PARMA
SUMMER SCHOOL
26 – 28 SEPTEMBER 2023, Parma

Innovative food products

Microalgae and cyanobacteria: opportunities and constraints

Vitor Vasconcelos/Director CIIMAR- Professor U Porto

EUROPEAN FOOD SAFETY AUTHORITY

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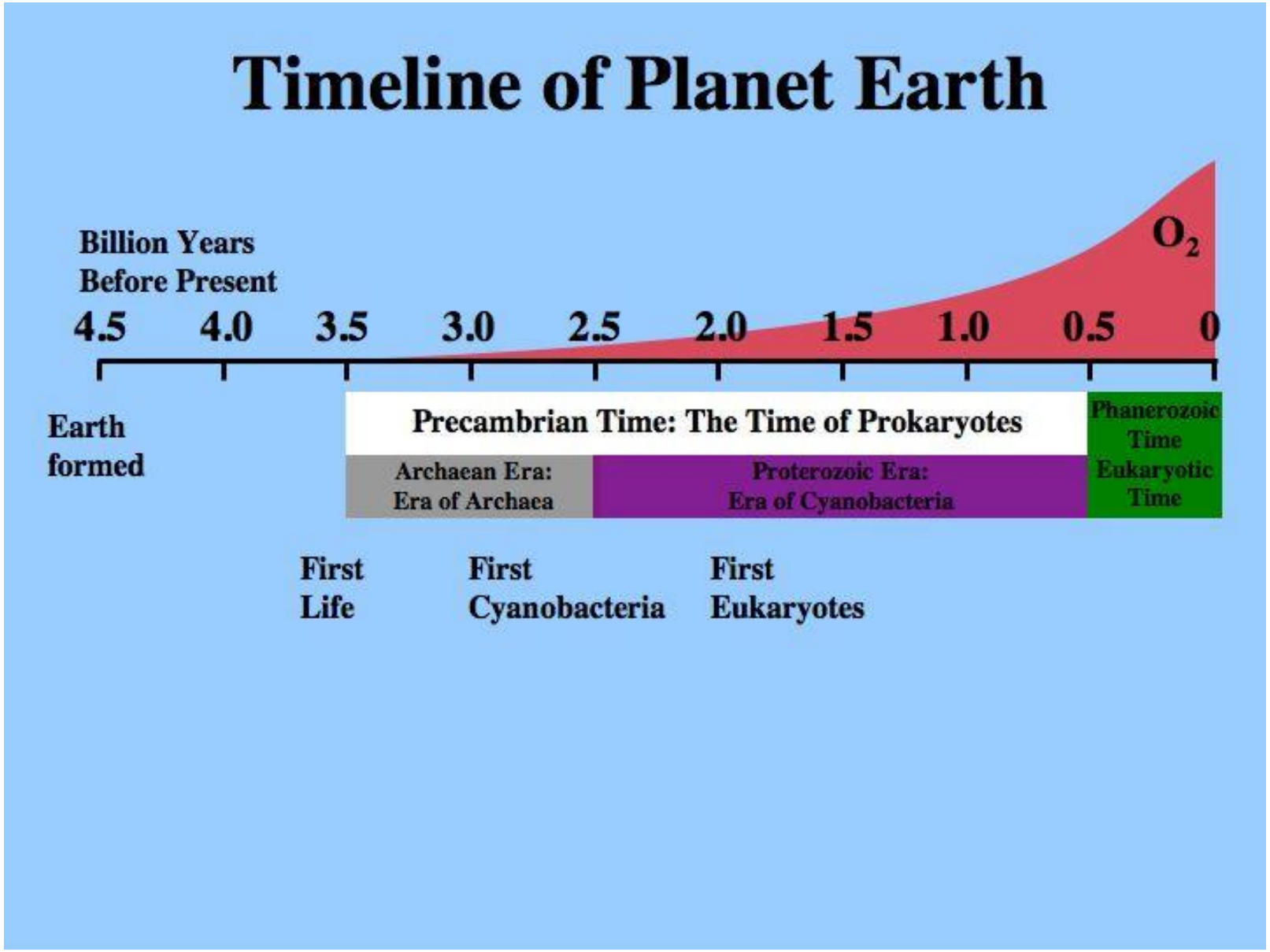
Cyanobacteria are everywhere.

Cyanotoxins as ecological drivers or drug leads?

Other cyanobacterial metabolites.

Nutraceuticals now and in the future?

Culture collections as sustainable sources



(http://plantphys.info/plant_biology/lechtml/cyanobacteria/)

(http://plantphys.info/plant_biology/lechtml/cyanobacteria/)

OXYGEN PRODUCTION IN THE OCEAN

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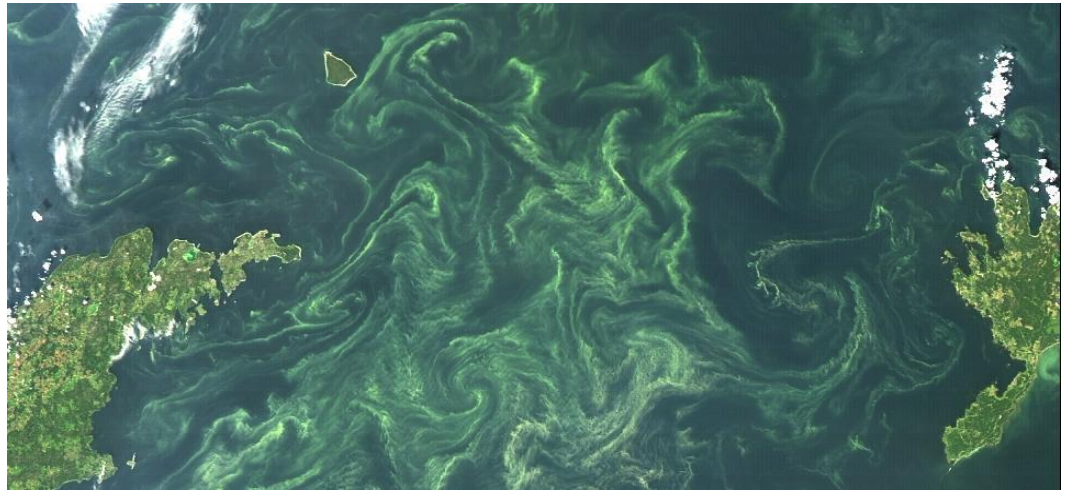
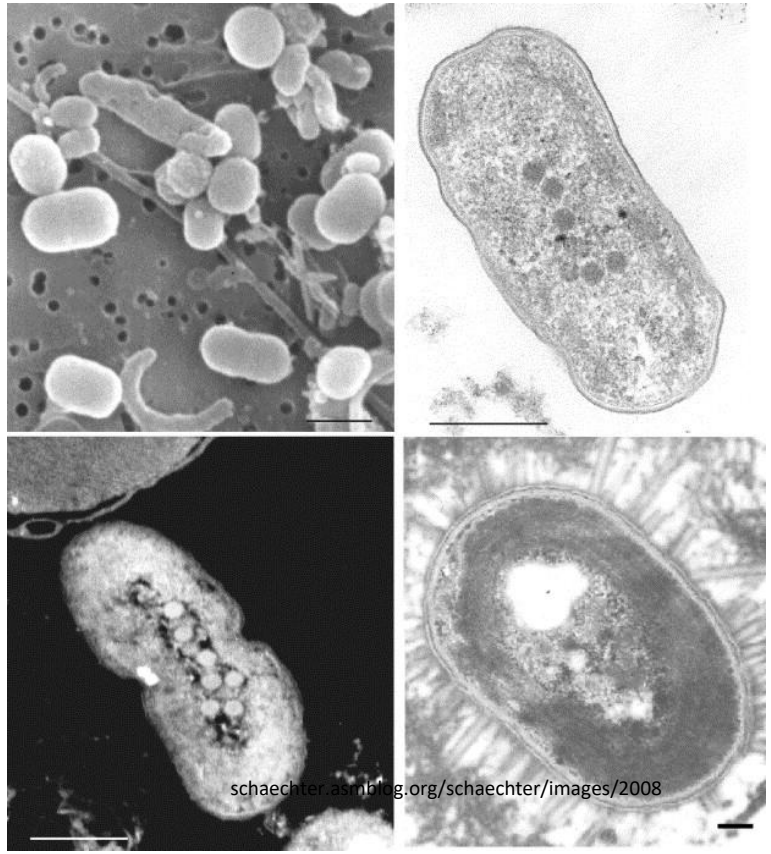
Picocyanobacteria are the highest oxygen producers in the ocean

