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Persistent organic pollutants and toxic metals in foods

Martin Rose and Alwyn Fernandes
Contents

Contributor contact details ............................................................... xi
Woodhead Publishing Series in Food Science, Technology and
Nutrition .......................................................................................... xiv
Foreword ........................................................................................... xxiii
Preface .............................................................................................. xxv

Part I Regulatory control and environmental pathways .............. 1

1 Persistent organic pollutants in foods: Science, policy and regulation 3
   D. N. Mortimer, Food Standards Agency, UK
   1.1 Introduction ......................................................................... 3
   1.2 Dietary exposure and total diet studies (TDSs) .................... 4
   1.3 Risk assessment, policy making and regulatory limits .......... 6
   1.4 Enforcement and implications for food businesses .......... 12
   1.5 Analytical methods and their influence on policy .......... 14
   1.6 Future trends and conclusions ....................................... 15
   1.7 References ............................................................................ 17

2 Regulatory control and monitoring of heavy metals and trace elements in foods ................................... 20
   K. D. Hargin and G. J. Shears, Food Standards Agency, UK
   2.1 Introduction ......................................................................... 20
   2.2 Risk assessment and policy making ................................. 21
   2.3 Monitoring of foodstuffs .................................................. 34
   2.4 Impact of legislation on industry and enforcement .......... 37
   2.5 Suitability of analytical methods ................................. 40
   2.6 Future trends ................................................................. 41
   2.7 Sources of further information ....................................... 43
   2.8 References ............................................................................ 44
3 Screening and confirmatory methods for the detection of dioxins and polychlorinated biphenyls (PCBs) in foods ........................................ 47
  J. F. Focant and G. Eppe, University of Liège, Belgium
  3.1 Introduction ........................................................................ 47
  3.2 Biological versus physico-chemical screening for dioxins and PCBs in food and feed ............................................................ 51
  3.3 Specific analytical requirements for biological and physico-chemical tools .................................................................................. 63
  3.4 Quantitative versus semi-quantitative approach ....................... 66
  3.5 Validation QA/QC ................................................................ 67
  3.6 Confirmatory methods for polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) and PCBs in food and feed ....... 67
  3.7 Future trends ...................................................................... 75
  3.8 Sources of further information and advice .............................. 76
  3.9 References ........................................................................... 76

4 Screening and confirmatory methods for the detection of heavy metals in foods .................................................................................. 81
  F. Arduini and G. Palleschi, Università di Roma Tor “Vergata”, Italy
  4.1 Introduction ........................................................................ 81
  4.2 Screening methods for heavy metal detection in food ............... 84
  4.3 Confirmatory methods for heavy metal detection in food .......... 95
  4.4 Quality assurance and method validation ............................... 99
  4.5 Future trends ...................................................................... 102
  4.6 References ........................................................................... 102

5 Responding to food contamination incidents: Principles and examples from cases involving dioxins .................................................. 110
  C. Tlustos, W. Anderson and R. Evans, Food Safety Authority of Ireland, Ireland
  5.1 Introduction ........................................................................ 110
  5.2 The risk analysis paradigm ................................................. 112
  5.3 Food traceability ................................................................ 115
  5.4 Food recall and withdrawal ............................................... 117
  5.5 Risk communication strategies ........................................ 120
  5.6 Future trends ...................................................................... 125
  5.7 Sources of further information ........................................... 126
  5.8 References ........................................................................... 127

6 Uptake of organic pollutants and potentially toxic elements (PTE) by crops ................................................................. 129
  C. Collins, University of Reading, UK
  6.1 Introduction ........................................................................ 129
  6.2 Uptake of organic pollutants by plants ................................... 131
Contents vii

6.3 Uptake of PTEs by plants .......................................................... 135
6.4 In situ monitoring of plant available pollutants .............................. 138
6.5 Conclusions ............................................................................. 139
6.6 References ............................................................................... 139

7 Transfer and uptake of dioxins and (PCBs) into sheep: A case study 145
   S. W. Panton, F. Smith and A. Fernandes, Food and Environment Research Agency (Fera), UK and C. Foxall, University of East Anglia, UK
   7.1 Introduction ............................................................................ 145
   7.2 Uptake pathways and sources ................................................. 147
   7.3 Transfer of PCBs and polychlorinated dibenzo-\(p\)-dioxins
      and dibenzofurans (PCDD/Fs) into animal tissues ..................... 151
   7.4 Experimental rearing, sampling and analysis ............................ 152
   7.5 Results and discussion for PCDD/Fs, dioxin-like PCBs
      (DL-PCBs) and ICES6 PCBs .................................................. 157
   7.6 Conclusions and future trends ................................................ 169
   7.7 Acknowledgements .................................................................. 169
   7.8 References ............................................................................... 170

