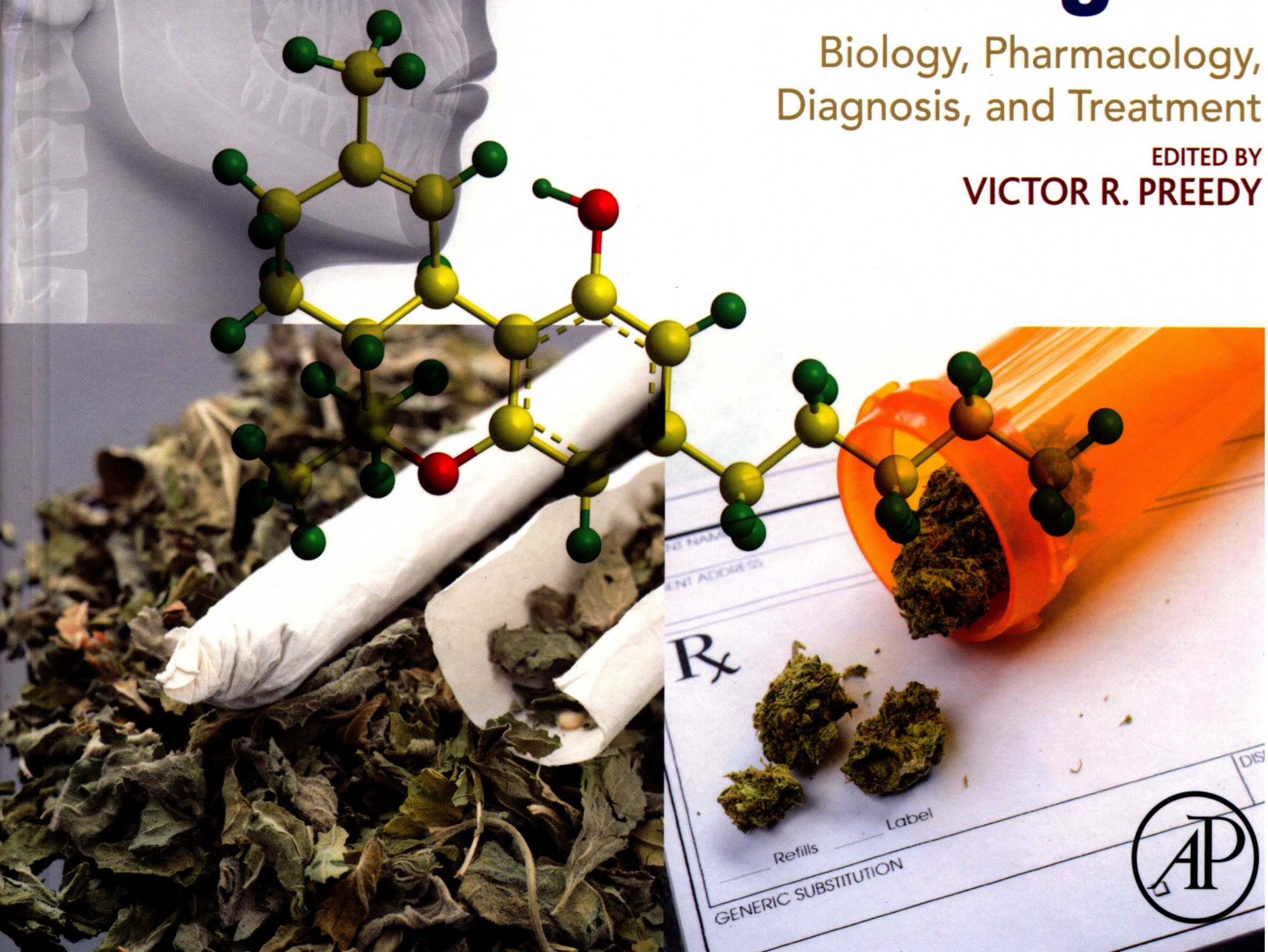


Handbook of **Cannabis and Related Pathologies**

Biology, Pharmacology,
Diagnosis, and Treatment

EDITED BY
VICTOR R. PREEDY



HANDBOOK OF CANNABIS AND RELATED PATHOLOGIES

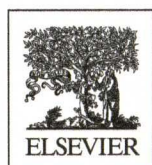
BIOLOGY, PHARMACOLOGY,
DIAGNOSIS, AND TREATMENT

Edited by

V.R. PREEDY

BSc, PhD, DSc, FRSB, FRSH, FRIPHH, FRSPH, FRCPATH, FRSC

*Faculty of Life Sciences and Medicine,
King's College London, London, United Kingdom*



ACADEMIC PRESS

An imprint of Elsevier
elsevier.com

Academic Press is an imprint of Elsevier
125 London Wall, London EC2Y 5AS, United Kingdom
525 B Street, Suite 1800, San Diego, CA 92101-4495, United States
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

Copyright © 2017 Elsevier Inc. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

ISBN: 978-0-12-800756-3

For information on all Academic Press publications
visit our website at <https://www.elsevier.com/>



Working together
to grow libraries in
developing countries

www.elsevier.com • www.bookaid.org

Publisher: Mara Conner
Acquisitions Editor: April Farr
Editorial Project Manager: Timothy Bennett
Production Project Manager: Chris Wortley
Designer: Mark Rogers

Typeset by Thomson Digital

HANDBOOK OF
CANNABIS AND
RELATED
PATHOLOGIES



ELSEVIER
*science &
technology books*

Companion Web Site:

<http://store.elsevier.com/product.jsp?&isbn=9780128007563>

Handbook of Cannabis and Related Pathologies

V.R. Preedy, Editor

Available Resources:

20 additional chapters are available online - see contents list.



TOOLS FOR ALL YOUR TEACHING NEEDS
textbooks.elsevier.com



ACADEMIC
PRESS

To adopt this book for course use, visit <http://textbooks.elsevier.com>.

List of Contributors

M. Aas NORMENT, KG Jebsen Centre for Psychosis Research, Division of Mental Health and Addiction, Oslo University Hospital & Institute of Clinical Medicine, University of Oslo, Oslo, Norway

R. Abalo Area of Pharmacology and Nutrition, Faculty of Health Sciences, University Rey Juan Carlos, Alcorcón; Associated Unit I+D+i of the Institute of Medicinal Chemistry (IQM) and of the Institute of Research in Food Sciences (CIAL), Spanish National Research Council (CSIC), Madrid, Spain

O.M.E. Abdel-Salam Department of Toxicology and Narcotics, National Research Centre, Dokki, Greater Cairo, Egypt

V.C. Abilio Department of Pharmacology, Federal University of Sao Paulo; Integrated Laboratory of Clinical Neurosciences (LiNC), Federal University of Sao Paulo, Sao Paulo, Brazil

G.R. Adelli Department of Pharmaceutics and Drug Delivery, School of Pharmacy, University of Mississippi, Oxford, MS, United States

M.H. Ahmed Department of Medicinal Chemistry, School of Pharmacy and Institute for Structural Biology and Drug Discovery, Virginia Commonwealth University, Richmond, VA, United States

M. Alhouayek Bioanalysis and Pharmacology of Bioactive Lipids Research Group, Louvain Drug Research Institute, Université catholique de Louvain, Brussels, Belgium

J. Allen Psychology Department, IKBSAS, University of British Columbia, Kelowna, BC, Canada

D.J. Allsop Psychopharmacology Laboratory, School of Psychology, University of Sydney, Sydney, NSW, Australia

