
Oxidative Stress: Diagnostic Methods and Applications in Medical Science

Pawan Kumar Maurya • Pranjal Chandra
Editors

Oxidative Stress: Diagnostic Methods and Applications in Medical Science

 Springer

Editors

Pawan Kumar Maurya
Amity Institute of Biotechnology
Amity University Uttar Pradesh
Noida, India

Universidade Federal de Sao Paulo
Vila Clementino, São Paulo, Brazil

Pranjal Chandra
Department of Biosciences and
Bioengineering
Indian Institute of Technology, Guwahati
Guwahati, Assam, India

ISBN 978-981-10-4710-7

ISBN 978-981-10-4711-4 (eBook)

DOI 10.1007/978-981-10-4711-4

Library of Congress Control Number: 2017953937

© Springer Nature Singapore Pte Ltd. 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by Springer Nature

The registered company is Springer Nature Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

An interdisciplinary approach in science has led to the development of oxidative stress monitoring in various models for real clinical and biomedical applications. Oxidative stress is associated with a diminished capacity of a biological system to overcome an overproduction of reactive oxygen species and other free radicals. Since oxidative stress is a leading cause of many diseases, there is an urgent need for oxidative stress monitoring using analytical approaches and its prevention. There is growing evidence that oxidative stress may cause autism in children. Several biomarkers of oxidative stress have also been identified. The development of methods requires versatile knowledge of biology, chemistry, molecular biology, immunology, and microbiology. The biomedical application of oxidative stress monitoring is extensive, and future influence will be matchless. Monitoring oxidative stress in humans can be done indirectly, by assaying the product of oxidative damage in clinical samples or by investigating the antioxidant potential of an organism, tissue, or body fluids to withstand further oxidation. Recent advances in nanotechnology led to the development of new diagnostic methods for monitoring oxidative stress status in medical science using nanodiagnosics methods. In this book, we will therefore also deal with nanodiagnosics methods for measuring oxidative stress. However, we will focus on the more recent development in this field.

In view of the clinical and healthcare importance of oxidative stress monitoring, this book has been proposed. This book starts with a brief introduction of the role of oxidative stress in major disease conditions and it mainly focuses on the current trends in oxidative stress monitoring using different *in vitro* and *in vivo* models which are very much important for on-site clinical applications and can be used in the prevention of diseases.

After numerous deliberations, we came up with the idea to explore the possibility of developing a book on oxidative stress to partially fill the void. Finally, we decided to develop a book by inviting experts in the field who have relevant research experience and an understanding of the intricacies of the subject. We had in mind a book that would help to alleviate most of the worries of both students and instructors. We discussed, argued, and disagreed until we came up with the thought that a resource book would be a reasonable format, as it could provide sufficient information and literature for instructors to teach the subject while providing students with ample information to gain better insight into the subject. Once we formulated these

thoughts to develop a resource book, the ball started rolling, and we identified various experts and convinced them to contribute chapters.

This is our maiden effort to produce a book on oxidative stress and its impact in medical science to help students and instructors. We hope that we will get support from the readers of this book. We are always open to criticism, suggestions, and recommendations that can help to improve the content and presentation of the book. Your suggestions and criticisms will give us an opportunity to explore other aspects of oxidative stress in our future ventures and endeavors.

Vila Clementino, São Paulo, Brazil
Guwahati, Assam, India

Pawan Kumar Maurya
Pranjal Chandra

Contents

1 Chemical Biology of Oxidative Stress and Its Role in the Pathophysiology of Neuropsychiatric Disorders	1
Dipti Chourasia and Sumit Sethi	
2 Oxidative Stress: Diagnostic Methods and Application in Medical Science	23
Vikram Dalal, Narendra Kumar Sharma, and Sagarika Biswas	
3 Nanomaterials in Antioxidant Research	47
Aditya Arya, Anamika Gangwar, and Narendra Kumar Sharma	
4 Gold Nanoparticle-Based Methods for Detection of Oxidative Stress Biomarkers	65
Sanjay Singh	
5 Hydroxamic Acids as Potent Antioxidants and Their Methods of Evaluation	97
Samir Mehndiratta, Kunal Nepali, and Mantosh Kumar Satapathy	
6 Oxidative Stress-Related MicroRNAs as Diagnostic Markers: A Newer Insight in Diagnostics	113
Shashank Kumar and Abhay K. Pandey	
7 Oxidative Stress Monitoring Using In Vitro Systems: Tools and Findings	127
Aditya Arya and Yasmin Ahmad	
8 Oxidative Stress-Mediated Human Diseases	141
Arti Srivastava and Ashutosh Srivastava	
9 Potential Applications of Antioxidants from Algae in Human Health	153
Nikunj Sharma, Anwasha Khanra, and Monika Prakash Rai	

About the Editors



Dr. Pawan Kumar Maurya is currently employed as assistant professor at Amity Institute of Biotechnology, Amity University–Noida, India. He has done a Ph.D. from the University of Allahabad (a central university), India, and postdoctoral training from Universidade Federal de Sao Paulo (UNIFESP), Brazil, and Taipei Medical University (TMU) and National Taiwan University (NTU), Taiwan. He is working on biochemical diagnostics, nanomedicine, and clinical biochemistry.

He has published over 48 research articles in reputed journals. He is recipient of a prestigious fellowship: Science Without Borders (Government of Brazil).



Dr. Pranjal Chandra is currently employed as assistant professor and principal investigator at the Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Assam, India. He earned his Ph.D. from Pusan National University, South Korea, and did postdoctoral training at Technion—Israel Institute of Technology, Israel. He has published over 50 research articles in reputed journals and one book (IET, UK). He is also a visiting scientist at IBST, South Korea. Pranjal’s research contributions are highly interdisciplinary, spanning a wide range in nanobio-

technology, nanobiosensors, lab-on-chip systems for biomedical diagnostics, and nanomedicine. His work has been highlighted in the world news of the Royal Society of Chemistry, Cambridge, as “A new system for cancer detection” and also featured as a key scientific article in the *Global Medical Discovery* in Canada. He is recipient of many prestigious awards and fellowships such as the Ramanujan fellowship (Government of India); BK21 and NRF fellowship of South Korea;

Technion postdoctoral fellowship, Israel; University of Montreal postdoc fellowship, Canada; NMS Young Scientist Award, etc. He is also editorial board member of a dozen international journals including *World Journal of Methodology*, USA; *Frontiers of Biosciences*, USA; *Journal of Biosensors and Bioelectronics*, USA, etc.