8 Risk assessment of chemical contaminants and residues in food 173
   D. J. Benford, Food Standards Agency, UK
   8.1 Introduction ............................................................................ 173
   8.2 Risk assessment ..................................................................... 176
   8.3 Risk characterisation .............................................................. 182
   8.4 Role of risk assessment in risk management .............................. 184
   8.5 Sources of further information ................................................ 185
   8.6 References ............................................................................... 185

Part II Particular persistent organic pollutants, toxic metals
   and metalloids ............................................................................ 189

9 Dioxins and polychlorinated biphenyls (PCBs) in foods .................. 191
   D. Schrenk and M. Chopra, University of Kaiserslautern, Germany
   9.1 Introduction ............................................................................ 191
   9.2 Properties and occurrence of polychlorinated dibenzo-\(p\)-dioxins
      and dibenzofurans (PCDD/Fs) ............................................... 192
   9.3 Toxicity of PCDD/Fs .............................................................. 195
   9.4 Toxic effects of PCDD/Fs in humans and experimental
      animals .................................................................................... 198
   9.5 Properties and occurrence of PCBs ........................................ 205
   9.6 Toxicity of PCBs .................................................................... 209
   9.7 References ............................................................................... 213
10 Non dioxin-like polychlorinated biphenyls (NDL-PCBs) in foods: Exposure and health hazards .............................................................. 215
L. E. Elabbas, E. Westerholm, R. Roos, K. Halldin, M. Korkalainen, M. Viluksela and H. Håkansson, Karolinska Institutet, Sweden
10.1 Introduction ......................................................................... 215
10.2 Sources, occurrence in food, limit values and monitoring methods ................................................................. 217
10.3 Human exposure and tissue levels ........................................ 219
10.4 Toxicokinetics and metabolism ............................................ 223
10.5 Classification of PCB congeners .......................................... 224
10.6 NDL-PCB regulatory status ................................................. 227
10.7 ATHON R&D project dedicated to generating NDL-PCB toxicity data for regulatory use ............................................. 228
10.8 Cell regulation and metabolism ............................................ 240
10.9 Classification of NDL-PCB congeners ................................. 247
10.10 Conclusions and future trends .......................................... 249
10.11 Acknowledgements .............................................................. 249
10.12 References ............................................................................ 251

11 Brominated flame retardants in food ............................................ 261
R. J. Law, The Centre for Environment, Fisheries and Aquaculture Science, UK
11.1 Introduction ......................................................................... 261
11.2 Sources, occurrence in food and human exposure .............. 262
11.3 Methods of analysis and monitoring of brominated flame retardants in food ................................................................. 267
11.4 Toxicity of brominated flame retardants .............................. 268
11.5 Major incidences of brominated flame retardant contamination of food ................................................................. 269
11.6 Implications for the food industry and policy makers for prevention and control of contamination ........................................... 270
11.7 Future trends ....................................................................... 270
11.8 Sources of further information and advice ........................... 271
11.9 References ............................................................................ 272

12 Human dietary exposure to per- and polyfluoroalkyl substances (PFASs) .............................................................. 279
R. Vestergren and I. T. Cousins, Stockholm University, Sweden
12.1 Introduction ......................................................................... 280
12.2 Analytical methods for PFASs in food ................................. 281
12.3 Levels of PFASs in food ....................................................... 284
12.4 Pathways of food contamination .......................................... 290
12.5 Estimated exposure from food and other exposure media .... 293
12.6 Conclusions and future trends .......................................... 298
# Contents

12.7 Acknowledgements .............................................................. 299
12.8 References ............................................................................ 299

## 13 Polycyclic aromatic hydrocarbons (PAHs) in foods .................. 308

_L. Duedahl-Olesen, National Food Institute – Technical University of Denmark, Denmark_

13.1 Introduction ......................................................................... 308
13.2 Sources and formation of PAHs in food .............................. 309
13.3 Methods of analysis of PAHs in food ................................. 314
13.4 Human dietary exposure to PAHs from food ....................... 319
13.5 Risk assessment of PAHs ..................................................... 322
13.6 Food scandals ................................................................. 324
13.7 Legislation of PAHs in foods within the EU ....................... 324
13.8 References ............................................................................ 326