R.C. Almada Laboratory of Neuroanatomy & Neuropsychobiology, Department of Pharmacology, Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP), Ribeirão Preto, São Paulo, Brazil

V. Almeida Department of Pharmacology, Federal University of Sao Paulo; Integrated Laboratory of Clinical Neurosciences (LiNC), Federal University of Sao Paulo, Sao Paulo, Brazil

A. Aloway Department of Pharmacology and Toxicology, University of Louisville School of Medicine, Louisville, KY, United States

S. Amanullah Woodstock General Hospital, Woodstock, ON, Canada; School of Medicine, University of Western Ontario, London, ON, Canada; and Faculty of Medicine, Dalhousie University, NS, Canada

S.L. Ames School of Community and Global Health, Claremont Graduate University, Claremont, CA, United States

B. Annaheim Institute for Biomedical Ethics (IBMB), University of Basel, Basel, Switzerland

G. Appendino Department of Pharmaceutical Science, University of Piemonte Orientale, Novara, Italy

H. Aramaki Department of Molecular Biology, Daiichi University of Pharmacy; Drug Innovation Research Center, Daiichi University of Pharmacy, Fukuoka, Japan

F. Arias-Horcajadas Psychiatric Department, Doce de Octubre Hospital, Madrid, Spain

C. Ariza Evaluation and Intervention Methods Service, Public Health Agency, Barcelona, Spain

J.C. Arnold School of Medicine, Western Sydney University, Campbelltown; University of Sydney, Department of Pharmacology, Bosch Institute, Sydney; Brain and Mind Research Institute, Camperdown, NSW, Australia

D. Asmaro Department of Psychology, Simon Fraser University, Burnaby, BC, Canada

V. Auwärter Department of Drug Abuse Research, Division of Forensic Sciences, Norwegian Institute of Public Health, Oslo, Norway; Forensic Toxicology Department, Medical Center, University of Freiburg, Institute of Forensic Medicine, Freiburg, Germany

S. Bachmann Clenia AG, Littenheid, Switzerland

A. Baker Priority Research Centre for Translational Neuroscience and Mental Health, University of Newcastle, Callaghan, NSW, Australia

R.E. Balter Division on Substance Abuse, New York State Psychiatric Institute and Department of Psychiatry, Columbia University Medical Center, New York, NY, United States

P.G. Baraldi Department of Chemistry and Pharmaceutical Science, University of Ferrara, Ferrara, Italy

P.A. Barber Department of Medicine, Centre for Brain Research, University of Auckland, Auckland, New Zealand

G. Bar-Sela Division of Oncology, Rambam Health Care Campus and Faculty of Medicine, Technion—Israel Institute of Technology, Haifa, Israel

L. Bastiani Institute of Clinical Physiology, The Italian National Research Council (IFC-CNR), Pisa, Italy

D. Basu Drug De-addiction and Treatment Centre, Department of Psychiatry, Postgraduate Institute of Medical Education and Research, Chandigarh, India

I. Basurte Gregorio Marañón Hospital, Madrid, Spain

O. Beck Department of Laboratory Medicine, Section of Clinical Pharmacology, Karolinska Institutet, Stockholm, Sweden

S. Behrendt Institute of Clinical Psychology and Psychotherapy, Technische Universität Dresden, Dresden, Germany

D. Bergen-Cico Department of Public Health, Addiction Studies, Syracuse University, Syracuse, NY, United States

- F. Berrendero** Department of Experimental and Health Sciences, Laboratory of Neuropharmacology, School of Health and Life Sciences, Pompeu Fabra University, Barcelona, Spain
- P. Bhagav** Department of Pharmaceutics and Drug Delivery, School of Pharmacy, University of Mississippi, Oxford, MS, United States
- S. Bhattacharyya** Department of Psychosis Studies, King's College London, Institute of Psychiatry, Psychology & Neuroscience, London, United Kingdom
- M. Bioque** Barcelona Clínic Schizophrenia Unit, Hospital Clínic de Barcelona, Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Barcelona, Spain
- S. Bolkent** Department of Medical Biology, Cerrahpasa Faculty of Medicine, Istanbul University, Istanbul, Turkey
- J.H. Boman IV** Department of Criminal Justice, University of Wyoming, Laramie, WY, United States
- P. Bondallaz** Traffic Medicine and Psychology Unit, University Center of Legal Medicine, University Hospital of Geneva, Geneva, Switzerland
- U. Bonnet** Department of Psychiatry, Psychotherapy and Psychosomatics, Evangelisches Krankenhaus Castrop-Rauxel, Academic Teaching Hospital of the University of Duisburg-Essen, Castrop-Rauxel, Germany
- R.S. Borges** Faculty of Pharmacy, Institute of Health Sciences, Federal University of Pará, Belém, Para, Brazil
- K. Borowiak** Department of Clinical and Forensic Toxicology, Pomeranian Medical University, Szczecin, Poland
- I. Boschi** Public Health Institute, Department of Forensic Medicine, Università Cattolica del Sacro Cuore, Rome, Italy
- L.K. Brents** Brain Imaging Research Center, Psychiatric Research Institute, University of Arkansas for Medical Sciences, Little Rock, AR, United States
- C.H. Bridts** Faculty of Medicine and Health Science, Department of Immunology-Allergology-Rheumatology, University of Antwerp, Antwerp, Belgium
- A. Bruno** Department of Biomedical, Dental Sciences and Morpho-functional Imaging, University of Messina, Messina, Italy
- B.T. Burrows** Department of Psychology, Arizona State University, Tempe, AZ, United States
- G.F. Busatto** Department of Psychiatry, Faculty of Medicine, Laboratory of Psychiatric Neuroimaging (LIM-21), University of São Paulo; Center for Interdisciplinary Research on Applied Neurosciences (NAPNA), University of São Paulo, São Paulo, Brazil
- R.C. Callaghan** Northern Medical Program, University of Northern British Columbia, Prince George, BC; Dalla Lana School of Public Health, University of Toronto, Toronto, ON; Human Brain Lab, Centre for Addiction and Mental Health, Toronto, ON, Canada
- A.C. Campos** Department of Pharmacology, Faculty of Medicine of Ribeirão Preto, University of São Paulo, Ribeirão Preto, São Paulo, Brazil
- U.M. Camsari** Department of Psychiatry and Psychology, Mayo Clinic Health System, and Mayo Clinic College of Medicine, Rochester, MN, United States
- A. Canfield** University of Toronto, Toronto, ON, Canada
- E. Carra** Department of Psychosis Studies, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom
- F.-J. Carrillo-Salinas** Neurobiology and Functional Systems Department, Cajal Institute, CSIC, Madrid, Spain
- F. Cascini** Public Health Institute, Department of Forensic Medicine, Università Cattolica del Sacro Cuore, Rome, Italy
- M.P. Castelli** Department of Biomedical Sciences, Division of Neuroscience and Clinical Pharmacology, Cittadella Universitaria, Monserrato, CA, Italy
- S.O. Cawich** Department of Clinical Surgical Sciences, University of the West Indies, St. Augustine Campus, St Augustine, Trinidad and Tobago
- E.E. Cawston** Department of Pharmacology and Clinical Pharmacology, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand
- C. Cedro** Department of Biomedical, Dental Sciences and Morpho-functional Imaging, University of Messina, Messina, Italy
- M.H.N. Chagas** Department of Neurosciences and Behavior, Faculty of Medicine, Ribeirão Preto, University of São Paulo, Ribeirão Preto; Barretos School of Health Sciences, Dr. Paulo Prata, Barretos, São Paulo, Brazil
- C. Chen** Neuroscience Center of Excellence, School of Medicine, Louisiana State University Health Sciences Center, New Orleans, LA, United States
- C. Chisari** University of York, York, United Kingdom
- H. Chtioui** Department of Clinical Pharmacology and Toxicology, University Hospital of Lausanne, Lausanne, Switzerland
- R.D. Cico** Columbia University, New York, NY, United States
- I.A. Ciechomska** Laboratory of Molecular Neurobiology, Neurobiology Center, Nencki Institute of Experimental Biology, Warsaw, Poland
- N.C. Coimbra** Laboratory of Neuroanatomy & Neuropsychobiology, Department of Pharmacology, Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP); Neurobiology of Emotions Research Centre (NAP-USP-NuPNE), Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP), Ribeirão Preto, São Paulo, Brazil
- J. Cole** Queen Elizabeth Hospital, Charlottetown, PE, Canada
- J. Cookey** Department of Psychiatry, Dalhousie University, Halifax, NS, Canada
- J. Copeland** National Cannabis Prevention and Information Centre, University of New South Wales, Randwick, Sydney, NSW, Australia
- Z.M. Coskun** Department of Molecular Biology and Genetics, Faculty of Arts and Sciences, Istanbul Bilim University, Istanbul, Turkey

