *B* – 2020 *Antwerp, Belgium*

Frank David
Research Institute for Chromatography, Kennedypark 26, *B* – 8500 *Kortrijk, Belgium*

Francesca Debegnach
Istituto Superiore di Sanità, Centro Nazionale per la Qualità degli Alimenti e per i Rischi Alimentari, Reparto OGM e Xenobiotici di origine fungina, Viale Regina Elena, 299, 00161 *Rome, Italy*

Edwin De Pauw
Department of Chemistry, Laboratory of Mass Spectrometry, CART (Centre of analysis of residues in trace), University of Liege, Allée de la Chimie, 6, *Bat B6c, Sart Tilman, B* – 4000 *Liege, Belgium*

Barbara De Santis
Istituto Superiore di Sanità, Centro Nazionale per la Qualità degli Alimenti e per i Rischi Alimentari, Reparto OGM e Xenobiotici di origine fungina, Viale Regina Elena, 299, 00161 *Rome, Italy*

Kyle D'Silva
Waters Corporation, Atlas Park, Simonsway, Manchester, M22 5PP, UK

Gauthier Eppe
Department of Chemistry, Laboratory of Mass Spectrometry, CART (Centre of analysis of residues in trace), University of Liege, Allée de la Chimie, 6, *Bat B6c, Sart Tilman, B* – 4000 *Liege, Belgium*

Marinel · la Farré
Environmental Chemistry, IIQAB – CSIC, Jordi Girona 18, 08034 *Barcelona, Spain*

James S. Felton
Chemistry, Materials, and Life Sciences Directorate, Lawrence Livermore National Laboratory, University of California, Livermore, California, USA

Jean-Francois Focant
Department of Chemistry, Laboratory of Mass Spectrometry, CART (Centre of analysis of residues in trace), University of Liege, Allée de la Chimie, 6, *Bat B6c, Sart Tilman, B* – 4000 *Liege, Belgium*

Ambrose Furey
PROTEOBIO, Mass Spectrometry Centre for Proteomics and Biotoxin Research, Cork Institute of Technology, Bishopstown, Cork, Ireland

Javier García Feráandez
PROTEOBIO, Mass Spectrometry Centre for Proteomics and Biotoxin Research, Cork Institute of Technology, Bishopstown, Cork, Ireland

Till Goldmann
Nestlé Research Centre, P. O. Box 44, *CH* 1000 *Lausanne* 26, *Switzerland*

Stuart Harrad
*Division of Environmental Health and Risk Management, Public Health Building, School of Geography, Earth, and Environmental Sciences, University of Birmingham, Birmingham, B*15 2*TT, UK*

Geert Houben
Analytical Research Department, TNO Quality of Life, Utrechtseweg 48, 3700 *AJ Zeist, The Netherlands*

Janice Huwe
Biosciences Research Laboratory, USDA – ARS, P. O. Box 5674, *University Station, Fargo, North Dakota* 58105, *USA*

Kevin J. James
PROTEOBIO, Mass Spectrometry Centre for Proteomics and Biotoxin Research, Cork Institute of Technology, Bishopstown, Cork, Ireland

Mark G. Knize
Chemistry, Materials, and Life Sciences Directorate, Lawrence Livermore National Laboratory, University of California, Livermore, California, USA

Sander Koster
Analytical Research Department, TNO Quality of Life, Utrechtseweg 48, 3700 *AJ Zeist, The Netherlands*

Bruno Le Bizec
LABERCA – Ecole Nationale Vétérinaire de Nantes, Route de Gachet, BP 50707, *F* – 44307 *Nantes Cedex* 3, *France*

Winfried Leeman
Analytical Research Department, *TNO Quality of Life*, *Utrechtseweg* 48, 3700 *AJ Zeist*, *The Netherlands*

Clinio Locatelli
Department of Chemistry "G. Ciamician", *University of Bologna*, *Via F. Selmi* 2, 1 - 40126 *Bologna*, *Italy and CIRSA* (*Centro Interdipartimentale di Ricerca per le Scienze Ambientali*), *Laboratory of Environmental Analytical Chemistry*, *University of Bologna*, *Via S. Alberto* 163, 1 - 48100 *Ravenna*, *Italy*