50% of Earth oxygen

Prochlorococcus and *Synechococcus*





schaechter.asmblog.org/schaechter/images/2008

Mati Kahru, mkahru@ucsd.edu

Cyanobacteria blooms in Portugal

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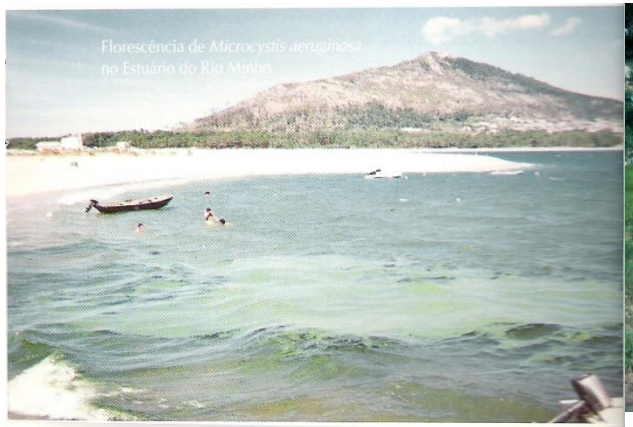

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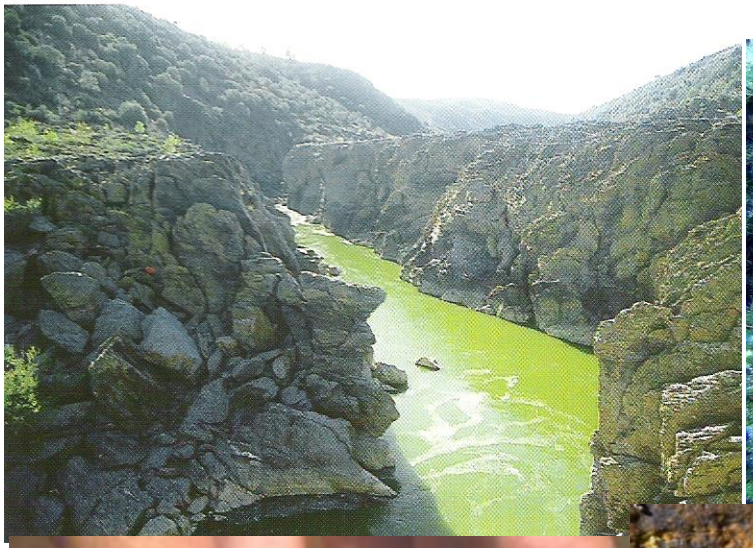
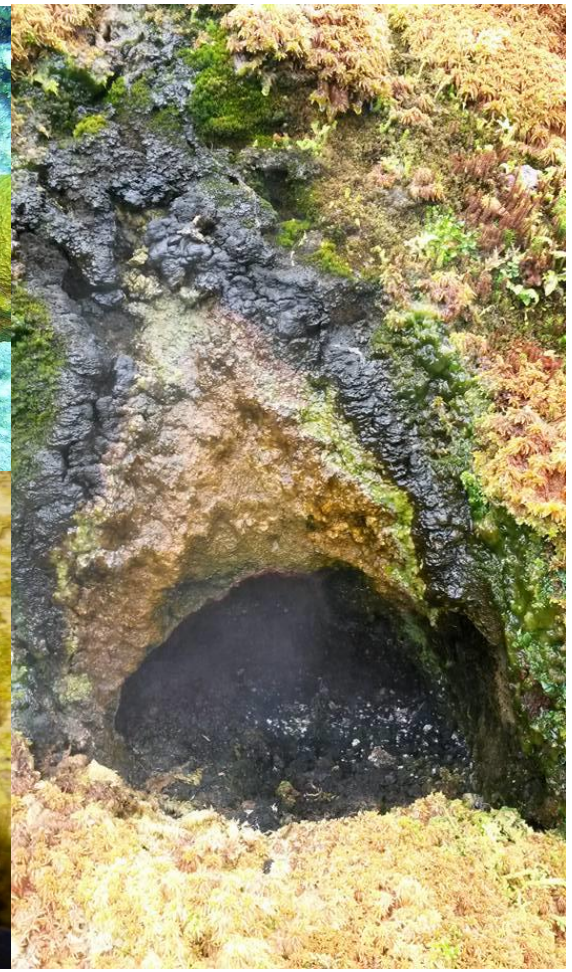
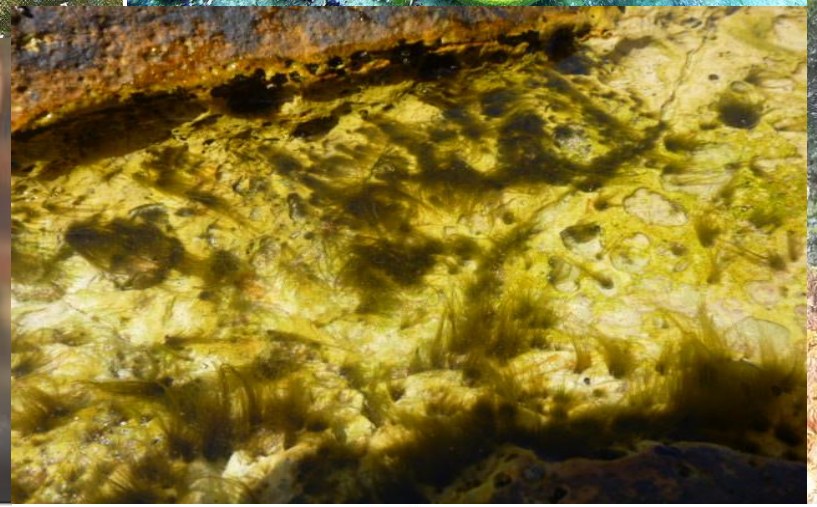
Cyanobacteria habitats