W.D. Crano Division of Behavioral and Organizational Sciences, School of Social Science, Policy and Evaluation, Claremont Graduate University, Claremont, CA, United States

J.A.S. Crippa Department of Neuroscience and Behavior, Faculty of Medicine, Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil

C.E. Crocker Department of Psychiatry, Dalhousie University; Division of Neurology, Department of Medicine, Dalhousie University, Halifax, NS, Canada

M.J. Cuesta Department of Psychiatry, IdiSNA, Navarra Institute for Health Research, Pamplona, Spain

P.J. Cunha Department of Psychiatry, Faculty of Medicine, Laboratory of Psychiatric Neuroimaging (LIM-21), University of São Paulo; Center for Interdisciplinary Research on Applied Neurosciences (NAPNA), University of São Paulo, São Paulo, Brazil

L. Cutando Department of Experimental and Health Sciences, Laboratory of Neuropharmacology, School of Health and Life Sciences, Pompeu Fabra University, Barcelona, Spain

A.B.F. da Silva Institute of Chemistry of São Carlos, University of São Paulo, São Carlos, São Paulo, Brazil

J.A. da Silva Laboratory of Neuroanatomy & Neuropsychobiology, Department of Pharmacology, Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP), Ribeirão Preto, São Paulo, Brazil

V.K. da Silva Neurobiology and Developmental Biology Laboratory, Faculty of Biosciences, Pontifical Catholic University, Porto Alegre, Rio Grande do Sul, Brazil

D. Dan Department of Clinical Surgical Sciences, University of the West Indies, St. Augustine Campus, St Augustine, Trinidad and Tobago

R.B. De Boni INI Evandro Chagas, FIOCRUZ, Rio de Janeiro, Rio de Janeiro, Brazil

F. Rodríguez de Fonseca Department of Psychobiology, Faculty of Psychology, Complutense University of Madrid, Pozuelo de Alarcón, Madrid, Spain

R. Gómez de Heras Department of Psychobiology, Faculty of Psychology, Complutense University of Madrid, Pozuelo de Alarcón, Madrid, Spain

A.C.P. de Oliveira Department of Pharmacology, ICB, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

A.C. de Souza Crippa Health Sciences Sector, Federal University of Paraná, Curitiba, Parana, Brazil

J.A. de Souza Crippa Department of Neuroscience and Behavior, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, São Paulo, Brazil

F. Degenhardt Laboratory of Technical Biochemistry, Department of Biochemical and Chemical Engineering, TU Dortmund University, Dortmund, Germany

L. Degenhardt National Drug and Alcohol Research Centre, University of New South Wales, Sydney, NSW, Australia

S. Deiana CNS Diseases Research Department, Boehringer Ingelheim Pharma GmbH & Co. KG, Birkendorfer Straße, Biberach an der Riss, Germany

U. Deonaraine Department of Clinical Surgical Sciences, University of the West Indies, St. Augustine Campus, St Augustine, Trinidad and Tobago

M. Di Forti Department of Psychosis Studies, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom

T. dos Anjos-Garcia Laboratory of Neuroanatomy & Neuropsychobiology, Department of Pharmacology, Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP), Ribeirão Preto, São Paulo, Brazil

R. Guimarães dos Santos Department of Neuroscience and Behavior, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, São Paulo, Brazil

M. Drozd Department of Pharmaceuticals, Medical University of Lublin, Lublin, Poland

F.L.S. Duran Department of Psychiatry, Faculty of Medicine, Laboratory of Psychiatric Neuroimaging (LIM-21), University of São Paulo; Center for Interdisciplinary Research on Applied Neurosciences (NAPNA), University of São Paulo, São Paulo, Brazil

M. Earleywine Department of Psychology, School of Arts and Sciences, University at Albany, State University of New York, Albany, NY, United States

D.G. Ebo Faculty of Medicine and Health Science, Department of Immunology-Allergology-Rheumatology, University of Antwerp, Antwerp, Belgium

N. Egashira Department of Pharmacy, Kyushu University Hospital; Department of Neuropharmacology, Faculty of Pharmaceutical Sciences, Fukuoka University, Fukuoka, Japan

J. Egnatios School of Medicine, University of California San Diego, La Jolla, CA, United States

A. Ellert-Miklaszewska Laboratory of Molecular Neurobiology, Neurobiology Center, Nencki Institute of Experimental Biology, Warsaw, Poland

S.A. ElShebiny Department of Toxicology and Narcotics, National Research Centre, Cairo, Egypt

M.A. ElSohly ElSohly Laboratories Inc., Oxford, MS, United States

C. Evren Research, Treatment and Training Center for Alcohol and Substance Dependence (AMATEM), Bakirkoy Training and Research Hospital for Psychiatry, Neurology and Neurosurgery, Istanbul, Turkey

L. Fañanás Faculty of Biology, Anthropology Unit, Department of Animal Biology, University of Barcelona, Biomedicine Institute of the University of Barcelona (IBUB), Barcelona; CIBER of Mental Health (CIBERSAM), Madrid, Spain

M.M. Faber Faculty of Medicine and Health Science, Department of Immunology-Allergology-Rheumatology, University of Antwerp, Antwerp, Belgium

