

The Handbook of Environmental Chemistry

Volume 96

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In over three decades, *The Handbook of Environmental Chemistry* has established itself as the premier reference source, providing sound and solid knowledge about environmental topics from a chemical perspective. Written by leading experts with practical experience in the field, the series continues to be essential reading for environmental scientists as well as for environmental managers and decision-makers in industry, government, agencies and public-interest groups.

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Meeting the needs of the scientific community, publication of volumes in subseries has been discontinued to achieve a broader scope for the series as a whole.

Non-Steroidal Anti-Inflammatory Drugs in Water

Emerging Contaminants and Ecological Impact

Volume Editor: Leobardo Manuel Gómez-Oliván

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Series Preface

With remarkable vision, Prof. Otto Hutzinger initiated *The Handbook of Environmental Chemistry* in 1980 and became the founding Editor-in-Chief. At that time, environmental chemistry was an emerging field, aiming at a complete description of the Earth's environment, encompassing the physical, chemical, biological, and geological transformations of chemical substances occurring on a local as well as a global scale. Environmental chemistry was intended to provide an account of the impact of man's activities on the natural environment by describing observed changes.

While a considerable amount of knowledge has been accumulated over the last four decades, as reflected in the more than 150 volumes of *The Handbook of Environmental Chemistry*, there are still many scientific and policy challenges ahead due to the complexity and interdisciplinary nature of the field. The series will therefore continue to provide compilations of current knowledge. Contributions are written by leading experts with practical experience in their fields. *The Handbook of Environmental Chemistry* grows with the increases in our scientific understanding, and provides a valuable source not only for scientists but also for environmental managers and decision-makers. Today, the series covers a broad range of environmental topics from a chemical perspective, including methodological advances in environmental analytical chemistry.

In recent years, there has been a growing tendency to include subject matter of societal relevance in the broad view of environmental chemistry. Topics include life cycle analysis, environmental management, sustainable development, and socio-economic, legal and even political problems, among others. While these topics are of great importance for the development and acceptance of *The Handbook of Environmental Chemistry*, the publisher and Editors-in-Chief have decided to keep the handbook essentially a source of information on "hard sciences" with a particular emphasis on chemistry, but also covering biology, geology, hydrology and engineering as applied to environmental sciences.

The volumes of the series are written at an advanced level, addressing the needs of both researchers and graduate students, as well as of people outside the field of

“pure” chemistry, including those in industry, business, government, research establishments, and public interest groups. It would be very satisfying to see these volumes used as a basis for graduate courses in environmental chemistry. With its high standards of scientific quality and clarity, *The Handbook of Environmental Chemistry* provides a solid basis from which scientists can share their knowledge on the different aspects of environmental problems, presenting a wide spectrum of viewpoints and approaches.

The Handbook of Environmental Chemistry is available both in print and online via www.springerlink.com/content/110354/. Articles are published online as soon as they have been approved for publication. Authors, Volume Editors and Editors-in-Chief are rewarded by the broad acceptance of *The Handbook of Environmental Chemistry* by the scientific community, from whom suggestions for new topics to the Editors-in-Chief are always very welcome.

Damià Barceló
Andrey G. Kostianoy
Series Editors

Preface

Pharmaceuticals are designed to persist and perform their therapeutic action and, consequently, once they enter the aquatic environment, they persist in it, damaging the health of organisms living in these ecosystems and even human health. Therefore, these products are currently of worldwide environmental concern and have been called “emerging contaminants”. The latter term includes non-steroidal anti-inflammatory drugs (NSAIDs), a heterogeneous group of pharmaceuticals with anti-inflammatory, analgesic and antipyretic properties, which act as selective inhibitors of the enzyme cyclooxygenase (COX), inhibiting cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2) which are responsible for the production of prostaglandins, prostacyclins and thromboxanes.

Some NSAIDs do not degrade in the environment, others are degradable but at a very slow pace and although some others are not persistent in the environment, they can be transformed through natural processes. The continuous introduction of this type of products from various sources (municipal, hospital and industrial effluents) prolongs and maintains its presence in the waters increasing any possible impact on aquatic life.

The appearance of NSAIDs in water represents a high risk to the environment for many reasons. The main one is that they contain active ingredients that were designed to induce specific pharmacological effects in humans but, when they dissolve in water, can reach non-target populations such as fish, amphipods, amphibians, among others, which produces toxicological effects. Diverse studies have reported NSAID-induced toxicity in aquatic organisms since these organisms are more susceptible to toxic effects due to their continued exposure to wastewater discharges throughout the life cycle.

In the chapters included in this book are indicated data about fate, occurrence, toxicological findings identified by the presence of NSAIDs in various aquatic organisms of economic and ecological interest. Also are included avant-garde technologies for the removal of NSAIDs and the regulatory framework for the presence of these drugs in the world.

The authors are well-known researchers from Mexico, Spain, Portugal, Italy, Australia and India and make exhaustive reviews and show the findings identified in their investigations related to NSAIDs occurrence, toxicity characterization using different biomarkers, as well as showing some technologies for the removal of NSAIDs and legal framework of the NSAIDs around the world. This compilation of research in world countries allows us to have a very specific vision of the specific water problem by NSAIDs and consider solution proposals.