## 14 Phthalates in foods ................................................................. 334

_T. Cirillo and R. Amodio Cocchieri, University of Naples “Federico II”, Italy_

14.1 Introduction ......................................................................... 334
14.2 Human exposure to phthalates ............................................. 335
14.3 Sources and occurrence in food ............................................ 339
14.4 Studies of the effects of phthalates on humans .................... 344
14.5 Methods of phthalate analysis and monitoring in food ........ 349
14.6 Implications for the food industry and policy making for prevention and control of contamination .......................... 352
14.7 Future trends ....................................................................... 353
14.8 Sources of further information and advice ........................... 355
14.9 References ............................................................................ 356

## 15 Polychlorinated naphthalenes (PCNs) in food: Sources, analytical methodology, occurrence and human exposure ................ 367

_A. Fernandes, The Food and Environment Research Agency, UK_

15.1 Introduction ......................................................................... 367
15.2 Sources of PCNs .................................................................. 368
15.3 Toxicology ............................................................................ 370
15.4 Methods of analysis of PCNs in foods .................................. 372
15.5 Occurrence in food ............................................................. 375
15.6 PCN occurrence in humans .................................................. 383
15.7 Conclusions and future trends .............................................. 386
15.8 References ............................................................................ 387

## 16 Mercury in foods ................................................................. 392

_E. M. Sunderland and M. Tumpney, Harvard University School of Public Health, USA_

16.1 Introduction ......................................................................... 392
Contents

16.2 Concentrations of mercury in foods .................................................... 396
16.3 Mercury exposures and risks from major food categories .... 403
16.4 References .......................................................................... 407

17 Arsenic in foods: Current issues related to analysis, toxicity and metabolism ......................................................... 414
K. A. Francesconi and G. Raber, Karl-Franzens-University, Austria
17.1 Introduction .................................................................... 414
17.2 Sources and occurrence in food ........................................... 415
17.3 Methods for determining arsenic in food ................................ 418
17.4 Toxicity of arsenic ............................................................ 421
17.5 Implications for the food industry and policy makers ............ 425
17.6 References .......................................................................... 426

18 Organotin compounds in foods .......................................................... 430
E. Rosenberg, Vienna University of Technology, Austria
18.1 Introduction .................................................................... 431
18.2 Technical, agricultural and industrial uses of organotin compounds ........................................................................ 432
18.3 Physical and chemical properties of organotin compounds .. 444
18.4 Analysis of organotin compounds in foods ......................... 445
18.5 Human dietary exposure to organotin compounds from foods ........................................................................ 451
18.6 Human exposure to organotin compounds from food packaging material .......................................................... 457
18.7 Health risks and toxicity of organotin compounds .............. 461
18.8 Conclusions and future trends ............................................. 466
18.9 References .......................................................................... 468
18.10 Appendix: Abbreviations .................................................... 474