S. Farag Technical University Dortmund, Technical Biochemistry Dortmund, Dortmund, Germany

- A. Farré** Dual Disorder Unit, Addiction Program, Institute of Neuropsychiatry and Addiction—INAD, and Hospital del Mar Medical Research Institute—IMIM, Barcelona, Spain
- M. Farré** Clinical Pharmacology Unit, Germans Trias i Pujol University Hospital—IGTP, and Human Pharmacology Unit, Hospital del Mar Medical Research Institute—IMIM, and Autonomous University of Barcelona, Barcelona, Spain
- M. Fatjó-Vilas** Faculty of Biology, Anthropology Unit, Department of Animal Biology, University of Barcelona, Biomedicine Institute of the University of Barcelona (IBUB), Barcelona; CIBER of Mental Health (CIBERSAM), Madrid, Spain
- B. Favrat** Traffic Medicine and Psychology Unit, University Center of Legal Medicine, University Hospital of Geneva, Geneva; Department of Ambulatory Care and Community Medicine, University Hospital of Lausanne, Lausanne, Switzerland
- D. Feingold** Department of Psychiatry, Sheba Medical Center, Tel Hashomer; Ariel University, Ariel, Israel
- A. Feliú** Neurobiology and Functional Systems Department, Cajal Institute, CSIC, Madrid, Spain
- A.A. Fernández** Forensic Laboratory Institute of Legal Medicine of Catalonia, Barcelona, Spain
- S. Fernández-Artamendi** Addictive Behaviors Research Group, Department of Psychology, University of Oviedo, Oviedo, Spain
- A.J. Ferrari** School of Public Health, University of Queensland, Herston; Institute for Health Metrics and Evaluation, University of Washington, Seattle, WA, United States; Queensland Centre for Mental Health Research, Wacol, QLD, Australia
- L. Ferraro** Biomedical Department of Internal and Specialist Medicine; Department of Experimental Biomedicine and Clinical Neuroscience, School of Medicine, University of Palermo, Palermo, Italy
- J. Fichna** Department of Biochemistry, Faculty of Medicine, Medical University of Lodz, Lodz, Poland
- D.B. Finlay** Department of Pharmacology and Clinical Pharmacology, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand
- J. Fiz** EDIR, Center for Diagnosis and Rehabilitation, San Martín Santa Fe, Argentina
- Á. Flores** Department of Experimental and Health Sciences, Laboratory of Neuropharmacology, School of Health and Life Sciences, Pompeu Fabra University, Barcelona, Spain
- J.S. Fogel** Department of Psychology, University of Kentucky College of Arts and Sciences, Lexington, KY, United States
- E. Fornari** CIBM, University Hospital of Lausanne, Lausanne, Switzerland
- L. Fortunato** Institute of Clinical Physiology, The Italian National Research Council (IFC-CNR), Pisa, Italy
- T. Fyfe** Northern Medical Program, University of Northern British Columbia, Prince George, BC, Canada
- A.E.D.M. Gaafar** Department of Photochemistry, Chemical Industries Division, National Research Centre, Cairo, Egypt
- S. Gade** Palo Alto University, Palo Alto, CA, United States
- E. Gaffal** Laboratory of Experimental Dermatology, Department of Dermatology and Allergy, University Hospital of the Friedrich-Wilhelm-University Bonn, Bonn, Germany
- A.F. Galal** Department of Toxicology and Narcotics, National Research Centre, Cairo, Egypt
- R. Gandhi** Academic Department of Diabetes and Endocrinology, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom
- P. Gates** National Cannabis Prevention and Information Centre, University of New South Wales, Randwick, Sydney, NSW, Australia
- J.M. Gatlley** Northern Medical Program, University of Northern British Columbia, Prince George, BC; Dalla Lana School of Public Health, University of Toronto, Toronto, ON; Human Brain Lab, Centre for Addiction and Mental Health, Toronto, ON, Canada
- C. Giroud** Forensic Toxicology and Chemistry Unit, University Center of Legal Medicine, University Hospital of Lausanne, Lausanne, Switzerland
- M. Glass** Department of Pharmacology and Clinical Pharmacology, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand
- S.R. Goldberg** Preclinical Pharmacology Section, Behavioral Neuroscience Branch, Intramural Research Program, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States
- I. González-Ortega** Department of Psychiatry, University Hospital of Alava-Santiago, CIBERSAM; University of the Basque Country; National Distance Education University (UNED)-Centro Asociado de Vitoria, Vitoria, Spain
- A. González-Pinto** Department of Psychiatry, University Hospital of Alava-Santiago, CIBERSAM; University of the Basque Country, Vitoria, Spain
- C. Guaza** Neurobiology and Functional Systems Department, Cajal Institute, CSIC, Madrid, Spain
- V. Guillon** Service des enquêtes et des sondages, Paris, France
- F.S. Guimarães** Department of Pharmacology, Faculty of Medicine of Ribeirão Preto, University of São Paulo, Ribeirão Preto, São Paulo, Brazil
- W. Gul** ElSohly Laboratories Inc., Oxford, MS, United States
- F.M. Guven** Turkish Association for Cognitive and Behavioural Therapies, Istanbul; Department of Psychiatry, Alcohol & Substance Use Disorders Treatment Center, Lara Anatolia Hospital, Antalya, Turkey
- W.D. Hall** Centre for Youth Substance Abuse Research, University of Queensland, Herston, QLD, Australia
- J.E.C. Hallak** Department of Neuroscience and Behavior, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, São Paulo, Brazil
- M. Hamerle** Department of Psychiatry and Psychotherapy, Ludwig-Maximilian-University Hospital, Munich, Germany

