

METHODS IN MOLECULAR BIOLOGY

Series Editor
John M. Walker
School of Life and Medical Sciences
University of Hertfordshire
Hatfield, Hertfordshire, AL10 9AB, UK

For further volumes:
<http://www.springer.com/series/7651>

Protein Arginylation

Methods and Protocols

Edited by

Anna S. Kashina

*Department of Animal Biology, School of Veterinary Medicine, University of Pennsylvania,
Philadelphia, PA, USA*

 Humana Press

Editor

Anna S. Kashina
Department of Animal Biology
School of Veterinary Medicine
University of Pennsylvania
Philadelphia, PA, USA

ISSN 1064-3745 ISSN 1940-6029 (electronic)
Methods in Molecular Biology
ISBN 978-1-4939-2934-4 ISBN 978-1-4939-2935-1 (eBook)
DOI 10.1007/978-1-4939-2935-1

Library of Congress Control Number: 2015946756

Springer New York Heidelberg Dordrecht London
© Springer Science+Business Media New York 2015

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.

Printed on acid-free paper

Humana Press is a brand of Springer
Springer Science+Business Media LLC New York is part of Springer Science+Business Media (www.springer.com)

Preface

Posttranslational modifications are pivotal regulators of virtually every biological process and the major contributors to the complexity of functions in every physiological system. Arginylation—tRNA-mediated posttranslational addition of arginine to proteins—is a post-translational modification of emerging importance that affects an estimated 25 % of the cellular proteome and is critical for multiple aspects of embryogenesis and the functioning of an adult organism. The intent of this book is to present a comprehensive overview of all the existing methods on analyzing protein arginylation, from the early methods utilizing crude protein preparations and whole-cell assays to the latest advanced methods involving recombinant protein techniques, antibodies, high precision mass spectrometry, and chemical probes. The book also includes essays from the founders of the field, who originally discovered arginylation in the early 1960s and brought it to international recognition. We hope that this book would be of interest not only to the emerging body of scientists involved in the studies of posttranslational arginylation but also to the rapidly growing community of researchers working on a broad range of posttranslational modifications, analysis of which often meets similar challenges and utilizes similar principles as posttranslational arginylation.

Philadelphia, PA, USA

Anna S. Kashina

Contents

<i>Preface</i>	<i>v</i>
<i>Contributors</i>	<i>ix</i>
1 Protein Arginylation: Over 50 Years of Discovery <i>Anna S. Kashina</i>	1
2 Recollection of How We Came Across the Protein Modification with Amino Acids by Aminoacyl tRNA-Protein Transferase <i>Hideko Kaji and Akira Kaji</i>	13
3 Arginyltransferase: A Personal and Historical Perspective <i>Richard L. Soffer</i>	19
4 Arginylation in a Partially Purified Fraction of 150k \times g Supernatants of Axoplasm and Injured Vertebrate Nerves <i>Nicholas A. Ingolia</i>	25
5 Preparation of ATE1 Enzyme from Native Mammalian Tissues <i>Anna S. Kashina</i>	33
6 Correlated Measurement of Endogenous ATE1 Activity on Native Acceptor Proteins in Tissues and Cultured Cells to Detect Cellular Aging <i>Hideko Kaji and Akira Kaji</i>	39
7 Assaying the Posttranslational Arginylation of Proteins in Cultured Cells <i>Mauricio R. Galiano and Marta E. Hallak</i>	49
8 Assaying ATE1 Activity in Yeast by β -Gal Degradation <i>Anna S. Kashina</i>	59
9 Bacterial Expression and Purification of Recombinant Arginyltransferase (ATE1) and Arg-tRNA Synthetase (RRS) for Arginylation Assays <i>Junling Wang and Anna S. Kashina</i>	67
10 Assaying ATE1 Activity In Vitro <i>Junling Wang and Anna S. Kashina</i>	73
11 High-Throughput Arginylation Assay in Microplate Format <i>Sougata Saha, Junling Wang, and Anna S. Kashina</i>	79
12 Assay of Arginyltransferase Activity by a Fluorescent HPLC Method <i>Koichi Takao</i>	83
13 Identification of Arginylated Proteins by Mass Spectrometry <i>Anna S. Kashina and John R. Yates III</i>	93
14 Analysis of Arginylated Peptides by Subtractive Edman Degradation <i>Anna S. Kashina and John R. Yates III</i>	105

15	Transferase-Mediated Labeling of Protein N-Termini with Click Chemistry Handles.	109
	<i>Anne M. Wagner, John B. Warner, Haviva E. Garrett, Christopher R. Walters, and E. James Petersson</i>	
16	Applying Arginylation for Bottom-Up Proteomics.	129
	<i>H. Alexander Ebbhardt</i>	
17	Development of New Tools for the Studies of Protein Arginylation	139
	<i>Anna S. Kashina</i>	
	<i>Index</i>	147

Contributors

- H. ALEXANDER EBHARDT • *Institute of Molecular Systems Biology, Eidgenössische Technische Hochschule (ETH) Zürich, Zürich, Switzerland*
- MAURICIO R. GALIANO • *Centro de Investigaciones en Química Biológica de Córdoba, CIQUIBIC, (UNC-CONICET), Departamento de Química Biológica, Universidad Nacional de Córdoba, Córdoba, Argentina*
- HAVIVA E. GARRETT • *Department of Chemistry, University of Pennsylvania, Philadelphia, PA, USA*
- MARTA E. HALLAK • *Centro de Investigaciones en Química Biológica de Córdoba, CIQUIBIC, (UNC-CONICET), Departamento de Química Biológica, Universidad Nacional de Córdoba, Córdoba, Argentina*
- NICHOLAS A. INGOGLIA • *Department of Pharmacology & Physiology, UMDNJ—New Jersey Medical School, Rutgers School of Biomedical Health Science, Newark, NJ, USA*
- AKIRA KAJI • *Department of Microbiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA*
- HIDEKO KAJI • *Department of Biochemistry and Molecular Biology, Jefferson Medical College, Thomas Jefferson University, Philadelphia, PA, USA*
- ANNA S. KASHINA • *Department of Animal Biology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA, USA*
- E. JAMES PETERSSON • *Laboratory of Chemical Biology, Department of Chemistry, University of Pennsylvania, Philadelphia, PA, USA*
- SOUGATA SAHA • *Department of Molecular Biology and Biotechnology, Tezpur University, Sonitpur, Assam, India*
- RICHARD L. SOFFER • *Weill Medical College, Cornell University, New York, NY, USA*
- KOICHI TAKAO • *Faculty of Pharmaceutical Sciences, Josai University, Sakado, Saitama, Japan*
- ANNE M. WAGNER • *Department of Chemistry, University of Pennsylvania, Philadelphia, PA, USA*
- CHRISTOPHER R. WALTERS • *Department of Chemistry, University of Pennsylvania, Philadelphia, PA, USA*
- JUNLING WANG • *Department of Animal Biology, University of Pennsylvania, Philadelphia, PA, USA*
- JOHN B. WARNER • *Department of Chemistry, University of Pennsylvania, Pennsylvania, PA, USA*
- JOHN R. YATES III • *Department of Chemical Physiology, The Scripps Research Institute, La Jolla, CA, USA*