

Molecular Biology of Kinetoplastid Parasites

<https://doi.org/10.21775/9781910190715>

Edited by

Hemanta K. Majumder

Infectious Diseases and Immunology Division
CSIR-Indian Institute of Chemical Biology
Kolkata
India



Copyright © 2018

Caister Academic Press
Norfolk, UK

www.caister.com

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-910190-71-5 (paperback)

ISBN: 978-1-910190-72-2 (ebook)

Description or mention of instrumentation, software, or other products in this book does not imply endorsement by the author or publisher. The author and publisher do not assume responsibility for the validity of any products or procedures mentioned or described in this book or for the consequences of their use.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher. No claim to original U.S. Government works.

Cover design adapted from images supplied by Hemanta K. Majumder.

Ebooks

Ebooks supplied to individuals are single-user only and must not be reproduced, copied, stored in a retrieval system, or distributed by any means, electronic, mechanical, photocopying, email, internet or otherwise.

Ebooks supplied to academic libraries, corporations, government organizations, public libraries, and school libraries are subject to the terms and conditions specified by the supplier.

Contents

	Preface	v
	About the Editor	vii
1	Genome-wide Profiling of Unique Domain Architectures Reveals Novel Epigenetic Regulators of <i>Leishmania infantum</i> V. S. Gowri, Nimisha Mittal, Rohini Muthuswami and Rentala Madhubala	1
2	Role of Hypoxia Inducible Factor-1 in <i>Leishmania</i> –Macrophage Interaction: A New Therapeutic Paradigm Amit K. Singh, Vishnu Vivek G., Shalini Saini, Sandhya Sandhya and Chinmay K. Mukhopadhyay	27
3	Response of B Lymphocytes During <i>Leishmania</i> Infection Koushik Mondal and Syamal Roy	39
4	Cellular Defence of the <i>Leishmania</i> Parasite Sanchita Das and Chandrima Shaha	67
5	Molecular Regulation of Macrophage Class Switching in Indian Post-kala-azar Dermal <i>Leishmaniasis</i> (PKDL) Mitali Chatterjee, Srija Moulik, Debkanya Dey, Debanjan Mukhopadhyay, Shibabrata Mukherjee and Susmita Roy	81
6	<i>Leishmania</i> Exploits Host’s Defence Machineries for Survival: A Tale of Immune Evasion Amrita Saha and Anindita Ukil	97
7	Ceramide in the Establishment of Visceral <i>Leishmaniasis</i> , an Insight into Membrane Architecture and Pathogenicity Junaid Jibrán Jawed, Shabina Parveen and Subrata Majumdar	111
8	The Role of Haemproteins in Different Life Cycle Stages of <i>Leishmania</i> Subhankar Dolai and Subrata Adak	119
9	Pre-adaptation of <i>Leishmania</i> Promastigotes to Intracellular Life: Ensuring a Successful Infection Roma Sinha and Nahid Ali	137

10	DNA Topoisomerases of Kinetoplastid Parasites: Brief Overview and Recent Perspectives	151
	Sourav Saha, Somenath Roy Chowdhury and Hemanta K. Majumder	
11	Host–Kinetoplastid Parasite Interaction at the Immune System Interface: Immune Evasion and Immunotherapy	169
	Arathi Nair, Sunil Kumar, Bhaskar Saha and Divanshu Shukla	
12	Extracellular Matrix Interacting Proteins of Trypanosomatids: Adhesion and Invasion of Host Tissues	207
	Shreyasi Palit and Pijush K. Das	
13	Effects of Phospholipid Analogues on Trypanosomatids	221
	Wanderley de Souza, Joseane Godinho, Emile Barrias, Marina Roussaki, Juliany Cola Fernandes Rodrigues and Theodora Calogeropoulou	
	Index	243

Preface

Parasitic diseases pose an enormous threat to human health and welfare. Admirable research efforts and promising advancement in the field of research on protozoan parasites have taken place in last few decades. The diseases caused by *Leishmania* and *Trypanosoma* affect many millions of people in both tropical and subtropical regions of the world. An estimated 700,000–1 million new cases of leishmaniasis and 20,000–30,000 deaths occur annually. There are three main forms of leishmaniasis: visceral leishmaniasis (VL), cutaneous leishmaniasis (CL) and mucocutaneous leishmaniasis. *Leishmania* species are found throughout Latin America, Africa and Asia. African trypanosomiasis (sleeping sickness) is fatal if untreated, and occurs in 36 African countries, particularly in East and Central Africa, where some 50 million people are at risk of acquiring infection. *Trypanosoma cruzi*, the causative agent of Chagas' disease, is endemic in Latin America. Emergence of parasites resistant to many of the available drugs is also responsible for the depressing scenario and cause of death. So the disease is not only complex but also cosmopolitan.

Leishmania and *Trypanosoma* share common biological traits and they cause low-priority diseases as they offer few commercial incentives to the pharmaceutical companies. These kinetoplastid protozoan parasites have attracted considerable attention from the scientific community because of their unusual biology. These two organisms have special features. They are characterized by the presence of unusual mitochondrion containing a massive intercatenated network structure of DNA called kinetoplast DNA or kDNA. None of the host organisms of these parasites contain DNA which resembles this unique kDNA. Therefore, these

kDNAs can be excellent targets for development of therapeutic agents.