- M. Haney** Division on Substance Abuse, New York State Psychiatric Institute and Department of Psychiatry, College of Physicians and Surgeons of Columbia University, New York, NY, United States
- H.E. Harding** Department of Surgery, University of the West Indies, Mona Campus, Kingston, Jamaica
- S. Hassan** Dalhousie University, Dartmouth, NS, Canada
- K. Haugland** National Criminal Investigation Service (NCIS) Norway, Forensic Science Department, Oslo, Norway
- A. Healey** School of Psychology, The University of Newcastle, University Drive, Callaghan, NSW, Australia
- C. Heck** City and County of Denver, Crime Prevention and Control Commission, Denver, CO, United States
- A. Helander** Department of Laboratory Medicine, Karolinska Institutet, and Karolinska University Laboratory, Stockholm, Sweden
- L. Hernandez-Folgado** Institute of Medical Chemistry, CSIC, Madrid, Spain
- D.A. Herzig** Clenia AG, Littenheid, Switzerland
- M. Hesse** Center for Alcohol and Drug Research, Aarhus University, Copenhagen Department, Copenhagen, Denmark
- M.G. Hill** The University of Arizona, Tucson, AZ, United States
- R. Hirst** Palo Alto University, Palo Alto, CA, United States
- C.R. Hjorthøj** Mental Health Center Copenhagen, Copenhagen University Hospital, Copenhagen, Denmark
- E. Hoch** Department of Psychiatry, Ludwig Maximilian University, Munich, Germany
- M.D. Holder** Psychology Department, IKBSAS, University of British Columbia, Kelowna, BC, Canada
- M. Holtkamp** Epilepsy-Center Berlin-Brandenburg, Department of Neurology, Charité – Universitätsmedizin Berlin, Berlin, Germany
- M.R. Hunter** Department of Pharmacology and Clinical Pharmacology, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand
- E. Ikeda** Department of Molecular Biology, Daiichi University of Pharmacy, Fukuoka, Japan
- Y. Izumi** Department of Psychiatry; The Taylor Family Institute for Innovative Psychiatric Research, Washington University School of Medicine, St. Louis, MO, United States
- T. Janus** Department of Clinical and Forensic Toxicology, Pomeranian Medical University, Szczecin, Poland
- B. Kaminska** Laboratory of Molecular Neurobiology, Neurobiology Center, Nencki Institute of Experimental Biology, Warsaw, Poland
- A.S. Kanaan** Clinic of Psychiatry, Social-Psychiatry and Psychotherapy, Hannover Medical School, Hannover; Nuclear Magnetic Resonance Unit, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
- R. Karinen** Norwegian Institute of Public Health, Division of Forensic Sciences, Oslo, Norway
- T. Karl** Neuroscience Research Australia, Randwick; School of Medicine, Western Sydney University, Campbelltown, NSW, Australia
- T. Katsu** Department of Pharmacy, Faculty of Pharmacy, Yasuda Women's University, Hiroshima, Japan
- F. Kay-Lambkin** NHMRC Centre for Research Excellence in Mental Health and Substance Use, National Drug and Alcohol Research Centre, University of New South Wales, Randwick, NSW, Australia
- O. Kayser** Technical University Dortmund, Technical Biochemistry Dortmund, Dortmund, Germany
- M. Kells** Division of Adolescent/Young Adult Medicine, Boston Children's Hospital, Boston, MA, United States
- B.C. Kelly** Department of Sociology, Purdue University, West Lafayette, IN, United States
- T.H. Kelly** Departments of Behavioral Science and Psychiatry, University of Kentucky College of Medicine, and Department of Psychology, University of Kentucky College of Arts and Sciences, Lexington, KY, United States
- A. Kokona** Department of Medical and Surgical Sciences, Bologna University, Bologna, Italy
- A. Kumar** Department of Pharmacology and Toxicology, University of Louisville School of Medicine, Louisville, KY, United States
- P. Kumar** Department of Pharmacology and Toxicology, University of Louisville School of Medicine, Louisville, KY, United States
- D. La Barbera** Department of Experimental Biomedicine and Clinical Neuroscience, School of Medicine, University of Palermo, Palermo, Italy
- T.V. Lagerberg** NORMENT KG Jebsen Centre for Psychosis Research, Institute of Clinical Medicine, University of Oslo; Division of Mental Health and Addiction, Oslo University Hospital, Oslo, Norway
- A. Lahat** Department of Gastroenterology, Chaim Sheba Medical Center, Tel-Hashomer, Israel
- H.J. Larsen** Mental Health Center Copenhagen, Copenhagen University Hospital, Copenhagen, Denmark
- A.S. Laun** Department of Pharmacology and Toxicology, University of Louisville School of Medicine, Louisville, KY, United States
- T. Lecomte** Research Centre of the University of Montreal Institute for Mental Health; Department of Psychology, University of Montreal, Montreal, QC, Canada
- S. Legleye** Institut national d'études démographiques (INED), Paris; University of Paris-Saclay, Univ. Paris-Sud, UVSQ, CESP, Inserm, Versailles, France
- S. Lev-Ran** Department of Psychiatry, Sheba Medical Center, Tel Hashomer; Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel
- J.A. Lile** Departments of Behavioral Science and Psychiatry, University of Kentucky College of Medicine, and Department of Psychology, University of Kentucky College of Arts and Sciences, Lexington, KY, United States

- R.P. Limberger** LABTOXICO: Laboratory of Toxicology, Faculty of Pharmacy, Federal University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil
- I.M.P. Linares** Department of Neuroscience and Behavior, Faculty of Medicine, Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil
- K.M. Lisdahl** Department of Psychology, University of Wisconsin-Milwaukee, Milwaukee, WI, United States
- M. Little** Center for Population Sciences, Department of Preventive Medicine, University of Tennessee Health Science Center, Memphis, TN, United States
- W. Liu** NORC at the University of Chicago, Bethesda, MD, United States
- M.J. Loflin** Department of Psychology, School of Arts and Sciences, University at Albany, State University of New York, Albany, NY, United States
- R. Lorente-Omeñaca** Department of Psychiatry, IdiSNA, Navarra Institute for Health Research, Pamplona, Spain
- V. Lorenzetti** Melbourne Neuropsychiatry Centre, The University of Melbourne and Melbourne Health, Melbourne; Brain & Mental Health Laboratory, Monash Institute of Cognitive and Clinical Neurosciences, School of Psychological Sciences, Monash University, Clayton, VIC, Australia
- D. Lu** Department of Pharmaceutical Sciences, Rangel College of Pharmacy, Texas A&M University, Kingsville, TX, United States
- J. Mørland** Department of Drug Abuse Research, Division of Forensic Sciences, Norwegian Institute of Public Health, Oslo, Norway
- K.R. Müller-Vahl** Clinic of Psychiatry, Social-Psychiatry and Psychotherapy, Hannover Medical School, Hannover, Germany
- A. Machoy-Mokrzyńska** Department of Pharmacology, Pomeranian Medical University, Szczecin, Poland
- P. Maeder** Department of Radiology, University Hospital of Lausanne, Lausanne, Switzerland
- S. Majumdar** Department of Pharmaceutics and Drug Delivery, School of Pharmacy, University of Mississippi, Oxford, MS, United States
- R. Maldonado** Department of Experimental and Health Sciences, Laboratory of Neuropharmacology, School of Health and Life Sciences, Pompeu Fabra University, Barcelona, Spain
- K.E. Maple** Department of Psychology, University of Wisconsin-Milwaukee, Milwaukee, WI, United States
- M. Martínez-Cengotitabengoa** Department of Psychiatry, University Hospital of Alava-Santiago, CIBERSAM; National Distance Education University (UNED)-Centro Asociado de Vitoria, Vitoria, Spain
- M. Isabel Martín-Fontelles** Area of Pharmacology and Nutrition, Faculty of Health Sciences, University Rey Juan Carlos, Alcorcón; Associated Unit I+D+i of the Institute of Medicinal Chemistry (IQM) and of the Institute of Research in Food Sciences (CIAL), Spanish National Research Council (CSIC), Madrid, Spain
- R. Martín-Santos** Department of Psychiatry and Psychology, Hospital Clinic, IDIBAPS, University of Barcelona, CIBERSAM, Barcelona, Spain
- K. Masuda** Department of Physical Chemistry, Graduate School of Clinical Pharmacy, Shujitsu University, Okayama, Japan
- A.L. McRae-Clark** Medical University of South Carolina, Charleston, SC, United States
- M. Mecha** Neurobiology and Functional Systems Department, Cajal Institute, CSIC, Madrid, Spain
- I. Melle** NORMENT, KG Jebsen Centre for Psychosis Research, Division of Mental Health and Addiction, Oslo University Hospital & Institute of Clinical Medicine, University of Oslo, Oslo, Norway
- S. Menaheem** Paediatric Cardiology Unit, Monash Health, Melbourne, Melbourne; Faculty of Medicine, Nursing and Health Sciences, Monash University, Clayton, VIC, Australia
- J. Mendes-Gomes** Laboratory of Neuroanatomy & Neuropsychobiology, Department of Pharmacology, Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP), Ribeirão Preto, São Paulo, Brazil
- B. Mesías** Instituto de Adicciones, Madrid, Spain
- S. Miller** Division of Behavioral and Organizational Sciences, School of Social Science, Policy and Evaluation, Claremont Graduate University, Claremont, CA, United States
- R. Mizrahi** Centre for Addiction and Mental Health (CAMH), Research Imaging Centre, Toronto, ON, Canada
- S. Molinaro** Institute of Clinical Physiology, The Italian National Research Council (IFC-CNR), Pisa, Italy
- C. Moore** Toxicology Research and Development, Immunalysis Corporation, Pomona, CA, United States
- M.F. Moraes** Department of Physiology and Biochemistry, ICB, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil
- F.A. Moreira** Department of Pharmacology, ICB, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil
- L. Moreno-Izco** Department of Psychiatry, IdiSNA, Navarra Institute for Health Research, Pamplona, Spain
- H.A. Morris** Department of Criminal Justice and Criminology, University of North Carolina at Charlotte, Charlotte, NC, United States
- E. Muñoz** Department of Cell Biology, Physiology and Immunology, University of Córdoba, Córdoba, Spain
- G.G. Muccioli** Bioanalysis and Pharmacology of Bioactive Lipids Research Group, Louvain Drug Research Institute, Université catholique de Louvain, Brussels, Belgium
- M.R.A. Muscatello** Department of Biomedical, Dental Sciences and Morpho-functional Imaging, University of Messina, Messina, Italy
- S.A. Nada** Department of Pharmacology, National Research Centre, Dokki, Greater Cairo, Egypt
- V. Naraynsingh** Department of Clinical Surgical Sciences, University of the West Indies, St. Augustine Campus, St Augustine, Trinidad and Tobago