Guy Maghuin-Rogister
Department of Food Sciences, *Laboratory of Food Analysis*, *CART* (*Centre of analysis of residues in traces*), *University of Liege*, *Boulevard de Colonster*, 20, *Bat B*43 - *bis*, *Sart Tilman*, *B* - 4000 *Liege*, *Belgium*

Elena Martinez
Environmental Chemistry, *IIQAB - CSIC*, *Jordi Girona* 18, 08034 *Barcelona*, *Spain*

Hans J. P. Marvin
RIKILT - Institute of Food Safety, *P. O. Box* 230, 6700 *AE Wageningen*, *The Netherlands*

Katerina Mastovska
USDA, *Agricultural Research Service*, *Eastern Regional Research Center*, 600 *East Mermaid Lane*, *Wyndmoor*, *PA* 19038, *USA*

Marina Miraglia
Istituto Superiore di Sanità, *Centro Nazionale per la Qualità degli Alimenti e per i Rischi Alimentari*, *Reparto OGM e Xenobiotici di origine fungina*, *Viale Regina Elena*, 299, 00161 *Rome*, *Italy*

Sidney S. Mirvish
Eppley Institute for Research in Cancer, *University of Nebraska Medical Center*, *Omaha*, *NE* 68198 - 6802, *USA*

Bas Muilwijk
Analytical Research Department, *TNO Quality of Life*, *Utrechtseweg* 48, 3700 *AJ Zeist*, *The Netherlands*

Michel W. E Nielen
RIKILT – Institute of Food Safety, P. O. Box 230, 6700 *AE Wageningen, The Netherlands and Wageningen University, Laboratory of Organic Chemistry, Dreijenplein* 8, 6703 *HB Wageningen, The Netherlands*

Daniel O'Driscoll
PROTEOBIO, Mass Spectrometry Centre for Proteomics and Biotoxin Research, Cork Institute of Technology, Bishopstown, Cork, Ireland

Ruud Peters
Analytical Research Department, TNO Quality of Life, Utrechtseweg 48, 3700 *AJ Zeist, The Netherlands*

Yolanda Picó
Laboratori de Bromatologia i Toxicologia, Facultat de Farmacia, Universitat de Valencia, Av. Vicent Andrés Estellés s/n, 46100 *Burjassot, Valencia, Spain*

Gaud Pinel
LABERCA-Ecole Nationale Vétérinaire de Nantes, Route de Gachet, BP 50707, *F* – 44307 *Nantes Cedex* 3, *France*

Monique Rennen
Analytical Research Department, TNO Quality of Life, Utrechtseweg 48, 3700 *AJ Zeist, The Netherlands*

Rinus Rijk
Analytical Research Department, TNO Quality of Life, Utrechtseweg 48, 3700 *AJ Zeist, The Netherlands*

Claude Saegerman
Department of Infectious and Parasitic Diseases, Epidemiology and Risk analysis applied to Veterinary Sciences, University of Liege, Boulevard de Colonster, 20, *Bat B*42, *Sart Tilman, B* – 4000 *Liege, Belgium*

Pat Sandra
Department of Organic Chemistry, University of Ghent, Krijgslaan 281 – *S4bis, B* – 9000 *Ghent, Belgium*

Anna Sannino
Stazione Sperimentale Conserve Alimentari, *Food Safety Department*, *Viale Tanara*,31/*A*, 43100 *Parma*, *Italy*

Georges Scholl
Department of Chemistry, *Laboratory of Mass Spectrometry*, *CART* (*Centre of analysis of residues in trace*), *University of Liege*, *Allée de la Chimie*, 6, *Bat B6c*, *Sart Tilman*, *B* – 4000 *Liege*, *Belgium*

Marie-Louise Scippo
Department of Food Sciences, *Laboratory of Food Analysis*, *CART* (*Centre of analysis of residues in traces*), *University of Liege*, *Boulevard de Colonster*, 20, *Bat B43 – bis*, *Sart Tilman*, *B* – 4000 *Liege*, *Belgium*