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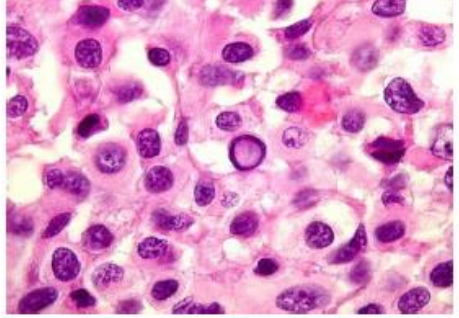
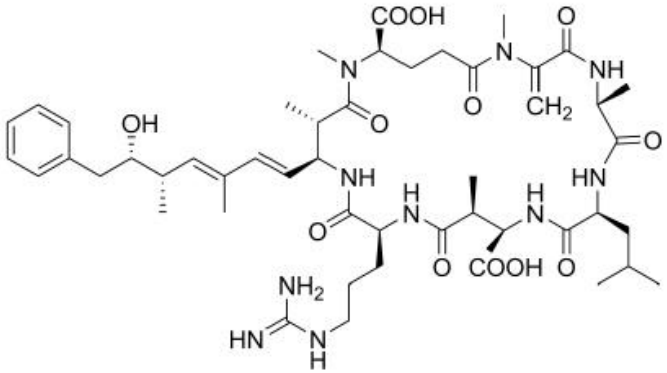
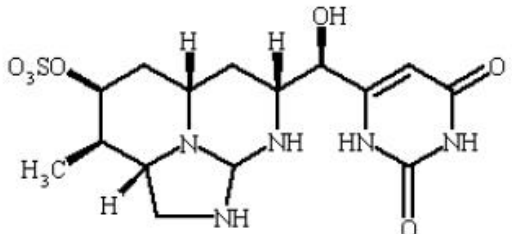
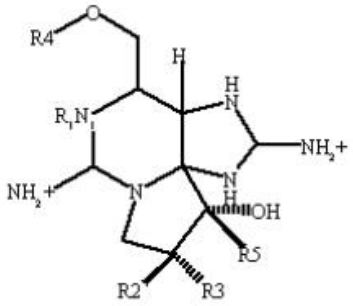




MICROCYSTINS



CYLINDROSPERMOPSIN



SAXITOXINS

CYANOTOXINS

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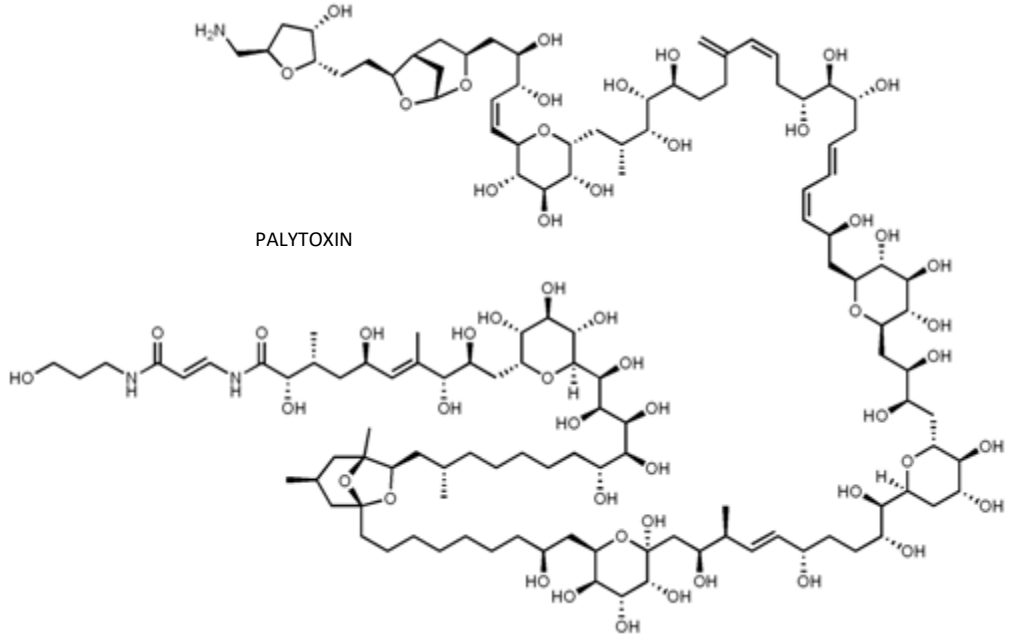
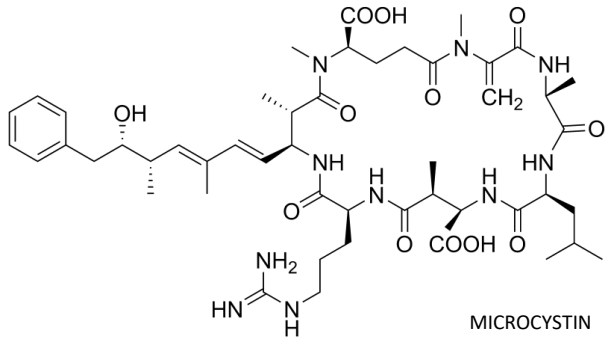
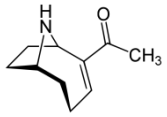


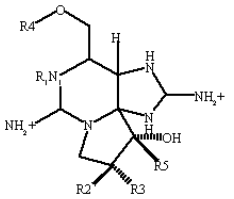
PALYTOXIN



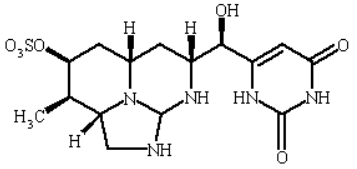
MICROCYSTIN



ANATOXIN-A



SAXITOXIN - GENERAL STRUCTURE



CYLINDROSPERMOPSIN

RISKS FOR HUMAN HEALTH EXPOSURE TO CYANOTOXINS

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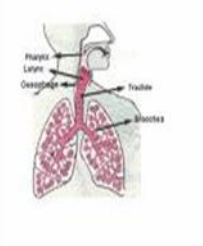
- **INHALATION**



- **INGESTION (WATER AND FOOD)**

- **CONTACT (RECREATION)**

INTRAVENOUS (HEMODIALYSIS)