- S. Narimatsu** Department of Health Chemistry, Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University, Okayama, Japan
- G. Nogueira-Filho** School of Health Sciences, University Salvador, Laureate International Universities, Salvador, Bahia, Brazil
- M. Nordentoft** Mental Health Center Copenhagen, Copenhagen University Hospital, Copenhagen, Denmark
- G. Oguz** Turkish Association for Cognitive and Behavioural Therapies, Istanbul; Department of Psychology, Canik Basari University, Samsun, Turkey
- Å.M.L. Øiestad** Norwegian Institute of Public Health, Division of Forensic Sciences, Oslo, Norway
- E.L. Øiestad** Norwegian Institute of Public Health, Division of Forensic Sciences, Oslo, Norway
- H. Okazaki** Drug Innovation Research Center, Daiichi University of Pharmacy, Fukuoka, Japan
- M.F. Olive** Department of Psychology, Arizona State University, Tempe, AZ, United States
- L. Orio** Department of Psychobiology, Faculty of Psychology, Complutense University of Madrid, Pozuelo de Alarcón, Madrid, Spain
- A. Ozaita** Department of Experimental and Health Sciences, Laboratory of Neuropharmacology, School of Health and Life Sciences, Pompeu Fabra University, Barcelona, Spain
- A. Pérez** Evaluation and Intervention Methods Service, Public Health Agency, Barcelona, Spain
- G. Panagis** University of Crete, Department of Psychology, Laboratory of Behavioral Neuroscience, Rethymnon, Crete, Greece
- G. Pandolfo** Department of Biomedical, Dental Sciences and Morpho-functional Imaging, University of Messina, Messina, Italy
- L.V. Panlilio** Preclinical Pharmacology Section, Behavioral Neuroscience Branch, Intramural Research Program, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States
- K. Paquin** Research Centre of the University of Montreal Institute for Mental Health; Department of Psychology, University of Montreal, Montreal, QC, Canada
- P. Parakh** Department of Psychiatry, Ruby General Hospital, Kolkata, India
- L.A. Parker** Department of Psychology and Collaborative Neuroscience Program, University of Guelph, Guelph, ON, Canada
- V.B. Patel** University of Westminster, School of Life Sciences, Department of Biomedical Science, London, United Kingdom
- M. Pawson** Department of Sociology, The Graduate Center, City University of New York, New York, NY, United States
- F.F. Peres** Department of Pharmacology, Federal University of Sao Paulo; Integrated Laboratory of Clinical Neurosciences (LiNC), Federal University of Sao Paulo, Sao Paulo, Brazil
- H. Petras** American Institutes for Research, Washington, DC, United States
- F. Pollastro** Department of Pharmaceutical Science, University of Piemonte Orientale, Novara, Italy
- A. Porcu** Department of Biomedical Sciences, Division of Neuroscience and Clinical Pharmacology, Cittadella Universitaria, Monserrato, CA, Italy
- R. Potente** Institute of Clinical Physiology, The Italian National Research Council (IFC-CNR), Pisa, Italy
- D.E. Potter** Department of Pharmaceutical Sciences, Rangel College of Pharmacy, Texas A&M University, Kingsville, TX, United States
- S. Potvin** Research Centre of the University of Montreal Institute for Mental Health; Department of Psychiatry, Faculty of Medicine, University of Montreal, Montreal, QC, Canada
- C. Prats** Faculty of Biology, Anthropology Unit, Department of Animal Biology, University of Barcelona, Biomedicine Institute of the University of Barcelona (IBUB), Barcelona; CIBER of Mental Health (CIBERSAM), Madrid, Spain
- V.R. Preedy** Faculty of Life Sciences and Medicine, King's College London, London, United Kingdom
- R. Rajendram** Faculty of Life Sciences and Medicine, King's College London, London, United Kingdom
- L. Rathke** Palo Alto University, Palo Alto, CA, United States
- K.L. Reed** The University of Arizona, Tucson, AZ, United States
- M.A. Repka** Department of Pharmaceutics and Drug Delivery, School of Pharmacy, University of Mississippi, Oxford, MS, United States
- H. Rigter** Youth Interventions Foundation, Curium, Department of Child and Adolescent Psychiatry, Leiden University Medical Center, Leiden, The Netherlands
- E.M. Rock** Department of Psychology and Collaborative Neuroscience Program, University of Guelph, Guelph, ON, Canada
- H. Rohrbacher** Practice for Cognitive Behaviour Therapy, Munich, Germany
- P.G.P. Rosa** Department of Psychiatry, Faculty of Medicine, Laboratory of Psychiatric Neuroimaging (LIM-21), University of São Paulo; Center for Interdisciplinary Research on Applied Neurosciences (NAPNA), University of São Paulo, São Paulo, Brazil
- F. Sánchez-Martínez** Evaluation and Intervention Methods Service, Public Health Agency, Barcelona, Spain
- A.M. Sánchez-Torres** Department of Psychiatry, IdiSNA, Navarra Institute for Health Research, Pamplona, Spain
- M. Sałaga** Department of Biochemistry, Faculty of Medicine, Medical University of Lodz, Lodz, Poland
- V. Sabato** Faculty of Medicine and Health Science, Department of Immunology-Allergology-Rheumatology, University of Antwerp, Antwerp, Belgium
- A.N. Sanders** Department of Criminal Justice and Criminology, University of North Carolina at Charlotte, Charlotte, NC, United States