Catherine Simoneau
Community Reference Laboratory for Food Contact Materials, *European Commission*, *DG – Joint Research Centre*, *Institute for Health and Consumer Protection*, *Unit Physical and Chemical Exposure*, *T. P.* 260, *Ispra Va* 21020, *Italy*

Richard H. Stadler
Quality Management Department, *Nestlé Product Technology Centre Orbe*, *CH* 1350 *Orbe*, *Switzerland*

Katsumi Tamakawa
Sendai City Institute of Public Health, 2 – 5 – 10, *Oroshimachi – higashi*, *Wakabayashi ward*, *Sendai city*, *Miyagi prefecture*, 984 – 0002, *Japan*

Sherry B. Turnipseed
US FDA, *Animal Drugs Research Center*, *Denver Fed Ctr*, *Lakewood*, *CO* 80225, *USA*

William D. van Dongen
Analytical Research Department, *TNO Quality of Life*, *Utrechtseweg* 48, 3700 *A J Zeist*, *The Netherlands*

Leo van Stee
Analytical Research Department, *TNO Quality of Life*, *Utrechtseweg* 48, 3700 *AJ Zeist*, *The Netherlands*

Gerd Vanhoenacker
Research Institute for Chromatography, *Kennedypark* 26, *B* – 8500 *Kortrijk*, *Belgium*

Peter Viberg
Technical Analytical Chemistry, *Lund University*, *Getingevagen* 60, *PO Box* 124, *SE* – 22100 *Lund*, *Sweden*

Stefan Voorspoels
European Commission, *Joint Research Centre*, *Institute for Reference Materials and Measurements* (*IRMM*), *Retieseweg* 111, 2440 *Geel*, *Belgium*

Esther Zondervan – van den Beuken
Analytical Research Department, *TNO Quality of Life*, *Utrechtseweg* 48, 3700 *AJ Zeist*, *The Netherlands*

前　言

以适当的价格期望高质量和安全的食品是消费者的权利。这一权利是经在美国举行的联合国食品和农业会议的参加者一致认可的，这次会议奠定了联合国粮农组织（FAO）成立的基础。由于这次会议，食品安全和消费者保护成为最具优先权的主题。同样，生产高质量的和安全的食品也是成功进行国内及国际贸易的先决条件，是保持国家农业资源发展的关键。化学分析是质量管理体系中的一个重要组成部分。

食品中有机污染物的检测需要方法学不断完善以及新技术的开发以提高方法的灵敏度、选择性、分离、释义和适用性。尽管在很多情况下体系是完善的，但由于分析化学家和仪器学家常常被新物质和已经被认可的受健康关注的外源性物质所挑战，新方法、新仪器及其改进对他们来说仍然是决定性的。

本书涉及食品中污染物和残留分析的不同方面，并突出该领域当前面临的一些关注点。书中内容从食品安全概论、食品中污染物和残留检测的目标与重要性，以及食品安全分析等相关问题和挑战开始，然后详细介绍欧盟和美国的相关法规。本书围绕着近些年新发展起来的如固相微萃取、液相色谱－质谱、免疫分析和生物传感器等新的分析技术，介绍了传统的色谱方法、适宜的前处理方法及后续仪器分析需要准备的相关物质等主题。本书中包含了从农药残留到真菌毒素或二噁英等一系列有毒污染物和残留物。本书实用性强，为选择最有效的检测技术提供了思路。

本书包括不同领域的专家撰写的覆盖了食品污染和残留分析领域中最新主题的22个章节。这些章节分成三部分：第一部分包括分析方法验证和质量保证法规框架，第二部分是分析技术的最新进展，第三部分是食品中某些特殊污染物检测的相关信息。

本书内容设置合理，并列举了大量的食品污染物和残留分析的实例，是一本食品分析的参考书，也可作为培训用书。本书旨在作为研究生学习的参考用书，也可作为生物学家、生物化学家、微生物学家、食品化学家、毒理学家、化学家、农学家、卫生学家以及需要使用分析技术进行食品安全评估的人员的较实用的参考用书。每一章都包括足够多的参考文献，可以帮助读者获得更多详细信息和有效资源。