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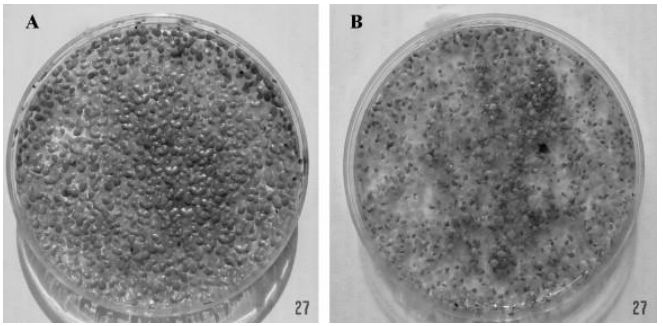
Allelopathy towards plants



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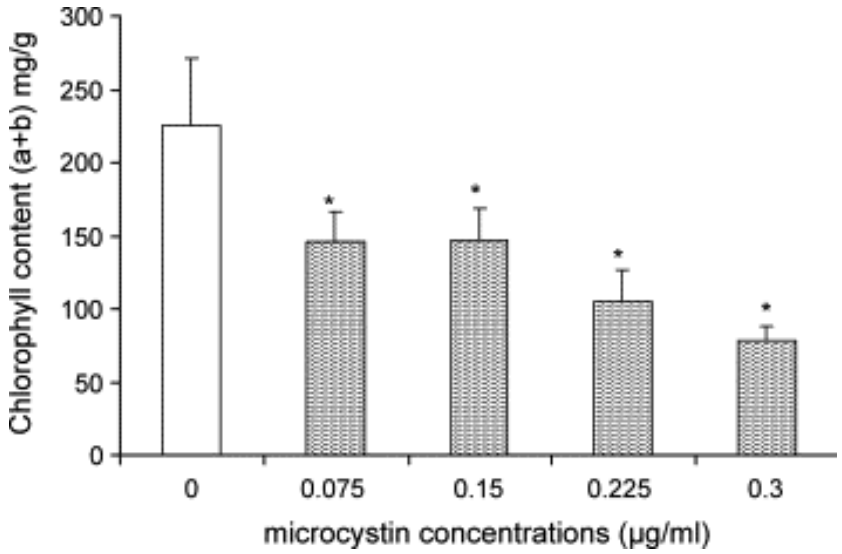
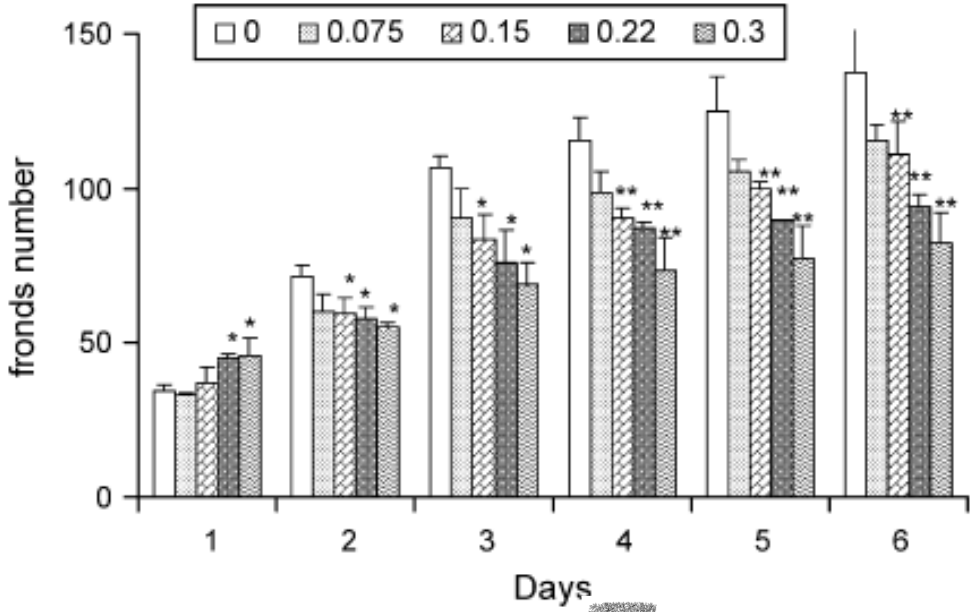
Effects of MC on *Lemna* growth and chlorophyll content





ELSEVIER

Aquatic Toxicology 83 (2007) 284–294

AQUATIC TOXICOLOGY

www.elsevier.com/locate/aquatox

Phytotoxic effects of cyanobacteria extract on the aquatic plant *Lemna gibba*: Microcystin accumulation, detoxication and oxidative stress induction

Sana Saqrane [a], Issam El ghazali [a], Youness Ouahid [c], Majida El Hassni [b], Ismaïl El Hadrami [b], Lahcen Bouarab [a], Franscica F. del Campo [c], Brahim Oudra [a], Vitor Vasconcelos [d,e,*]

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Anatoxin-a in carp development

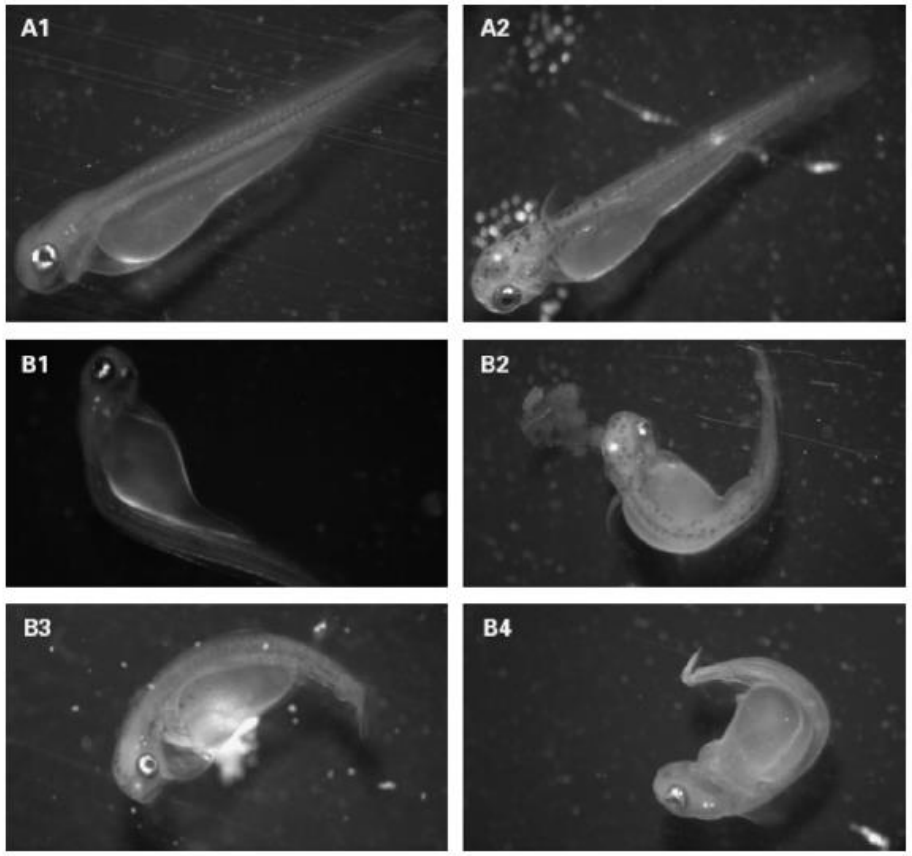

Fig. 1. Examples of post-hatching (within 24 h after hatchment) skeletal deformities observed in carp larvae: A1, A2—normal larvae; B1, B2, B3, and B4—larvae exposed to pure anatoxin-a.

