

# Natural Product Reports

High impact, critical reviews in natural product research and related areas

[rsc.li/npr](https://rsc.li/npr)

The Royal Society of Chemistry is the world's leading chemistry community. Through our high impact journals and publications we connect the world with the chemical sciences and invest the profits back into the chemistry community.

## IN THIS ISSUE

ISSN 0265-0568 CODEN NPPRRDF 40(11) 1689–1810 (2023)



### Cover

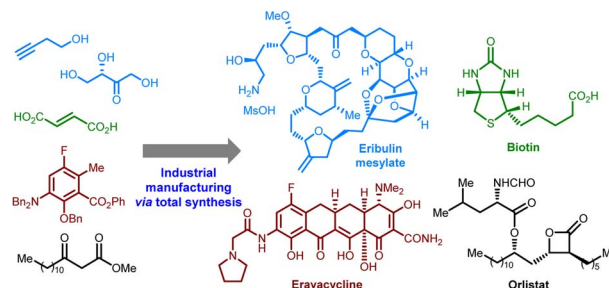
See Paul M. D'Agostino, pp. 1701–1717. Photograph courtesy of Dr. Patrick Jung. Image reproduced by permission of Patrick Jung and Paul D'Agostino from *Nat. Prod. Rep.*, 2023, **40**, 1701.

## VIEWPOINT

1694

### Industrial total synthesis of natural medicines

Xiao-Yu Liu and Yong Qin\*

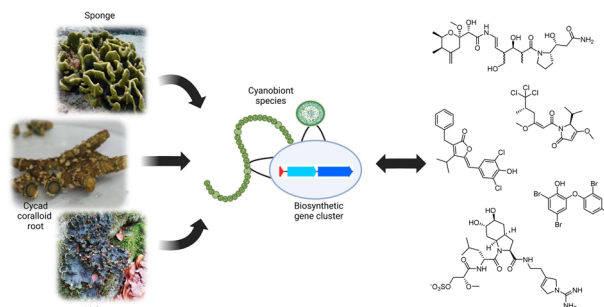


## HIGHLIGHT

1701

### Highlights of biosynthetic enzymes and natural products from symbiotic cyanobacteria

Paul M. D'Agostino



## Editorial Staff

### Executive Editor

Katie Lim

### Deputy Editor

Jack Washington

### Development Editor

Daniel Robertshaw

### Editorial Production Manager

Sarah Anthony

### Publishing Editors

Nicola Burton, Tom Cozens, Katie Fernandez, Ryan Kean, Roxane Owen

### Editorial Assistant

Amy Cook

### Publishing Assistant

Andrea Whiteside

### Publisher

Sam Keltie

For queries about submitted articles please contact Sarah Anthony, Editorial Production Manager, in the first instance. E-mail [npr@rsc.org](mailto:npr@rsc.org)

For pre-submission queries please contact Katie Lim, Executive Editor. E-mail [npr-rsc@rsc.org](mailto:npr-rsc@rsc.org)

Natural Product Reports (electronic: ISSN 1460-4752) is published 12 times a year by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK CB4 0WF.

All orders, with cheques made payable to the Royal Society of Chemistry, should be sent to the Royal Society of Chemistry Order Department, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK  
Tel +44 (0)1223 432398; E-mail [orders@rsc.org](mailto:orders@rsc.org)

2023 Annual (electronic) subscription price: £1257 US\$2212. Customers in Canada will be subject to a surcharge to cover GST. Customers in the EU subscribing to the electronic version only will be charged VAT.

If you take an institutional subscription to any Royal Society of Chemistry journal you are entitled to free, site-wide web access to that journal. You can arrange access via Internet Protocol (IP) address at [www.rsc.org/ip](http://www.rsc.org/ip)

Customers should make payments by cheque in sterling payable on a UK clearing bank or in US dollars payable on a US clearing bank.

Whilst this material has been produced with all due care, the Royal Society of Chemistry cannot be held responsible or liable for its accuracy and completeness, nor for any consequences arising from any errors or the use of the information contained in this publication. The publication of advertisements does not constitute any endorsement by the Royal Society of Chemistry or Authors of any products advertised. The views and opinions advanced by contributors do not necessarily reflect those of the Royal Society of Chemistry which shall not be liable for any resulting loss or damage arising as a result of reliance upon this material. The Royal Society of Chemistry is a charity, registered in England and Wales, Number 207890, and a company incorporated in England by Royal Charter (Registered No. RC000524), registered office:

Burlington House, Piccadilly, London W1J 0BA, UK,  
Telephone: +44 (0) 207 4378 6556.

### Advertisement sales:

Tel +44 (0) 1223 432246; Fax +44 (0) 1223 426017;  
E-mail [advertising@rsc.org](mailto:advertising@rsc.org)

For marketing opportunities relating to this journal, contact [marketing@rsc.org](mailto:marketing@rsc.org)

# Natural Product Reports

[rsc.li/npr](http://rsc.li/npr)

*Natural Product Reports* is a critical review journal that stimulates progress in all areas of natural products research, including isolation, structural and stereochemical determination, biosynthesis, biological activity and synthesis. The scope of the journal is very broad, and many reviews discuss the role of natural products in the wider bioinorganic, bioorganic and chemical biology communities.