- L.C. Santos** Department of Psychiatry, Faculty of Medicine, Laboratory of Psychiatric Neuroimaging (LIM-21), University of São Paulo; Center for Interdisciplinary Research on Applied Neurosciences (NAPNA), University of São Paulo, São Paulo, Brazil
- M. Scalese** Institute of Clinical Physiology, The Italian National Research Council (IFC-CNR), Pisa, Italy
- M.S. Schaufelberger** Department of Psychiatry, Faculty of Medicine, Laboratory of Psychiatric Neuroimaging (LIM-21), University of São Paulo; Center for Interdisciplinary Research on Applied Neurosciences (NAPNA), University of São Paulo, São Paulo; Department of Neuroscience and Behavior, Faculty of Medicine, Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil
- N. Schröder** Neurobiology and Developmental Biology Laboratory, Faculty of Biosciences, Pontifical Catholic University, Porto Alegre, Rio Grande do Sul, Brazil
- G. Scimeca** Department of Biomedical, Dental Sciences and Morpho-functional Imaging, University of Messina, Messina, Italy
- R. Secades-Villa** Addictive Behaviors Research Group, Department of Psychology, University of Oviedo, Oviedo, Spain
- D. Selvarajah** Department of Human Metabolism, Medical School, University of Sheffield, Sheffield, United Kingdom
- O. Senormanci** Department of Psychiatry, Bülent Ecevit University School of Medicine, Zonguldak, Turkey
- K. Shivakumar** Health Sciences North, Department of Psychiatry, and Northern Ontario School of Medicine, Sudbury, ON, Canada
- L.A. Shrier** Division of Adolescent/Young Adult Medicine, Boston Children's Hospital, and Department of Pediatrics, Harvard Medical School, Boston, MA, United States
- V. Siciliano** Institute of Clinical Physiology, The Italian National Research Council (IFC-CNR), Pisa, Italy
- L. Sideli** Department of Experimental Biomedicine and Clinical Neuroscience, School of Medicine, University of Palermo, Palermo, Italy
- J.T. Siegel** Division of Behavioral and Organizational Sciences, School of Social Science, Policy and Evaluation, Claremont Graduate University, Claremont, CA, United States
- A.A. Sleem** Department of Pharmacology, National Research Centre, Dokki, Greater Cairo, Egypt
- J. Sobczyński** Department of Pharmaceutics, Medical University of Lublin, Lublin, Poland
- L. Sodos** Palo Alto University, Palo Alto, CA, United States
- N. Solowij** School of Psychology, University of Wollongong, Wollongong, NSW, Australia
- Z.-H. Song** Department of Pharmacology and Toxicology, University of Louisville School of Medicine, Louisville, KY, United States
- A.W. Stacy** School of Community and Global Health, Claremont Graduate University, Claremont, CA, United States
- F. Stehle** Laboratory of Technical Biochemistry, Department of Biochemical and Chemical Engineering, TU Dortmund University, Dortmund, Germany
- J.M. Stogner** Department of Criminal Justice and Criminology, University of North Carolina at Charlotte, Charlotte, NC, United States
- S. Sussman** Departments of Preventive Medicine and Psychology, and School of Social Work, Institute for Health Promotion and Disease Prevention Research, University of Southern California, Los Angeles, CA, United States
- W. Swift** NHMRC Centre for Research Excellence in Mental Health and Substance Use, National Drug and Alcohol Research Centre, University of New South Wales, Randwick, NSW, Australia
- N. Szerman** Gregorio Marañón Hospital, Madrid, Spain
- T. Tüting** Laboratory of Experimental Dermatology, Department of Dermatology and Allergy, University Hospital of the Friedrich-Wilhelm-University Bonn, Bonn, Germany
- M. Aghazadeh Tabrizi** Department of Chemistry and Pharmaceutical Science, University of Ferrara, Ferrara, Italy
- O. Taglialatela-Scafati** Department of Pharmacy, University of Napoli Federico II, Napoli, Italy
- R.N. Takahashi** Department of Pharmacology, CCB, Federal University of Santa Catarina, Florianópolis, Santa Catarina, Brazil
- S. Takeda** Laboratory of Xenobiotic Metabolism and Environmental Toxicology, Faculty of Pharmaceutical Sciences, Hiroshima International University (HIU), Kure, Hiroshima, Japan
- I. Tarricone** Department of Medical and Surgical Sciences, Bologna University; Department of Mental Health, Bologna, Italy
- D.P. Tashkin** Division of Pulmonary and Critical Care, Department of Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States
- T. Tellioglu** Brown University, Alpert Medical School, Substance Abuse Division, Rhode Island Hospital, Providence, RI, United States
- Z. Tellioglu** Brown University, Alpert Medical School, Rhode Island Hospital, Providence, RI, United States
- S. Tesfaye** Academic Department of Diabetes and Endocrinology, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom
- L. Thornton** NHMRC Centre for Research Excellence in Mental Health and Substance Use, National Drug and Alcohol Research Centre, University of New South Wales, Randwick, NSW, Australia
- B. Thylstrup** Center for Alcohol and Drug Research, Aarhus University, Copenhagen Department, Copenhagen, Denmark
- P.G. Tibbo** Department of Psychiatry, Dalhousie University, Halifax, NS, Canada
- G. Todd** School of Pharmacy and Medical Sciences, University of South Australia, Adelaide, SA, Australia

M. Torrens Addiction Program, Institute of Neuropsychiatry and Addiction—INAD, and Hospital del Mar Medical Research Institute—IMIM, Barcelona, Spain

J. Tsai Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States

H.-H. Tseng Centre for Addiction and Mental Health (CAMH), Research Imaging Centre, Toronto, ON, Canada; Department of Psychosis Studies, Institute of Psychiatry, King's College London, London, United Kingdom

A. Turner Priority Research Centre for Translational Neuroscience and Mental Health, University of Newcastle, Callaghan, NSW, Australia

S.S. Tuv Department of Drug Abuse Research, Division of Forensic Sciences, Norwegian Institute of Public Health, Oslo, Norway

F. Ullah Laboratory of Neuroanatomy & Neuropsychobiology, Department of Pharmacology, Ribeirão Preto Medical School of the University of São Paulo (FMRP-USP), Ribeirão Preto, São Paulo, Brazil

T. Van der Linden Department Drugs and Toxicology, National Institute of Criminalistics, Brussels, Belgium

A.L. Van Gasse Faculty of Medicine and Health Science, Department of Immunology-Allergology-Rheumatology, University of Antwerp, Antwerp, Belgium

P. Vega Instituto de Adicciones, Madrid, Spain

G. Vera Area of Pharmacology and Nutrition, Faculty of Health Sciences, University Rey Juan Carlos, Alcorcón; Associated Unit I+D+i of the Institute of Medicinal Chemistry (IQM) and of the Institute of Research in Food Sciences (CIAL), Spanish National Research Council (CSIC), Madrid, Spain

M. Verdichevski Northern Medical Program, University of Northern British Columbia, Prince George, BC, Canada

T.R. Vieira Sousa Center for Drug and Alcohol Research, Hospital de Clinicas de Porto Alegre, Federal University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil

L.R. Vilela Department of Pharmacology, ICB, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

V. Vindenes Department of Drug Abuse Research, Division of Forensic Sciences, Norwegian Institute of Public Health, Oslo, Norway

Z. Walsh Psychology Department, IKBSAS, University of British Columbia, Kelowna, BC, Canada

K. Watanabe Department of Hygienic Chemistry, Faculty of Pharmaceutical Sciences, Hokuriku University, Kanazawa; Pharmaceutical Education Support Center, Daichi University of Pharmacy, Fukuoka, Japan

L.R. Watterson Department of Psychology, Arizona State University, Tempe, AZ, United States

J.M. White School of Pharmacy and Medical Sciences, University of South Australia, Adelaide, SA, Australia

N.E. Wright Department of Psychology, University of Wisconsin-Milwaukee, Milwaukee, WI, United States

M. Yücel Melbourne Neuropsychiatry Centre, The University of Melbourne and Melbourne Health, Melbourne; Brain & Mental Health Laboratory, Monash Institute of Cognitive and Clinical Neurosciences, School of Psychological Sciences, Monash University, Clayton, VIC, Australia