Ecotoxicology and Environmental Safety 72 (2009) 473–478

Contents lists available at ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv

Effects of cyanobacterial extracts containing anatoxin-a and of pure anatoxin-a on early developmental stages of carp

J. Osswald [a], A.P. Carvalho [a,b], J. Claro [c], V. Vasconcelos [a,b,*]

[a] Interdisciplinary Centre of Marine and Environmental Research (CIMAR/CIIMAR), University of Porto, Rua dos Bragas 289, 4050-123 Porto, Portugal
[b] Department of Zoology and Anthropology, Faculty of Sciences, University of Porto, Praça Gomes Teixeira, 4099-002 Porto, Portugal
[c] Department of Electrical and Computer Engineering, Faculty of Engineering, University of Porto, Porto, Portugal

- Carp eggs exposure for 4 days to anatoxin-a extracts showed no deaths but malformations
- Pure toxins had little effects compared to extracts

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Food Safety Aspects of Integrated Food Systems

Toxins **2014**, *6*, 1837-1854; doi:10.3390/toxins6061837

OPEN ACCESS

toxins

ISSN 2072-6651

www.mdpi.com/journal/toxins

Article

Exposure of *Lycopersicon Esculentum* to Microcystin-LR: Effects in the Leaf Proteome and Toxin Translocation from Water to Leaves and Fruits

Daniel Gutiérrez-Praena [1,†], Alexandre Campos [2,†,*], Joana Azevedo [2,3], Joana Neves [2], Marisa Freitas [2,3], Remédios Guzmán-Guillén [1], Ana María Cameán [1], Jenny Renaut [4] and Vitor Vasconcelos [2,5]

Table 2. Concentration of MC-LR determined in the different tomato plant tissues including fruits. Not analyzed (ND); concentrations below the limit of detection of the equipment (LD, 0.58 µg/L).

Tissue	Treatment	MC-LR (µg/kg FW Tissue)	
		Week 1	Week 2
Root	C	ND	<LD
	MCE	ND	1635.21 ± 941.11
	MCP	ND	<LD
Leaves	C	<LD	<LD
	MCE	12,298.18 ± 8962.03	nd
	MCP	ND	<LD
Green tomato	C	<LD	<LD
	MCE	5.41 ± 0.49	<LD
	MCP	5.15 ± 0.93	<LD
Mature tomato	C	<LD	<LD
	MCE	10.52 ± 6.48	<LD
	MCP	10.83 ± 0.94	<LD

Tomato plants exposed to MC-LR accumulated high levels of toxin in fruits

Extracts and pure toxin had similar accumulation levels

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MC accumulation in aquatic animals

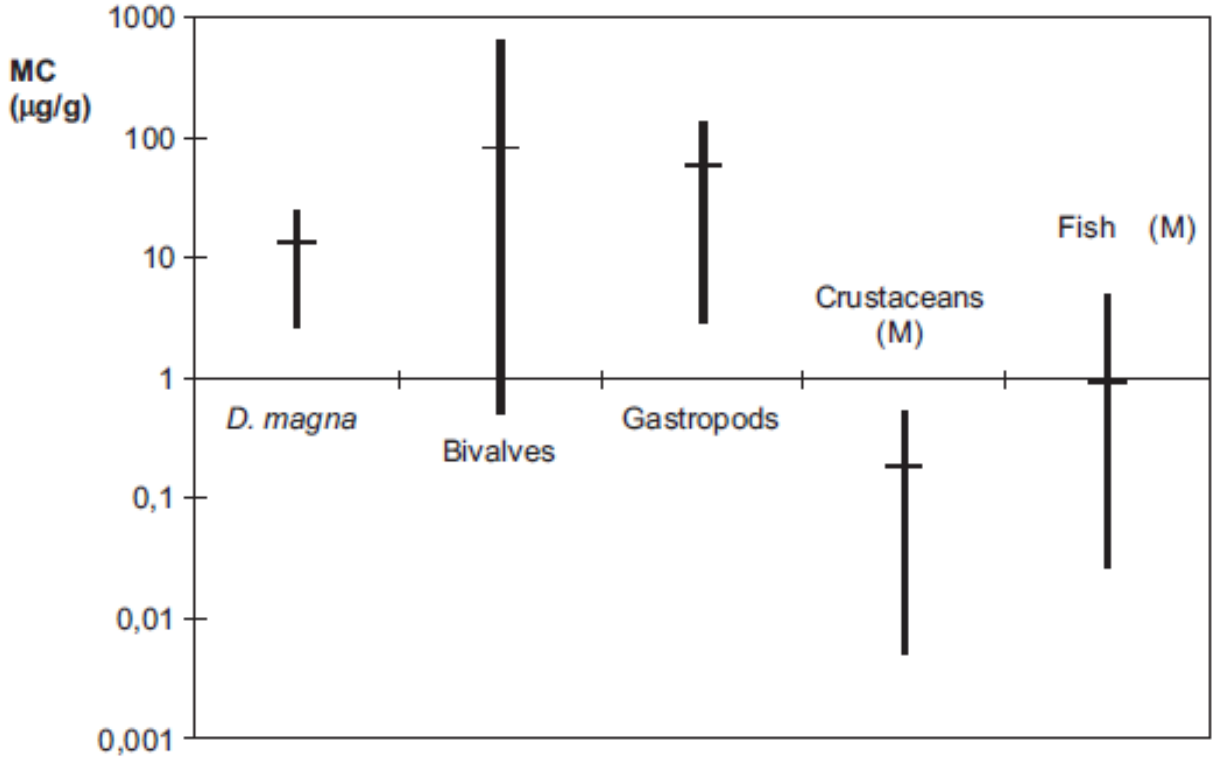

FIGURE 1. Average, maximum, and minimum concentration of MC in different animal species in laboratorial and field conditions (data from Tables 1 to 5) (horizontal bar represents average and M, muscle).

