Microbiology Monographs

Volume 9

Series Editor
Alexander Steinbüchel
Münster, Germany

More information about this series at http://www.springer.com/series/7171

Jan Tachezy
Editor

Hydrogenosomes and Mitosomes: Mitochondria of Anaerobic Eukaryotes

Second Edition

Springer

Editor
Jan Tachezy
Faculty of Science
Department of Parasitology
BIOCEV
Charles University
Vestec, Czech Republic

ISSN 1862-5576 ISSN 1862-5584 (electronic)
Microbiology Monographs
ISBN 978-3-030-17940-3 ISBN 978-3-030-17941-0 (eBook)
https://doi.org/10.1007/978-3-030-17941-0

This Springer imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

We were very pleased by the invitation of Springer-Verlag to prepare the second edition of the *Microbiology Monographs volume Hydrogenosomes and Mitosomes: Mitochondria of Anaerobic Eukaryotes*. First, it was a signal that the first edition was successful and interesting for readers in cell biology, parasitology, evolutionary biology, and other fields of biology as we hoped. Second, it provides us the opportunity to upgrade the first edition from 2008; there was a tremendous increase in knowledge about evolution, biogenesis, and function of mitochondria and their various anaerobic forms. New technologies, particularly in genomics and proteomics, allow a much more detailed analysis of hydrogenosomes and mitosomes to learn about their functions. For example, initial proteomic study identified only 61 proteins in hydrogenosomes of *Trichomonas vaginalis* in 2007, while about tenfold more proteins are known today. Moreover, various mitochondria that are adapted to anaerobiosis to a great extent have been described in disparate protists across almost all eukaryotic lineages. In this context, hydrogenosomes and mitosomes appeared to be only two most extreme forms of mitochondrial continuum, functioning as aerobic, facultatively anaerobic, or anaerobic organelles. The unexpected versatility of mitochondria was found not only in energy metabolism that ranges from classical Krebs cycle and oxidative phosphorylation, via extended glycolysis to the complete loss of ATP synthesis, but also in the most conserved pathways mediating assembly of FeS (ISC). Although ISC pathway that was inherited from proteobacterial ancestor is present in the vast majority of mitochondria, there are organisms that were able to replace ISC with alternative nitrogen fixation system (NIF) or sulphur-mobilization proteins (SUF) during the course of adaptation to anaerobic environments. NIF system can operate in mitochondria and in the cytosol, which is a case of *Mastigamoeba balamuthi* or exclusively in the cytosol in related *Entamoeba histolytica*. Similarly, SUF proteins were suggested to reside in mitochondria and the cytosol of *Pygsuia biforma* and in the cytosol of *Monocercomonoides* sp. The cytosolic localization of the SUF pathway possibly enabled even the entire loss of mitochondria in the latter organism. In addition to hydrogenosomes and mitosomes, different names for mitochondria with peculiar biochemical properties were defined such as mitochondrion-related organelles in broad sense for mitochondria in anaerobic protists, anaerobic mitochondria that do not produce hydrogen, and hydrogen-producing mitochondria that retain membrane-associated electron transport chain. However, additional studies revealed more subtypes of mitochondria and a more complex mosaic of specific functions. For example, how to call mitochondria in *Dysnectes* that most likely produce hydrogen as hydrogenosomes but do not synthesize ATP as mitosomes? These discoveries gradually erode lines between defined mitochondrion subtypes, and perhaps it is time to call all these organelles simply mitochondria based on their common evolutionary origin.

We highly appreciate the efforts of all the authors who enthusiastically upgraded their original chapters or contributed with new chapters to this book. We believe that the second edition will provide comprehensive contemporary information to scientists with broad interest in biology as well as specialists in cell biology, protistology, and the evolution of eukaryotic cell.

Vestec, Czech Republic Jan Tachezy
Münster, Germany Alexander Steinbüchel
June 2019

Contents