I. Yamamoto Hokuriku University, Kanazawa, Japan

S. Yamaori Department of Pharmacy, Shinshu University Hospital, Matsumoto, Japan

A. Zalesky Melbourne Neuropsychiatry Centre, The University of Melbourne and Melbourne Health, Melbourne, VIC, Australia

D. Zalman Division of Oncology, Rambam Health Care Campus and Faculty of Medicine, Technion—Israel Institute of Technology, Haifa, Israel

J. Zhang Neuroscience Center of Excellence, School of Medicine, Louisiana State University Health Sciences Center, New Orleans, LA, United States

Y. Zhang Department of Medicinal Chemistry, School of Pharmacy and Institute for Structural Biology and Drug Discovery, Virginia Commonwealth University, Richmond, VA, United States

R. Zoccali Department of Biomedical, Dental Sciences and Morpho-functional Imaging, University of Messina, Messina, Italy

C.F. Zorumski Department of Psychiatry; The Taylor Family Institute for Innovative Psychiatric Research, Washington University School of Medicine, St. Louis, MO, United States

A.W. Zuardi Department of Neuroscience and Behavior, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, São Paulo, Brazil

Preface

Cannabis is probably one of the most commonly used drugs of misuse. It has a wide range of adverse effects including impairing learning and memory. At the same time, the medical use of cannabis has been advocated due to its ability to relieve pain as an example. Understanding the nature of the pleasure-seeking, disinhibition, and other effects have also paved the way for the specialized field of cannabis pharmacology. This includes elucidating the nature of cannabinoid receptors, which has led to the development of synthetic cannabinoid agonists. However, the aforementioned is a rather simplistic synopsis. The long-term use of cannabis may also increase the risk of schizophrenia, paranoia, and other psychoses. Its use can affect cells, organs, individuals, families, subcultures, groups, and communities. This is because the interrelationships between cannabis and individual components, diagnosis, screening, social and community effects, psychopathology, neuropathology, non-CNS effects, polydrug use, medicinal applications, treatments, and pharmacology are complex. Furthermore, although the active agents in cannabis are known, the individual steps between exposure by ingestion or inhalation and effects on cells and the body are multifactorial, and cut across many scientific disciplines. It is thus important to learn from these interrelationships to embrace a multidisciplinary approach to understand all the threads and ramifications of cannabis use, misuse, and applications. For example, some cellular mechanisms elucidated by studying one anatomical CNS component may also be relevant to other areas of the CNS, or other fields of cannabis toxicity and pharmacology. Another example relates to the impact of cannabis on social dysfunction, which may also be relevant to other psychosocial scenarios, or useful in devising new treatment strategies. An additional example relates to preclinical studies which may be relevant to understanding clinical pathologies, psychomorbidities, or therapeutic drugs. Unraveling these complex relationships is difficult, as there is a wide myriad of material related to cannabis. In simple terms, the material on cannabis use and misuse has hitherto been either scattered, diffused, or crosses different disciplines. These limitations are,

however, addressed in *The Handbook of Cannabis and Related Pathologies: Biology, Pharmacology, Diagnosis, and Treatment* which embraces all aspects of cannabis in a one-stop-shop approach. Where appropriate, positive aspects of cannabis and related metabolites are described.

The book is divided into eight major parts as follows:

1. Setting the Scene, Botanical, General, and International Aspects
2. Personal, Social, and Community Aspects of Cannabis Use
3. Cannabis, Behavior, Psychopathology, and Neuropathology
4. Cannabis, Organs, Tissues, and non-CNS Aspects
5. Pharmacology and Cellular Activities of Cannabinoids and Endocannabinoids
6. Effects of Specific Natural and Synthetic Cannabinoids
7. Medicinal Cannabis Use
8. Screening, Diagnosis, and Treatments

The Editor recognizes the difficulties in ascribing chapters to particular sections, and even their location within separate sections. This is because some chapters can be categorized in many ways. However, this issue is resolved with the excellent indexing carried out by Elsevier.

The Handbook of Cannabis and Related Pathologies: Biology, Pharmacology, Diagnosis, and Treatment transcends both multiple disciplinary and intellectual divides, as each chapter has:

- Key Facts
- Mini-Dictionary
- Summary Points

Finally, there is a chapter on Resources and Recommended Reading, suggested by some of the book's contributors.

The Handbook of Cannabis and Related Pathologies: Biology, Pharmacology, Diagnosis, and Treatment has been designed for those working in the field of cannabis and cannabinoids, drug abuse workers, neurologists, specialists in addictive behaviors, health scientists, public health and community workers, doctors,

pharmacologists, research scientists, and other specialists. The book is valuable as a personal reference book, and also for academic libraries that cover the domains of health sciences or addictions. Contributions are from leading national and international experts, including those from world renowned institutions. It is suitable

for undergraduates, postgraduates, lecturers, and academic professors.

**Professor V.R. Preedy, BSc, PhD, DSc,
FRSB, FRSH, FRIPHH, FRSPH, FRCPath, FRSC**
King's College London, London, United Kingdom

Contents

List of Contributors Preface

xv
xxv

9. Cannabis, Migration, and Psychosis Onset 79
A. KOKONA, I. TARRICONE, M. DI FORTI, E. CARRA

I

SETTING THE SCENE, BOTANICAL, GENERAL AND INTERNATIONAL ASPECTS

1. The *Cannabis* Plant: Botanical Aspects 3
S. FARAG, O. KAYSER
2. The Biosynthesis of Cannabinoids 13
F. DEGENHARDT, F. STEHLE, O. KAYSER
3. Increasing Plant Concentrations of THC and
Implications on Health Related Disorders 24
V. VINDENES, J. MØRLAND
4. Age as a Predictor of Cannabis Use 33
D. BERGEN-CICO, R.D. CICO
5. Lifetime Cannabis Use and Cognition
in Psychosis Spectrum Disorders 44
M.J. CUESTA, A.M. SÁNCHEZ-TORRES, R. LORENTE-OMENACA,
L. MORENO-IZCO
6. A Profile of Synthetic Cannabinoid Users 53
A.N. SANDERS, J.M. STOGNER
7. Dual Disorders in Cannabis Misuse 61
F. ARIAS-HORCAJADAS, N. SZERMAN, P. VEGA,
I. BASURTE, B. MESÍAS
8. Cannabis Use and Cognitive Function 70
C. EVREN

10. The Global Epidemiology and Disease
Burden of Cannabis Use and Dependence 89
L. DEGENHARDT, A.J. FERRARI, W.D. HALL
11. International Aspects of Cannabis Use
and Misuse: the Australian Perspective 101
D.J. ALLSOP, W.D. HALL
12. International Aspects of Cannabis Use
and Misuse: Egypt 110
O.M.E. ABDEL-SALAM, A.F. GALAL, S.A. ELSHEBINEY,
A.E.D.M. GAAFAR
13. Cannabis Body Packing: A Caribbean
Perspective 122
S.O. CAWICH, D. DAN, V. NARAYNSINGH

II

PERSONAL, SOCIAL AND COMMUNITY ASPECTS OF CANNABIS USE

14. Gender Differences in Cannabis
Use Disorders 131
R. SECADES-VILLA, S. FERNÁNDEZ-ARTAMENDI
15. The Role of Age in the Onset and Further
Development of Cannabis Use Disorders 138
S. BEHRENDT
16. Effects of Cannabis Use on Neurocognition
in Adolescents and Emerging Adults 151
N.E. WRIGHT, K.E. MAPLE, K.M. LISDAHL