Martins and Vasconcelos, 2009. J Toxicol. Env. Health Part B: 12:62-82

Other exemples of cyanobacteria products as drug leads

Portoamides – allelopathic compounds from cyanobacteria

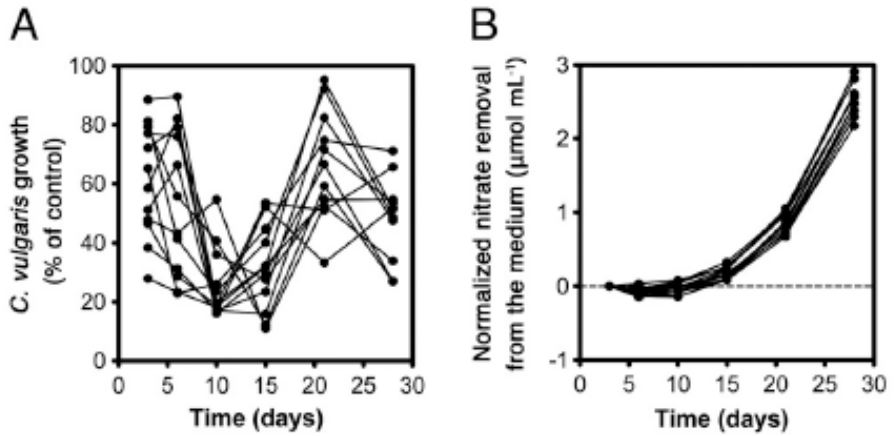

Fig. 1. Allelopathic activity of filtrates from OSC grown at different cell densities. (*A*) Growth of *C. vulgaris* in the OSC filtrates retrieved at different growth stages. (*B*) Growth profile of the OSC cultures, as inferred from nitrate removal from the medium.

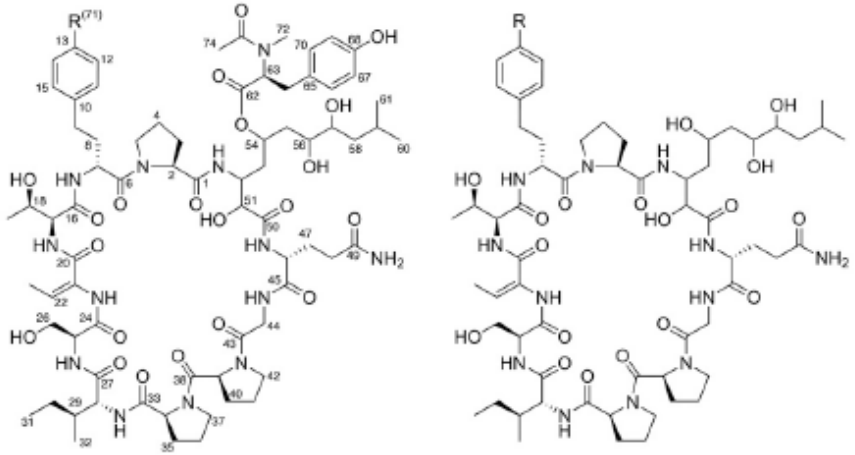

Fig. 2. Major secondary metabolites isolated from OSC biomass or media. Numbering corresponds to portoamide A (**1**).

PNAS | June 22, 2010 | vol. 107 | no. 25 | 11183–11188

Synergistic allelochemicals from a freshwater cyanobacterium

Pedro N. Leão[a,b,1], Alban R. Pereira[b,1], Wei-Ting Liu[c], Julio Ng[d], Pavel A. Pevzner[d], Pieter C. Dorrestein[b,c,e], Gabriele M. König[f], Vitor M. Vasconcelos[a,g,2], and William H. Gerwick[b,e,2]

PORTOAMIDES

ANTIFOULING

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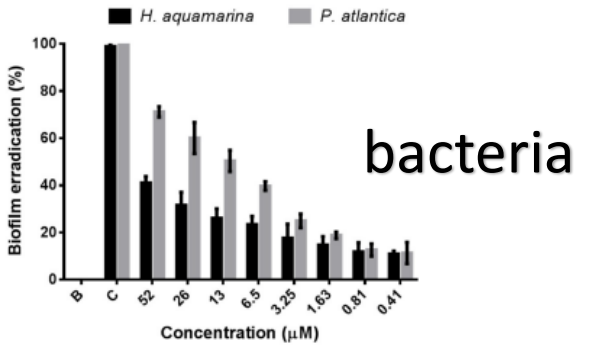
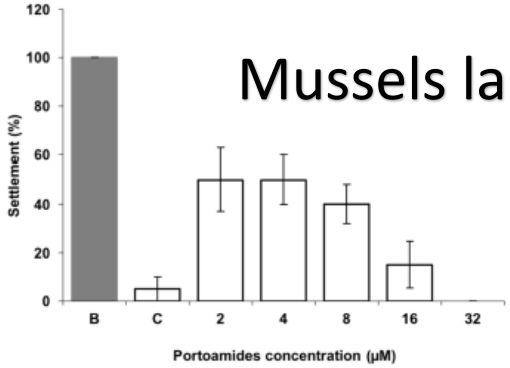
Food Safety Aspects of Integrated Food Systems

Mar. Drugs **2019**, *17*, 111; doi:10.3390/md17020111



bacteria

Figure 5. Antibiofilm dose–response activity of portoamides towards the marine bacteria *Halomonas aquamarina* and *Pseudoalteromonas atlantica*. B: 0.1% DMSO; C: 4:100 dilution of penicilin-streptomycin-neomycin stabilized solution (Sigma P4083).



Mussels larvae

Figure 1. Dose–response antisettlement activity of portoamides towards plantigrade larvae of the mussel *Mytilus galloprovincialis*. B: DMSO control (0.01%); C: 5 μM $CuSO_4$ as the positive control.

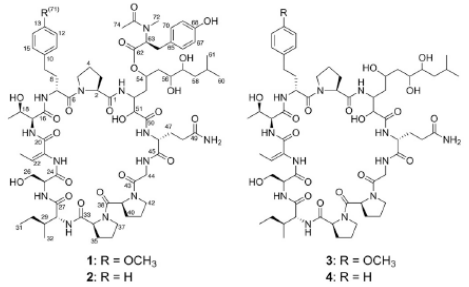
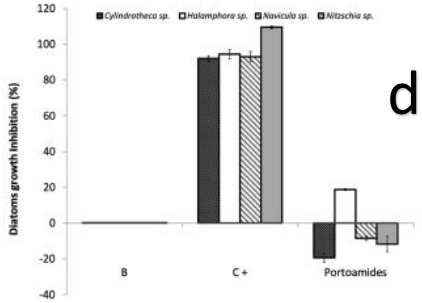
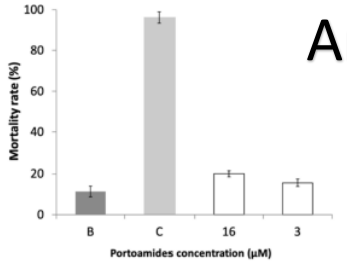


Fig. 2. Major secondary metabolites isolated from OSC biomass or media. Numbering corresponds to portoamide A (**1**).



diatoms

Figure 4. Antimicroalgal activity of portoamides at a concentration of 6.5 μM towards four biofilm-forming marine diatoms *Cylindrotheca* sp., *Halamphora* sp., *Nitzschia* sp. and *Navicula* sp. (B: 0.1% DMSO); 3.55 μM cycloheximide was used as the positive control (C+).