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<th>Page</th>
<th>Title</th>
<th>Editor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>135</td>
<td>Maximising the value of marine by-products</td>
<td>F. Shahidi</td>
</tr>
<tr>
<td>136</td>
<td>Chemical migration and food contact materials</td>
<td>K. Barnes, R. Sinclair and D. Watson</td>
</tr>
<tr>
<td>137</td>
<td>Understanding consumers of food products</td>
<td>L. Frewer and H. van Trijp</td>
</tr>
<tr>
<td>138</td>
<td>Reducing salt in foods: Practical strategies</td>
<td>D. Kilcast and F. Angus</td>
</tr>
<tr>
<td>139</td>
<td>Modelling microorganisms in food</td>
<td>S. Brul, S. Van Gerwen and M. Zwietering</td>
</tr>
<tr>
<td>140</td>
<td>Tamime and Robinson’s Yoghurt: Science and technology Third edition</td>
<td>A. Y. Tamime and R. K. Robinson</td>
</tr>
<tr>
<td>141</td>
<td>Handbook of waste management and co-product recovery in food processing Volume 1</td>
<td>K. W. Waldron</td>
</tr>
<tr>
<td>142</td>
<td>Improving the flavour of cheese</td>
<td>B. Weimer</td>
</tr>
<tr>
<td>143</td>
<td>Novel food ingredients for weight control</td>
<td>C. J. K. Henry</td>
</tr>
<tr>
<td>144</td>
<td>Consumer-led food product development</td>
<td>H. MacFie</td>
</tr>
<tr>
<td>145</td>
<td>Functional dairy products Volume 2</td>
<td>M. Saarela</td>
</tr>
<tr>
<td>146</td>
<td>Modifying flavour in food</td>
<td>A. J. Taylor and J. Hort</td>
</tr>
<tr>
<td>147</td>
<td>Cheese problems solved</td>
<td>P. L. H. McSweeney</td>
</tr>
<tr>
<td>148</td>
<td>Handbook of organic food safety and quality</td>
<td>J. Cooper, C. Leifert and U. Niggli</td>
</tr>
<tr>
<td>149</td>
<td>Understanding and controlling the microstructure of complex foods</td>
<td>D. J. McClements</td>
</tr>
<tr>
<td>150</td>
<td>Novel enzyme technology for food applications</td>
<td>R. Rastall</td>
</tr>
<tr>
<td>151</td>
<td>Food preservation by pulsed electric fields; From research to application</td>
<td>H. L. M. Lelieveld and S. W. H. de Haan</td>
</tr>
<tr>
<td>152</td>
<td>Technology of functional cereal products</td>
<td>B. R. Hamaker</td>
</tr>
<tr>
<td>153</td>
<td>Case studies in food product development</td>
<td>M. Earle and R. Earle</td>
</tr>
<tr>
<td>154</td>
<td>Delivery and controlled release of bioactives in foods and nutraceuticals</td>
<td>N. Garti</td>
</tr>
<tr>
<td>155</td>
<td>Fruit and vegetable flavour: Recent advances and future prospects</td>
<td>B. Brückner and S. G. Wyllie</td>
</tr>
<tr>
<td>156</td>
<td>Food fortification and supplementation: Technological, safety and regulatory aspects</td>
<td>P. Berry Ottaway</td>
</tr>
<tr>
<td>157</td>
<td>Improving the health-promoting properties of fruit and vegetable products</td>
<td>F. A. Tomás-Barberáñ and M. I. Gil</td>
</tr>
<tr>
<td>158</td>
<td>Improving seafood products for the consumer</td>
<td>T. Borresen</td>
</tr>
<tr>
<td>159</td>
<td>In-pack processed foods: Improving quality</td>
<td>P. Richardson</td>
</tr>
<tr>
<td>160</td>
<td>Handbook of water and energy management in food processing</td>
<td>J. Klemes, R. Smith and J.-K. Kim</td>
</tr>
<tr>
<td>161</td>
<td>Environmentally compatible food packaging</td>
<td>E. Chiellini</td>
</tr>
<tr>
<td>162</td>
<td>Improving farmed fish quality and safety</td>
<td>O. Lie</td>
</tr>
<tr>
<td>163</td>
<td>Carbohydrate-active enzymes</td>
<td>K.-H. Park</td>
</tr>
<tr>
<td>164</td>
<td>Chilled foods: A comprehensive guide Third edition</td>
<td>M. Brown</td>
</tr>
<tr>
<td>165</td>
<td>Food for the ageing population</td>
<td>M. M. Raats, C. P. G. M. de Groot and W. A Van Staveren</td>
</tr>
<tr>
<td>166</td>
<td>Improving the sensory and nutritional quality of fresh meat</td>
<td>J. P. Kerry and D. A. Ledward</td>
</tr>
<tr>
<td>167</td>
<td>Shellfish safety and quality</td>
<td>S. E. Shumway and G. E. Rodrick</td>
</tr>
<tr>
<td>168</td>
<td>Functional and speciality beverage technology</td>
<td>P. Paquin</td>
</tr>
<tr>
<td>169</td>
<td>Functional foods: Principles and technology</td>
<td>M. Guo</td>
</tr>
</tbody>
</table>

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Woodhead Publishing Series in Food Science, Technology and Nutrition  xix

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xxii Woodhead Publishing Series in Food Science, Technology and Nutrition

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Foreword*

Editors: Rose and Fernandes

The safety of our food is a primary concern. However, with increased industrialization and globalization of world economies and food supplies, ensuring the safety of our food presents huge regulatory challenges. Chemical contamination of the food supply is perhaps one of the more difficult challenges. Persistent organic pollutants and toxic metals are ubiquitous environmental pollutants. Following their release into the air, water or soil, these chemicals slowly degrade and bioaccumulate in the food chain. The bioaccumulation results in low-level contamination of our food supply. Because of the long biological half-life of these chemicals in humans, even contamination at parts per trillion in the food can result in human body burdens approaching those in which adverse effects are observed in experimental studies in animals, and in observational studies in people. At present, detecting most chemical contaminants in food at parts per trillion levels can only be done with the most sophisticated, and costly, analytical techniques. In addition, because of the perishable nature of food, most analytical techniques are too time consuming to allow data generation in a real-time manner. The development of cost effective screening and intervention approaches for these chemicals are subjects of intense scientific and regulatory debates.

