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Preface

AAA ATPases: Structure and function

Life depends on the activity of molecular "machines" that provide the driving force for common cellular processes. The AAA (ATPases associated with various cellular activities) family is a functionally diverse group of such dynamic proteins that are able to undergo conformational changes which can be transmitted to a wide range of substrate proteins. AAA proteins are defined by a structurally conserved ATPase domain that assembles into oligomeric rings and transforms chemical energy into conformational changes during cycles of nucleotide binding and hydrolysis. The AAA domain that defined the original AAA family has been considered in combination with structural information which has led to further members being added to what is now referred to as the AAA+ family. Over the past 20 years, about 30,000 AAA+ proteins have been identified throughout all kingdoms of life. The nucleotide-dependent conformational switch of the AAA-module may apply force to bound substrates and thereby allow the AAA+-proteins to unfold polypeptides, dissociate protein–protein or protein–DNA interactions, or to move microtubule motors. Thus, AAA+ proteins represent a broad class of mechanoenzymes that have evolved a unique molecular principle which is applied in many different biological settings.

In this special issue of BBA Molecular Cell Research on "Structure and Function of AAA Proteins", we review the features and motifs that define AAA proteins and discuss the role of AAA+-proteins in a wide variety of cellular functions. AAA+ proteins play important roles in numerous cellular activities, including proteolysis, protein folding, membrane trafficking, cytoskeleton stability, organelle biogenesis, gene expression, DNA replication, and intracellular motility. We describe these cellular activities mediated by selected AAA+ proteins and pay special attention to the question of how AAA+ proteins use conserved mechanistic principles to accomplish these diverse biological actions.

Dr. Ralf Erdmann is Professor and Chair of Physiological Chemistry at the Medical Faculty of the University of Bochum. He received his PhD in Biology in 1989 from the University of Bochum under the guidance of Dr. Wolf-Hubert Kunau. From 1991 to 1995 he joined the laboratory of Dr. Günter Blobel at the Howard Hughes Medical Institute of the Rockefeller University in New York as a postdoctoral fellow. In 1995, he moved to the University of Bochum as independent junior group leader. In 1998 he was appointed Associate Professor of Biochemistry at the Free University of Berlin until 2002 when he accepted his current position in Bochum. In 1991, he discovered that some ATPases of different function are characterized by a novel conserved domain and group into a novel ATPase family, the AAA proteins. His research focuses on the biogenesis and function of peroxisomes.

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