Artemia

Figure 7. Mortality rate of *Artemia salina* nauplii after 48 h of exposure to portoamides. B: 1% DMSO in filtered seawater. C: $K_2Cr_2O_7$ at a concentration of 13.6 μM.

marine drugs

MDPI

Article

A Multi-Bioassay Integrated Approach to Assess the Antifouling Potential of the Cyanobacterial Metabolites Portoamides

Jorge Antunes [1,2], Sandra Pereira [1], Tiago Ribeiro [1], Jeffrey E. Plowman [3], Ancy Thomas [3], Stefan Clerens [3,4,5], Alexandre Campos [1], Vitor Vasconcelos [1,2,*] and Joana R. Almeida [1,*]

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ANTIMICROBIAL

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Mar. Drugs **2008**, *6*(1), 1–11

OPEN ACCESS

Marine Drugs

ISSN 1660-3397

www.mdpi.org/marinedrugs

Full Paper

Antimicrobial and Cytotoxic Assessment of Marine Cyanobacteria - *Synechocystis* and *Synechococcus*

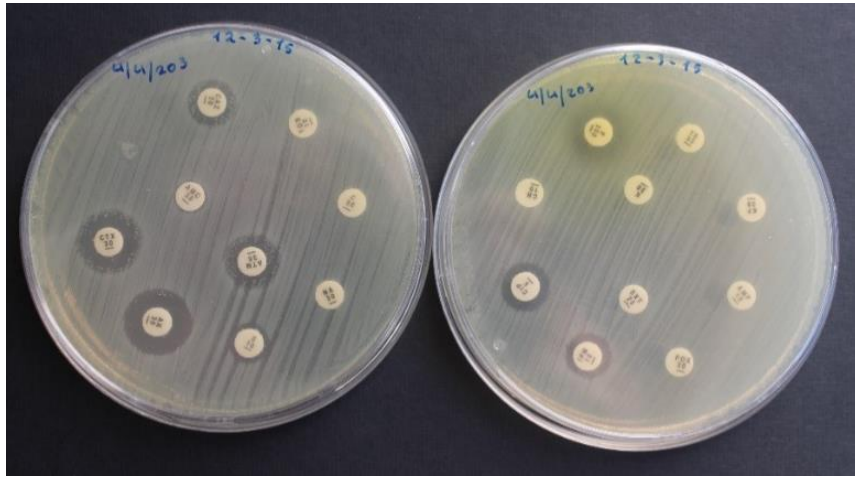
Rosário F. Martins [1,2,3], Miguel F. Ramos [1], Lars Herfindal [4], José A. Sousa [1,2], Kaja Skærven [4] and Vitor M. Vasconcelos [1,2,*]

(1) Departamento de Zoologia e Antropologia, Faculdade de Ciências, Universidade do Porto, Praça Gomes Teixeira, 4099-002 Porto, Portugal

(2) Centro Interdisciplinar de Investigação Marinha e Ambiental, CIMAR/CIIMAR, Rua dos Bragas 289, 4050-123 Porto, Portugal

(3) Escola Superior de Tecnologia da Saúde do Porto, Rua João de Oliveira Ramos 87, 4000-294 Porto, Portugal

(4) Department of Biomedicine, University of Bergen, Jonas Lies vei 91, N-5009 Bergen, Norway



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ANTIMICROBIAL

antibiotics

MDPI

Article

Inhibition of Bacterial and Fungal Biofilm Formation by 675 Extracts from Microalgae and Cyanobacteria

Virginio Cepas [1], Yuly López [1], Yaiza Gabasa [1], Clara B. Martins [2], Joana D. Ferreira [2], Maria J. Correia [2], Lília M.A. Santos [2], Flávio Oliveira [3], Vitor Ramos [3], Mariana Reis [3], Raquel Castelo-Branco [3], João Morais [3], Vitor Vasconcelos [3,4], Ian Probert [5], Emilie Guilloud [5], Mohamed Mehiri [6] and Sara M. Soto [1,*]

Antibiotics **2019**, *8*, 77; doi:10.3390/antibiotics8020077

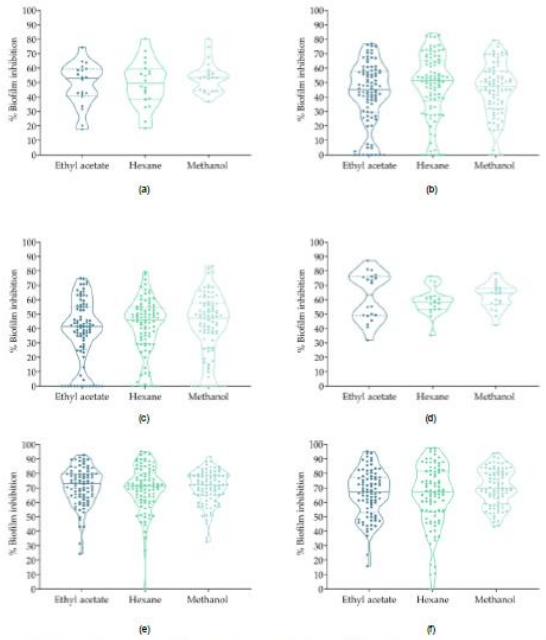

Figure 2. Individual biofilm inhibition ratios of *Charophyta*, *Chlorophyta*, and Cyanobacteria extracts against *E. cloacae* and *C. parapsilopsis*, represented as percentages. (**a**): *Charophyta* against *E. cloacae*; (**b**) *Chlorophyta* against *E. cloacae*; (**c**) Cyanobacteria against *E. cloacae*; (**d**) *Charophyta* against *C. albicans*; (**e**) *Chlorophyta* against *C. albicans*; (**f**) *Cyanobacteria* against *C. albicans*.

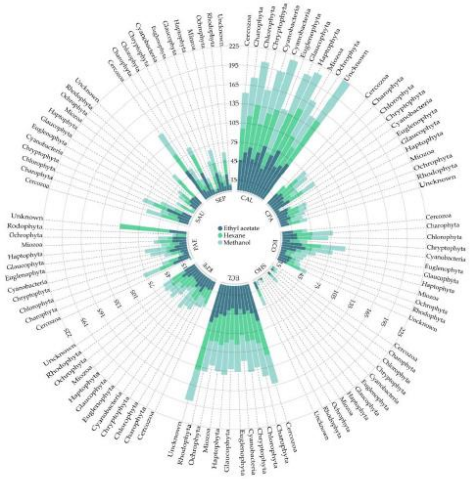

Figure 1. Circular dot plot representing the biofilm inhibition ratio (%) of each bacterium in relation to the solvent employed (ethyl acetate, hexane, and methanol), according to the microalgae and cyanobacteria phylum. CAL: *C. albicans*; CPA: *C. parapsilopsis*; ECO: *E. coli*; SHO: *S. hominis*; ECL: *E. cloacae*; KPE: *K. pneumoniae*; PAE: *P. aeruginosa*; SAU: *S. aureus*; SEP: *S. epidermidis*.

