

Natural Product Reports

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

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 NPRRDF 40(4) 753–958 (2023)



Cover

See Dorothea Tholl et al., pp. 766–793. Image reproduced by permission of Dorothea Tholl from *Nat. Prod. Rep.*, 2023, **40**, 766. Cover art by Dorothea Tholl. Photo: Mating harlequin bugs (*Murgantia histrionica*), courtesy of Jim Tokuhsa. DT and JT are at the Department of Biological Sciences, Virginia Tech, USA.

EDITORIAL

759

Introduction to volatile natural products

Stefan Schulz

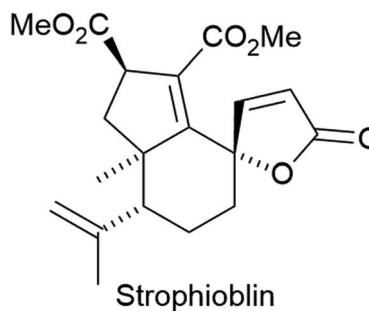


HOT OFF THE PRESS

761

Hot off the Press

Robert A. Hill and Andrew Sutherland



Editorial Staff

Executive Editor

Rebecca Garton

Deputy Editor

Jack Washington

Development Editor

Daniel Robertshaw

Editorial Production Manager

Sarah Whitehouse

Publishing Editors

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

Editorial Assistant

Amy Cook

Publishing Assistant

Andrea Whiteside

Publisher

Sam Keltie

For queries about submitted articles please contact Sarah Whitehouse, Editorial Production Manager, in the first instance. E-mail npr@rsc.org

For pre-submission queries please contact Rebecca Garton, Executive Editor. E-mail 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

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

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

For marketing opportunities relating to this journal, contact marketing@rsc.org

Natural Product Reports

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 Brötter-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
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
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
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
Kira Weissman, Lorraine University, France
Craig Williams, The University of Queensland, Australia
Zhen Yang, Peking University, China
Yeo Joon Yoon, Seoul National University, Korea

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 Rebecca Garton, Editor. E-mail: npr-rsc@rsc.org Full details are available from the website at 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

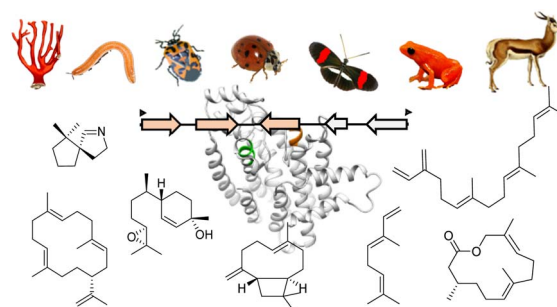


REVIEWS

766

Terpene synthases and pathways in animals: enzymology and structural evolution in the biosynthesis of volatile infochemicals

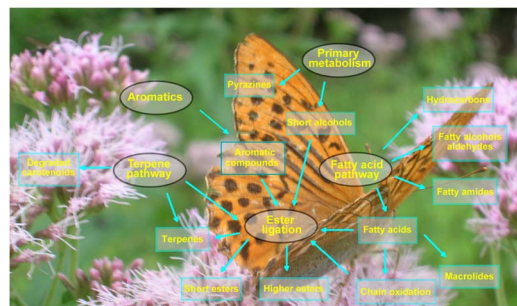
Dorothea Tholl,* Zarley Rebholz, Alexandre V. Morozov and Paul E. O'Maille



794

The scent chemistry of butterflies

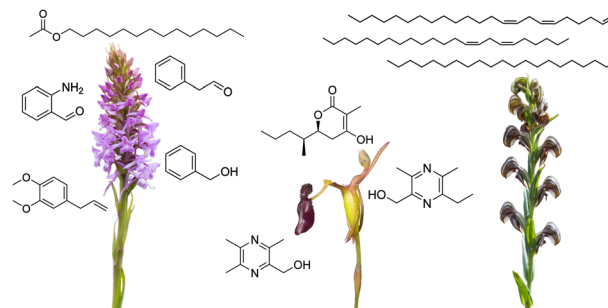
Stephanie Ehlers and Stefan Schulz



819

The volatile chemistry of orchid pollination

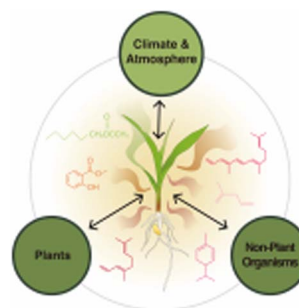
James Perkins, Tobias Hayashi, Rod Peakall, Gavin R. Flematti and Björn Bohman*



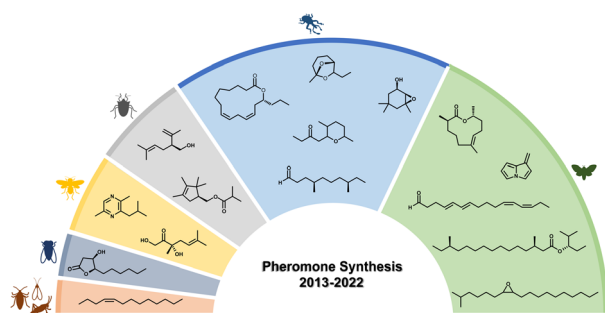
840

Dynamic environmental interactions shaped by vegetative plant volatiles

Rocío Escobar-Bravo, Po-An Lin, Jamie M. Waterman* and Matthias Erb*



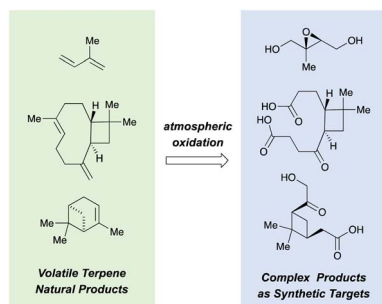
866



Recent advances in the synthesis of insect pheromones: an overview from 2013 to 2022

João P. A. Souza, Pamela T. Bandeira, Jan Bergmann* and Paulo H. G. Zarbin*

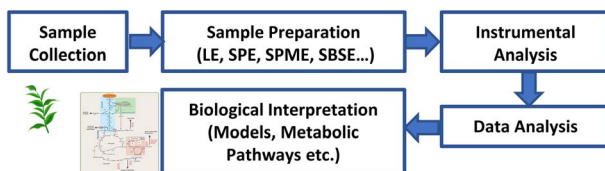
890



Organic synthesis in the study of terpene-derived oxidation products in the atmosphere

Mary Alice Upshur, Ariana Gray Bé, Jingyi Luo, Jonathan G. Varelas, Franz M. Geiger and Regan J. Thomson*

922



Analytical methods for the analysis of volatile natural products

Yue Li*