许多人直接或间接地参与了此书的撰写工作，在此一并表示谢意。感谢 Damià Barceló 教授对我本人的信任，让我来负责完成此书的撰写，在此期间也得到了他的帮助和支持；感谢爱思唯尔（Elsevier）的编辑人员（Andrew Gent，Joan Annuels，Anne Russum）在此书的编辑和出版过程中耐心地解决问题以及付出的辛勤劳动；最重要的是感谢此书的所有作者和读者，没有大家的通力合作就不会有此书的编辑出版，每位读者都是使食品污染物和残留研究成为一个统一整体的贡献者。希望本书能够不辜负读者的期望。

Yolanda Picó

丛书主编前言

食品安全已经成为当今社会的一个主要问题，我们所消费的大多数食品是来自于世界各地的。总体而言，大众消费者更加关注他们每天所消费产品的质量，为满足这一需求，就需要在媒介上有更多信息可供查询。各种事件都成了头条新闻，如比利时的二噁英事件、从亚洲进口到欧洲的虾中抗生素事件、与美国三文鱼相比在欧洲三文鱼中检测出高污染水平的持久性有机物事件。

总体上，这些事件警醒政府和消费者应更多地关注食品控制。

就此而言，我的好朋友和同事 Yolanda Picó 所主编的这一卷书是很及时的，我很高兴我能说服她担任《Wilson & Wilson's 综合分析化学》系列丛书中这一卷的主编。本书是这一系列中有关食物残留主题的第二本书。这一主题的第一本书，也就是这一系列丛书的第43卷，书名为《农药残留》，是由我的另外一位朋友和同事 AR Fernandez Alba 所主编的。我相信食品安全将是今后其他卷丛书的主题。

这本书包括22章，前三章是食品分析的总体层面。第四章到第八章介绍样品处理技术、色谱-质谱方法、毛细管电泳和免疫化学方法。第九章到第二十二章是包括农药、抗生素、生长促进剂、霉菌毒素、生物毒素、持久性有机污染物溴系阻燃剂和杂环胺等在内的一系列污染物的分析应用。其中的内容广泛深入，覆盖了食品残留分析中所能遇到的大多数问题，因此本书也作为该领域新人或专业食品实验室人员的参考用书。

这本书讨论了食品污染物和残留分析的各个方面，我期待本书能够成为食品残留专家的主要参考用书。

最后，我谨对为此书文字编纂做出巨大工作的编辑和各章作者所付出的辛苦劳动表示衷心地感谢！

D. Barceló

环境化学系，IIQAB - CSIC

巴塞罗那，西班牙

《Wilson & Wilson's 综合分析化学》系列书名

Vol. 1A	Analytical Processes
	Gas Analysis
	Inorganic Qualitative Analysis
	Organic Qualitative Analysis
	Inorganic Gravimetric Analysis
Vol. 1B	Inorganic Titrimetric Analysis
	Organic Quantitative Analysis
Vol. 1C	Analytical Chemistry of the Elements
Vol. 2A	Electrochemical Analysis
	Electrodeposition
	Potentiometric Titrations
	Conductometric Titrations
	High – Frequency Titrations
Vol. 2B	Liquid Chromatography in Columns
	Gas Chromatography
	Ion Exchangers
	Distillation
Vol. 2C	Paper and Thin Layer Chromatography
	Radiochemical Methods
	Nuclear Magnetic Resonance and Electron Spin Resonance Methods
	X – ray Spectrometry
Vol. 2D	Couiometric Analysis
Vol. 3	Elemental Analysis with Minute Sample
	Standards and Standardization
	Separation by Liquid Amalgams
	Vacuum Fusion Analysis of Gases in Metals
	Electroanalysis in Molten Salts
Vol. 4	Instrumentation for Spectroscopy
	Atomic Absorption and Fluorescence Spectroscopy
	Diffuse Reflectane Spectroscopy
Vol. 5	Emission Spectroscopy
	Analytical Microwave Spectroscopy
	Analytical Applications of Electron Microscopy