## Editorial Board

### Chair

Tobias Gulder, Technical University of Dresden, Germany

### Members

Heike Brötz-Oesterheld, University of Tübingen, Germany  
Nadja Cech, University of North Carolina, Greensboro, USA  
Alessandra Eustáquio, University of Illinois at

Chicago, USA

Hendrik Luesch, University of Florida, USA  
Marnix Medema, Wageningen University, Netherlands

Dong-Chan Oh, Seoul National University, South Korea

Cassandra Quave, Emory University, USA  
Margherita Sosio, Naicons Srl, Milan, Italy  
Eriko Takano, University of Manchester, UK

Hidetoshi Tokuyama, Tohoku University, Japan

Christopher Vanderwal, University of California, Irvine, USA

Changsheng Zhang, South China Sea Institute of Oceanology, China Academy of Sciences, China

## Advisory Board

Giovanni Appendino, Università del Piemonte Orientale, Italy

Roberto Berlinck, University of Sao Paulo, Brazil

Carole Bewley, National Institutes of Health, USA

Christopher Boddy, University of Ottawa, Canada

Robert Britton, Simon Fraser University, Canada

Margaret Brimble, University of Auckland, New Zealand

Mark Brönstrup, Helmholtz Centre for Infection Research, Germany

Guy Carter, Carter-Berman Consulting, USA

Russell Cox, Leibniz Universität Hannover, Germany

Pieter Dorrestein, University of California San Diego, USA

Susana P. Gaudêncio, Nova University Lisbon, Portugal

Olga Genilloud, Fundación MEDINA, Spain

Rebecca Goss, St Andrews University, UK

Seth Herzon, Yale University, USA

Chambers Hughes, University of Tübingen, Germany

Marcel Jaspars, University of Aberdeen, UK

Martin Kaltenpoth, Max Planck Institute for Chemical Ecology, Germany

Andreas Kirschning, University of Hannover, Germany

Julia Kubanek, Georgia Institute of Technology, USA

Wen Liu, Shanghai Institute of Organic Chemistry, China

Sandra Loesgen, University of Florida, USA

Dawei Ma, Shanghai Institute of Organic Chemistry, China

Fidele Ntie-Kang, University of Buea, Cameroon

Sarah O'Connor, Max Planck Institute for Chemical Ecology, Jena, Germany

Jörn Piel, ETH Zürich, Switzerland

Jürgen Rohr, University of Kentucky, USA

Martin Schmeing, McGill University, Canada

Stefan Schulz, TU Braunschweig, Germany

Michael Sherburn, Australia National University, Australia

Thomas J Simpson, University of Bristol, UK

Janet Smith, University of Michigan, USA

Renxiang Tan, Nanjing University, China

Dirk Trauner, University of Pennsylvania, USA

Reiko Ueoka, Kitasato University, Japan

Kira Weissman, Lorraine University, France

Craig Williams, The University of Queensland, Australia

Zhen Yang, Peking University, China

Yeo Joon Yoon, Seoul National University, Korea

Weidong Zhang, Second Military Medical University, Shanghai, China

## Information for Authors

Articles in *Natural Product Reports* are generally commissioned by the editorial staff and editorial board, however, offers of articles for publication may be considered by submitting a short synopsis to Dr Katie Lim, Editor. E-mail: [npr-rsc@rsc.org](mailto:npr-rsc@rsc.org) Full details are available from the website at [www.rsc.org/npr](http://www.rsc.org/npr)

Authors may reproduce/republish portions of their published contribution without seeking permission from the Royal Society of Chemistry, provided that any such republication is accompanied by an acknowledgement in the form: (Original Citation)–Reproduced by permission of the Royal Society of Chemistry.

This journal is © The Royal Society of Chemistry 2023.

Apart from fair dealing for the purposes of research or private study for non-commercial purposes, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988 and the Copyright and Related Rights Regulation 2003, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the Publishers or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency in the UK. US copyright law is applicable to users in the USA.

Registered charity number: 207890

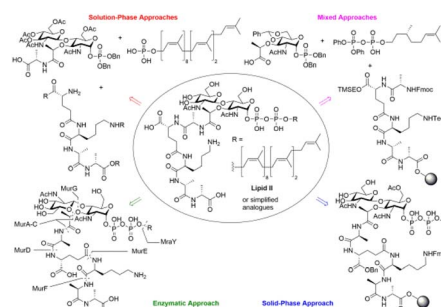


## REVIEWS

1718

## Strategies and tactics for the synthesis of lipid I and II and shortened analogues: functional building blocks of bacterial cell wall biosynthesis

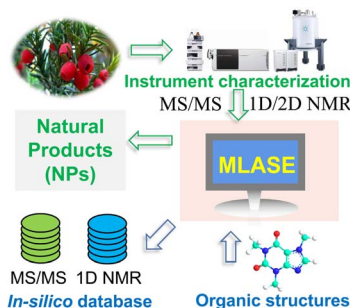
Christina Braun, Lukas Martin Wingen and Dirk Menche\*



1735

## Machine learning-assisted structure annotation of natural products based on MS and NMR data

Guilin Hu and Minghua Qiu\*



1754

## Natural products as anthelmintics: safeguarding animal health

Angela A. Salim, Mark S. Butler, Mark A. T. Blaskovich, Ian R. Henderson and Robert J. Capon\*