Low-level contamination of the food supply with persistent organic pollutants and toxic metals is an excellent example of the interaction of science and public policy. The ubiquitous microcontamination of our environment with these chemicals presents complex scientific and regulatory problems. In contrast to microbiological contaminates in food, typical hygienic practices

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and thermal processes are often ineffective in preventing or removing chemical contaminants. Because of their ubiquitous presence in the environment, these chemicals get into the food on our tables through complex and often unknown pathways. Thus, in order to understand the level of contamination of our food, our only alternative is to measure these chemicals in the food. However, methods of detecting chemical contaminants are chemical-class specific and due to the large number of potential environmental chemicals that may get into our food, we must prioritize which chemicals we evaluate. In addition, as interest in a specific chemical class increases, analytical chemists develop better and more sensitive methods of detection, resulting in the discovery that these chemicals are present in a greater percentage of our food than previously understood. Analytical methods have increased sensitivity by orders of magnitude over the past several decades. Chemicals that were once “not present” in our foods are now commonly found. To complement these advances in analytical chemistry, we must refine our risk assessment methods to better interpret the chemical contaminants occurrence and concentration data. Finally, given the wide range of foods, food sources and chemical contaminants, we would need much larger screening programs to ensure the safety of our food supply, with respect to chemical contaminants. However, the sizes of these screening programs are limited by the costs associated with them. Thus, developing cost effective screening programs that combine statistical approaches to sample selection, and analytical sensitivity and specificity are necessary.

In their book, ‘Persistent organic pollutants and toxic metals in food’, editors, Dr Martin Rose and Dr Alwyn Fernandes, present both the regulatory and scientific challenges in ensuring our food supply is safe from these chemicals. This book is one of the few that presents both of these important issues. The first section of the book covers regulatory efforts to screen and control for persistent organic pollutants and toxic metals. It also includes case studies on regulatory responses to accidental contamination incidences for dioxins. These examples nicely set the stage for the second section of the book that describes the occurrence, exposure and toxicity of individual chemicals and chemical classes. This book provides the scientific and policy foundations for those interested in chemical contaminants and food safety.

Linda S. Birnbaum and Michael J. DeVito
National Institute of Environmental Health Sciences, USA
Preface
Editors: Martín Rose and Alwyn Fernandes

It has been our great pleasure to work with so many distinguished experts to put together a book that deals with the immensely important subject of chemical contamination of food. The fundamental concept behind this work was to bring together a range of perspectives on this subject – to include analytical, scientific, risk assessment and regulatory issues – and collate a useful resource for those with interests crossing these perspectives. We wanted to demonstrate how the best scientific evidence gets used for risk assessment and in turn translated into regulation. The wealth of experience and different backgrounds of our contributors has enabled us to collect together topics that cover not only a range of inorganic and organic contaminants, but also a range of viewpoints on their consequences in terms of exposure and human health.

The topics covered in this book also demonstrate two further aspects of the subject: the diversity of disciplines that are fundamental to our understanding of food safety, and the diversity of contaminants – some arising inadvertently, some through our purposeful anthropogenic activity – that analytical chemists, toxicologists, risk assessors and regulators are increasingly having to deal with. And although new and emerging issues surface regularly, new findings, improvements in measurement techniques and toxicological updates on older contaminants continue to provide insights into the interaction and influence of these chemicals on human health. Thus for example, decades after originally being alerted to the immediate toxicity of PCBs experienced by victims of acute exposure, we learn latterly about more subtle and long-term effects such as endocrine-disrupting activity and the dioxin-like toxicity of these food contaminants. Similarly, evolving knowledge of the toxicity of the different species of arsenic and mercury, combined with the advances in analytical methodology that allow speciation of these elements, has allowed refinement of the risk assessment and regulation.
xxvi Preface

We hope that the breadth of topics will also provide a useful introduction to students, a helpful resource for regulators and a general text for all those seeking further knowledge on the complex subject of food safety and human health. All that remains is for us to thank both the contributors and the staff at Woodhead for making the project so interesting and rewarding for us. We hope that you enjoy reading the book as much as we enjoyed the editing process.