The authors and I hope that our book complies with the diverse and generalized expectations and needs for information about the contamination problem in the world by NSAIDs.

I thank all the authors of this book for their professional expertise and thoroughness in writing up their chapters; the Universidad Autónoma del Estado de México for the unending support it has shown as my employing entity; my research group; and my family, most especially my mother, Aida Oliván, and friends for the enthusiasm and support they have always shown.

Toluca, Mexico

Leobardo Manuel Gómez-Oliván

Contents

Introduction and Historical Findings That Focused Nonsteroidal Anti-Inflammatory Drugs as Emerging Pollutant	1
Gustavo Axel Elizalde-Velázquez and Leobardo Manuel Gómez-Oliván	
Overview of Non-steroidal Anti-inflammatory Drugs as Emerging Contaminants	41
Alejandro Mejía-García, Hariz Islas-Flores, Leobardo Manuel Gómez-Oliván, Nely SanJuan-Reyes, José Mario Ortega-Olvera, and María Dolores Hernández-Navarro	
Worldwide Occurrence, Detection, and Fate of Nonsteroidal Anti-inflammatory Drugs in Water	55
Lucila I. Castro-Pastrana, Erika Palacios-Rosas, M. Luisa Toledo-Wall, and Mónica Cerro-López	
Quantification of Non-steroidal Anti-inflammatory Drug in Water . . .	83
Keila Isaac-Olivé, Eunice Olivé-Alvarez, Amado E. Navarro-Frómeta, Ninfa Ramírez-Durán, Enrique Morales-Avila, Liliana Aranda-Lara, Horacio Sandoval-Trujillo, and Pablo Moreno-Pérez	
DNA Alterations and Cellular Damage Induced by Non-steroidal Anti-inflammatories on Different Species of Fish	105
Nely SanJuan-Reyes, Leobardo Manuel Gómez-Oliván, Ricardo Pérez-Pastén Borja, Hariz Islas-Flores, Marcela Galar-Martínez, and Sandra García-Medina	
Teratogenesis and Embryotoxicity Induced by Non-steroidal Anti-Inflammatory Drugs in Aquatic Organisms	115
Itzayana Pérez-Alvarez, Hariz Islas-Flores, Leobardo Manuel Gómez-Oliván, and Octavio Dublán García	

Ecotoxicological Effects of the Drug Paracetamol: A Critical Review of Past Ecotoxicity Assessments and Future Perspectives	131
Bruno Nunes	
Adverse Effects Induced by Nonsteroidal Anti-inflammatory Drugs on Freshwater Invertebrates	147
Marco Parolini	
Ibuprofen and Diclofenac: Effects on Freshwater and Marine Aquatic Organisms – Are They at Risk?	161
Chiara Trombini, Julián Blasco, and Miriam Hampel	
Toxicity Assessment of Acetylsalicylic Acid to a Freshwater Fish <i>Cyprinus carpio</i>: Haematological, Biochemical, Enzymological and Antioxidant Responses	191
Subramaniam Siddeswaran, Sathisaran Umamaheswari, and Mathan Ramesh	
Contemporary Methods for Removal of Nonsteroidal Anti-inflammatory Drugs in Water Reclamations	217
Luong N. Nguyen, Audrey S. Commault, Donna Sutherland, Galilee U. Semblante, Seungdae Oh, and Long D. Nghiem	
Photo-Fenton Treatment of a Pharmaceutical Industrial Effluent Under Safe pH Conditions	241
Reyna Natividad, Arisbeth Mendoza, Sharon E. Brewer, Sandra Luz Martínez-Vargas, J. L. Pérez-Mazariego, Karen Adriana Novoa, Leobardo Manuel Gómez-Oliván, and Rubi Romero	
Use of Membrane for Removal of Nonsteroidal Anti-inflammatory Drugs	261
Rosa María Gómez-Espinosa and Daniel Arizmendi-Cotero	
Nanotechnologies for Removal of Nonsteroidal Anti-inflammatory Drug from Wastewater	277
Monica Cerro-Lopez, Jorge Jiménez Cisneros, Miguel A. Méndez-Rojas, and Lucila I. Castro-Pastrana	
Biological Technologies Used for the Removal of Nonsteroidal Anti-inflammatory Drugs	303
Ninfa Ramírez-Durán, Lorna Catalina Can-Ubando, Gaudy Lizeth Manzanares-Leal, M. P. A. Moreno-Pérez, Keila Isaac-Olivé, and Angel Horacio Sandoval-Trujillo	

**Risk Evaluation and Legal Framework of the Nonsteroidal
Anti-inflammatory Drugs Around the World 321**
Jesus Daniel Cardoso-Vera, Hariz Islas-Flores, Nely SanJuan-Reyes,
and Leobardo Manuel Gómez-Oliván

Conclusions 337
Leobardo Manuel Gómez-Oliván