Measures to control these diseases have not been very successful and attempts to develop effective vaccines are still far from success. Therefore, improved and rational measures for drug development are still desirable.

Recent progress in molecular biology with reference to whole genome sequencing has greatly facilitated drug design, drug delivery and immunotherapy to provide newer intervention strategies against these parasites.

When I was contacted by Hugh Griffin of Caister Academic Press to edit a book, I accepted the invitation and I felt that it is the right time to address the important subject on molecular biology of kinetoplastid parasites. The book contains 13 chapters contributed by eminent scientists working in this field.

The articles deal with the biology and biochemistry of different targets, molecular immunology in relation to immune evasion and immunotherapy, host–parasite interaction, cellular defence mechanism adopted by the parasites for survival, membrane architecture as targets, life cycle and epigenetic regulation of the parasites.

I am thankful to the scientists for their contribution in this book. Finally the book was made possible because of continuous help from my PhD students Sourav Saha and Somenath Roy Chowdhury.

Hemanta K. Majumder, PhD
Infectious Diseases and Immunology Division,
CSIR-Indian Institute of Chemical Biology,
Kolkata, India

Current Books of Interest

DNA Tumour Viruses: Virology, Pathogenesis and Vaccines	2018
Pathogenic <i>Escherichia coli</i> : Evolution, Omics, Detection and Control	2018
Postgraduate Handbook: A Comprehensive Guide for PhD and Master's Students and their Supervisors	2018
Enteroviruses: Omics, Molecular Biology, and Control	2018
Bacterial Evasion of the Host Immune System	2017
Illustrated Dictionary of Parasitology in the Post-genomic Era	2017
Next-generation Sequencing and Bioinformatics for Plant Science	2017
The CRISPR/Cas System: Emerging Technology and Application	2017
Brewing Microbiology: Current Research, Omics and Microbial Ecology	2017
Metagenomics: Current Advances and Emerging Concepts	2017
<i>Bacillus</i> : Cellular and Molecular Biology (Third Edition)	2017
Cyanobacteria: Omics and Manipulation	2017
Foot-and-Mouth Disease Virus: Current Research and Emerging Trends	2017
Brain-eating Amoebae: Biology and Pathogenesis of <i>Naegleria fowleri</i>	2016
<i>Staphylococcus</i> : Genetics and Physiology	2016
Chloroplasts: Current Research and Future Trends	2016
Microbial Biodegradation: From Omics to Function and Application	2016
Influenza: Current Research	2016
MALDI-TOF Mass Spectrometry in Microbiology	2016
<i>Aspergillus</i> and <i>Penicillium</i> in the Post-genomic Era	2016
The Bacteriocins: Current Knowledge and Future Prospects	2016
Omics in Plant Disease Resistance	2016
Acidophiles: Life in Extremely Acidic Environments	2016
Climate Change and Microbial Ecology: Current Research and Future Trends	2016
Biofilms in Bioremediation: Current Research and Emerging Technologies	2016
Microalgae: Current Research and Applications	2016
Gas Plasma Sterilization in Microbiology: Theory, Applications, Pitfalls and New Perspectives	2016
Virus Evolution: Current Research and Future Directions	2016
Arboviruses: Molecular Biology, Evolution and Control	2016
<i>Shigella</i> : Molecular and Cellular Biology	2016
Aquatic Biofilms: Ecology, Water Quality and Wastewater Treatment	2016
Alphaviruses: Current Biology	2016
Thermophilic Microorganisms	2015
Flow Cytometry in Microbiology: Technology and Applications	2015

About the Editor

Hemanta K. Majumder is a Senior Scientist Platinum Jubilee Fellow of National Academy of Sciences (India) at CSIR-Indian Institute of Chemical Biology, Kolkata. He was the former Head of the Infectious Diseases and Immunology Division of the Institute. He served the State Council of Science and Technology, Government of West Bengal as the Working Chairman from 2004 to 2011. His main research interests include biochemistry and molecular biology of DNA topoisomerases of *Leishmania* in relation to development of therapeutics targeted to these enzymes and understanding the mechanism of programmed cell death in this unicellular protozoan parasite.

Dr Majumder is in the editorial board of many national and international journals. He received his PhD degree in biochemistry in 1975 from Calcutta University. He did his post doctoral studies at Albert Einstein College of Medicine, New York, USA (1976–9), and at the University of Zurich, Switzerland (1979–81). He was a Visiting Associate Research Molecular Biologist at University of California at Berkeley (1988–9). He was also a visiting Fellow at University of Rome, Italy (2008), University of Aarhus, Denmark (2010), Robert Koch Institute at Berlin (2013), LMU Germany



(2013 and 2015) and Leiden University Medical Center, The Netherlands (2015).

Dr Majumder is a Fellow of all the National Academies in the country, e.g. Indian National Science Academy (INSA), Indian Academy of Sciences (FASc), National Academy of Sciences (FNASc) and also The World Academy of Sciences (FTWAS).

