Molecular Biology Intelligence Unit

CAPACITATIVE CALCIUM ENTRY

James W. Putney, Jr., Ph.D.

Laboratory of Signal Transduction National Institute of Environmental Health Sciences Research Triangle Park, North Carolina, U.S.A.



Springer New York Berlin Heidelberg London Paris Tokyo Hong Kong Barcelona Budapest

R.G. LANDES COMPANY AUSTIN

MOLECULAR BIOLOGY INTELLIGENCE UNIT

CAPACITATIVE CALCIUM ENTRY F 3 6/144 R.G. LANDES CONTAINE Austin, Texas, U.S. Anno-Hohn-Bibliothek biophysikelische Chemie

International Copyright © 1997 Springer-Verlag, Heidelberg, Germany 97/161

All rights reserved.

No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the publisher. Printed in the U.S.A.

Please address all inquiries to the Publishers: R.G. Landes Company, 810 S. Church Street, Georgetown, Texas, U.S.A. 78626 Phone: 512/ 863 7762; FAX: 512/ 863 0081

International distributor (except North America): Springer-Verlag GmbH & Co. KG Tiergartenstrasse 17, D-69121 Heidelberg, Germany

Springer

International ISBN: 3-540-62483-X

While the authors, editors and publisher believe that drug selection and dosage and the specifications and usage of equipment and devices, as set forth in this book, are in accord with current recommendations and practice at the time of publication, they make no warranty, expressed or implied, with respect to material described in this book. In view of the ongoing research, equipment development, changes in governmental regulations and the rapid accumulation of information relating to the biomedical sciences, the reader is urged to carefully review and evaluate the information provided herein.

Library of Congress Cataloging-in-Publication Data

Putney, James W.

Capacitative calcium entry/ by James W. Putney

p. cm. — (Medical intelligence unit)

Includes bibliographical references and index.

ISBN 0-57059-431-7 (alk. paper)

 Calcium—Physiological transport. 2. Calcium channels. 3. Cellular signal transduction. I. Title. II. Series. [DNLM: 1. Calcium—metabolism. 2. Calcium Channels. 3. Electric Conductivity. 4. Cell Membrane—physiology. 5. Signal Transduction—physiology. QV 276 P993c 1997]

QP535.C2P88 1997 572'.516—dc21 DNLM/DLC for Library of Congress

96-52387 CIP

CONTENTS =

1.	General Aspects of Calcium Signaling1
	The Concept of Calcium as a Cellular Signal 1
	Measurement of Cellular Calcium Levels and Movements
	Calcium Stores, Calcium Pools
	The Phosphoinositide Story
	(1,4,5)IP ₃ Receptors and Intracellular Ca ²⁺ Release
	Metabolism of Inositol Phosphates
	Calciosomes
	Intracellular Calcium Oscillations
	Freitable ve Nonevoitable Celle
	Excitable vs. Nonexcitable Cells
	Concluding Remarks
2.	Capacitative Calcium Entry
	Biphasic Calcium Signaling
	The Capacitative Model is Proposed
	Proofs of the Capacitative Model: Calcium "Overshoot," Thapsigargin
	and Mn ²⁺ Quench
	The Pathway for Calcium Entry
	The Falliway for Calcium Entry
3.	The Signal for Capacitative Calcium Entry77
	Conformational Coupling77
	Evidence Against Conformational Coupling
	Evidence for a Diffusible Messenger for Capacitative Calcium Entry 85
	Calcium as a Signal for Calcium Entry
	Calcium Influx Factor (CIF)
	Metabolites of Cytochrome P-450
	Cyclic GMP
	(1,3,4,5)IP ₄
	$\begin{array}{c} (19,71,9)\Pi_4 \\ \text{Tyrosine Kinase} \\ 100 \end{array}$
	G-Protein(s)
	Conclusions
4.	Electrophysiology and Regulation of Capacitative
	Calcium Entry
	Properties of I _{crac}
	Single Channels?
	Regulation of Capacitative Ca ²⁺ Entry Channels
	by Feedback Inhibition
	Regulation of Capacitative Ca ²⁺ Entry Channels
	by Protein Phosphorylation
	Conclusions
	Conclusions

Entry Channels	
Drosophila <i>trp</i> and <i>trpl</i>	
Functional Studies of Expressed trp and trpl	
Mammalian Homologs of trp	
Expression of Mammalian trps	
A plasma Membrane (1,4,5)IP ₃ Receptor	
Conclusions	
5. Physiological, Pharmacological and Pathologica of Capacitative Calcium Entry	17
of Capacitative Calcium Entry Physiological Functions of Capacitative Calcium Ent	17 ry—Short Térm
of Capacitative Calcium Entry	17 ry—Short Térm
of Capacitative Calcium Entry Physiological Functions of Capacitative Calcium Ent	
of Capacitative Calcium Entry Physiological Functions of Capacitative Calcium Ent Responses	
of Capacitative Calcium Entry Physiological Functions of Capacitative Calcium Ent Responses Physiological Functions of Capacitative Calcium Ent	
of Capacitative Calcium Entry Physiological Functions of Capacitative Calcium Ent Responses Physiological Functions of Capacitative Calcium Ent Responses	
of Capacitative Calcium Entry Physiological Functions of Capacitative Calcium Ent Responses Physiological Functions of Capacitative Calcium Ent Responses Pharmacology of Capacitative Calcium Entry	

..