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Preface

Mitochondrial complex III and related *bc*-complexes

A phenomenon of oxidant-induced reduction of cytochrome *b* has fascinated generations of scientists since its discovery by Britton Chance in the early 50s. This unusual biochemical reaction has turned out to be a key element of the protonmotive Q-cycle introduced by Peter Mitchell to explain general principles of the operation of the cofactor chains and the catalytic sites of enzymes belonging to the family of cytochrome *bc* complexes.

Decades of intensive biochemical and biophysical studies, the accessibility of site-directed mutagenesis in several bacterial and eukaryotic systems, the resolution of crystal structures of mitochondrial complex III, bacterial cytochrome bc_1, and cyanobacterial/algae cytochrome b_6f, have all contributed to in-depth structural and kinetic characterization of a number of *bc*-type complexes. This has greatly advanced our understanding of the molecular mechanism of reactions catalyzed by these enzymes, the way they function in living cells, and the physiological roles that they play. This knowledge now provides an outstanding working platform for advanced discussions on all aspects related to the operation of *bc*-type complexes that still remain to be exposed, characterized and understood.

A selection of review articles assembled in this special issue adds momentum to this discussion in presenting current views on what is known and remains unknown about the molecular engineering of energy conversion in the *bc*-type complexes. The articles combine our knowledge on eukaryotic and prokaryotic enzymes not only of the central family but also on the group of alternative complexes III that although structurally distant from the *bc*-complexes still perform the same function.

This issue is not intended to be comprehensive. Rather it aims to present a collection of many, but certainly not all, ideas to foster new ideas and inspire future research. The topics of the articles range from key aspects of the core structure–function relationships through the molecular mechanisms of quinone catalytic sites, also in relation to the formation of reactive oxygen species and their suppression/regulation, and finally they cover physiology and evolution of complex III and related complexes. Several controversial and hotly debated issues, such as a dimeric function of cytochrome bc_1, expose some of the future challenges for the field. Undoubtedly, as our thinking and methodology advances to better link physics/chemistry with physiology, these masterpieces of bioenergetic machinery will excite us with new discoveries at all levels.

I am privileged to have been invited by BBA—Bioenergetics to guest edit this Special Issue and must admit that it was my great pleasure to participate in this project together with all contributors. I would like to thank all the authors for their excellent writing as well as the reviewers for their help and expertise. I would also like to thank the publishing staff of BBA—Bioenergetics, in particular Sandra Tokashiki, for their great editorial assistance in preparing this issue.

Artur Osyczka is a professor in the Department of Molecular Biophysics at the Jagiellonian University in Kraków. His interest in natural engineering of bioenergetic systems started with his MSc thesis prepared in 1993 under the guidance of Professor Wojciech Froncisz at the Jagiellonian University. In 1996 he was awarded a Japanese Government (Monbusho) Scholarship to carry out doctoral studies on bacterial electron transfer chains in the group of Professor Katsumi Matsuura at Tokyo Metropolitan University. His PhD thesis (1999) described molecular interaction between soluble electron donors and the tetraheme cytochrome *c* subunit bound to photosynthetic reaction center. From 1999 till 2006 he worked with Professor P. Leslie Dutton at the University of Pennsylvania in Philadelphia, first as a post-doc and later as a research associate, studying molecular mechanism of energy conversion in cytochrome bc_1. In 2006 he was awarded an International Senior Research Fellowship from the Wellcome Trust and moved back to the Jagiellonian University to establish the Laboratory of Molecular Bioenergetics. His research aims at understanding the molecular mechanisms of operation of energy conserving systems from the physicochemical point of view and also in relation to cellular physiology. Currently, he focuses on enzymatic catalysis/regulation and electron/proton transfers in quinone oxidoreductases and on dynamics of protein–protein interactions in redox systems. The experimental approach combines molecular biology and biochemical and biophysical methods with emphasis on time-resolved optical and electron paramagnetic resonance spectroscopy.

Artur Osyczka
Dept. of Molecular Biophysics, Faculty of Biochemistry, Biophysics and Biotechnology, Jagiellonian University, ul. Gronostajowa 7, 30-387 Kraków, Poland
E-mail address: artur.osyczka@uj.edu.pl.

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