Vol. 6 Analytical Infrared Spectroscopy
Vol. 7 Thermal Methods in Analytical Chemistry
Substoichiometric Analytical Methods
Vol. 8 Enzyme Electrodes in Analytical Chemistry
Molecular Fluorescence Spectroscopy
Photometric Titrations
Analytical Applications of Interferometry
Vol. 9 Ultraviolet Photoelectron and Photoion Spectroscopy
Auger Electron Spectroscopy
Plasma Excitation in Spectrochemical Analysis
Vol. 10 Organic Spot Tests Analysis
The History of Analytical Chemistry
Vol. 11 The Application of Mathematical Statistics in Analytical Chemistry Mass Spectrometry Ion Selective Electrodes
Vol. 12 Thermal Analysis
Part A. Simultaneous Thermoanalytical Examination by Means of the Derivatograph
Part B. Biochemical and Clinical Application of Thermometric and Thermal Analysis
Part C. Emanation Thermal Analysis and other Radiometric Emanation Methods
Part D. Thermophysical Properties of Solids
Part E. Pulse Method of Measuring Thermophysical Parameters
Vol. 13 Analysis of Complex Hydrocarbons
Part A. Separation Methods
Part B. Group Analysis and Detailed Analysis
Vol. 14 Ion – Exchangers in Analytical Chemistry
Vol. 15 Methods of Organic Analysis
Vol. 16 Chemical Microscopy
Thermomicroscopy of Organic Compounds
Vol. 17 Gas and Liquid Analysers
Vol. 18 Kinetic Methods in Chemical Analysis Application of Computers in Analytical Chemistry
Vol. 19 Analytical Visible and Ultra – violet Spectrometry
Vol. 20 Photometric Methods in Inorganic Trace Analysis
Vol. 21 New Developments in Conductometric and Oscillometric Analysis
Vol. 22 Titrimetric Analysis in Organic Solvents
Vol. 23 Analytical and Biomedical Applications of Ion – Selective Field – Effect

Transistors
Vol. 24 Energy Dispersive X – ray Fluorescence Analysis
Vol. 25 Preconcentration of Trace Elements
Vol. 26 Radionuclide X – ray Fluorecence Analysis
Vol. 27 Voltammetry
Vol. 28 Analysis of Substances in the Gaseous Phase
Vol. 29 Chemiluminescence Immunoassay
Vol. 30 Spectrochemical Trace Analysis for Metals and Metalloids
Vol. 31 Surfactants in Analytical Chemistry
Vol. 32 Environmental Analytical Chemistry
Vol. 33 Elemental Speciation – New Approaches for Trace Element Analysis
Vol. 34 Discrete Sample Introduction Techniques for Inductively Coupled Plasma Mass Spectrometry
Vol. 35 Modern Fourier Transform Infrared Spectroscopy
Vol. 36 Chemical Test Methods of Analysis
Vol. 37 Sampling and Sample Preparation for Field and Laboratory
Vol. 38 Countercurrent Chromatography: The Support – Free Liquid Stationary Phase
Vol. 39 Integrated Analytical Systems
Vol. 40 Analysis and Fate of Surfactants in the Aquatic Environment
Vol. 41 Sample Preparation for Trace Element Analysis
Vol. 42 Non – destructive Microanalysis of Cultural Heritage Materials
Vol. 43 Chromatographic – Mass Spectrometric Food Analysis for Trace Determination of Pesticide Residues
Vol. 44 Biosensors and Modern Biospecific Analytical Techniques
Vol. 45 Analysis and Detection by Capillary Electrophoresis
Vol. 46 Proteomics and Peptidomics: New Technology Platforms Elucidating Biology
Vol. 47 Modern Instrumental Analysis
Vol. 48 Passive Sampling Techniques in Environmental Monitoring
Vol. 49 Electrochemical (Bio) Sensor Analysis
Vol. 50 Analysis, Fate and Removal of Pharmaceuticals in the Water Cycle