NoMorFilm PARTNERS

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LEGE-CC, ACOI and ROSTOC CC

Looking for antimicrobial extracts against infections in prothesis and catheters

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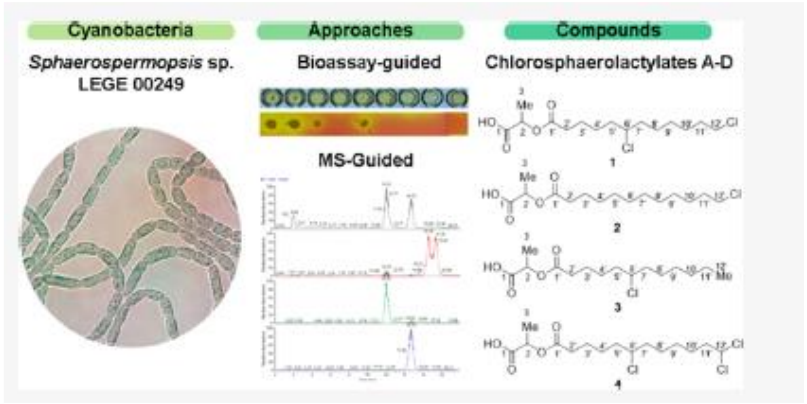

JOURNAL OF NATURAL PRODUCTS

J. Nat. Prod. 2020, 83, 1885–1890

pubs.acs.org/jnp

Article

Chlorosphaerolactylates A–D: Natural Lactylates of Chlorinated Fatty Acids Isolated from the Cyanobacterium *Sphaerospermopsis* sp. LEGE 00249

Ignacio Gutiérrez-del-Río,[#] Nelly Brugerolle de Fraissinette,[#] Raquel Castelo-Branco,[#] Flavio Oliveira, João Morais, Saúl Redondo-Blanco, Claudio J. Villar, María José Iglesias, Raquel Soengas, Virginio Cepas, Yuly López Cubillos, Giacomo Sampietro, Liliana Rodolfi, Felipe Lombó, Sara M. Soto González, Fernando López Ortiz,* Vitor Vasconcelos, and Mariana A. Reis*

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Food Safety Aspects of Integrated Food Systems

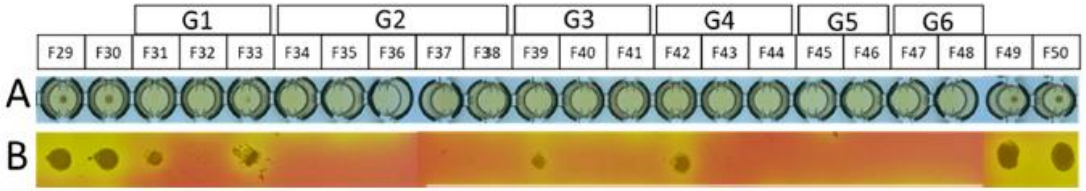
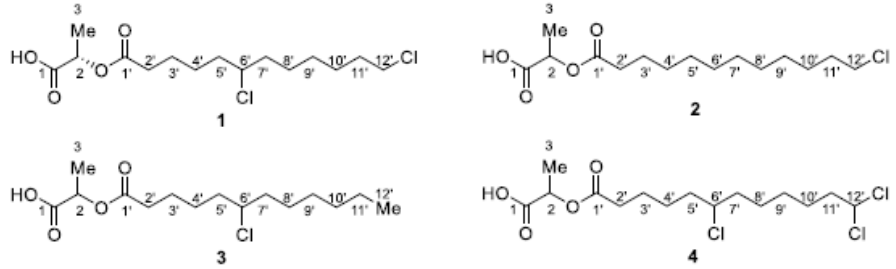


Figure 1. Bioassay-guided discovery of antibacterial compounds. Schematic representation of a 96-well plate containing active fractions: (A) microbial sediments obtained after the microdilution antibiotic susceptibility test; (B) result of the bactericidal assay after the upper wells were subcultured onto a solid agar medium (MSA). Inhibition of *S. aureus* S54F9 growth was observed in fractions F32, F34–38, F40, F41, F43–F48. The groups G1–G6 were defined according to their chemical composition after HRESIMS analyses.

Chart 1



Chlorosphaerolactylates

Patented knowledge

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OPEN ACCESS Freely available online

PLOS | ONE

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Food Safety Aspects of Integrated Food Systems

Antitumor Activity of Hierridin B, a Cyanobacterial Secondary Metabolite Found in both Filamentous and Unicellular Marine Strains

Pedro N. Leão[1,2*], Margarida Costa[1], Vitor Ramos[1], Alban R. Pereira[2], Virgínia C. Fernandes[3], Valentina F. Domingues[3], William H. Gerwick[2,4], Vitor M. Vasconcelos[1,5], Rosário Martins[1,6,7]

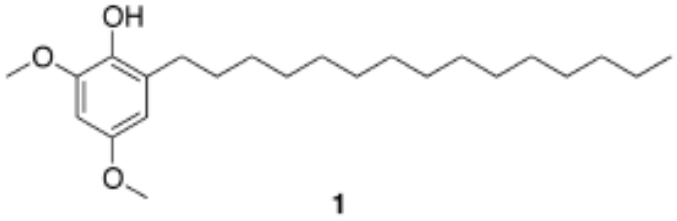

Figure 1. Structure of hierridin B (1).
doi:10.1371/journal.pone.0069562.g001

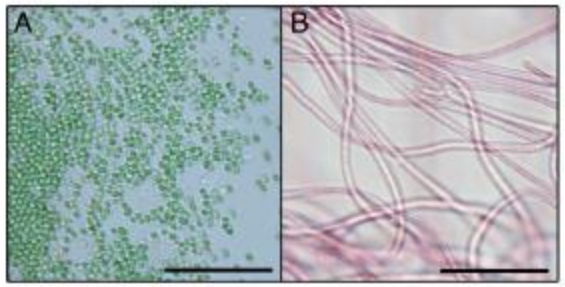

Figure 3. Microphotographs of the two cyanobacterial strains known to produce 1. A – *Cyanobium* sp. LEGE 06133; B – *Phormidium ectocarpi* SAG 60.90. Scale bar = 20 µm.
doi:10.1371/journal.pone.0069562.g003

Table 1. Cytotoxicity of **1** towards a panel of human cell lines. (+ growth inhibition observed, − no growth inhibition observed).

Cell line	Type	Growth inhibition (IC_{50})
HepG2	hepatocellular carcinoma	− (n/a)
HT-29	colon adenocarcinoma	+ (100.2 µM)
MG63	osteosarcoma	− (n/a)
PNT2	normal prostate epithelium	− (n/a)
RKO	colon adenocarcinoma	− (n/a)
SHSY5Y	neuroblastoma	− (n/a)
SKBR3	breast adenocarcinoma	− (n/a)
T47D	breast ductal carcinoma	− (n/a)

doi:10.1371/journal.pone.0069562.t001

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marine drugs

Mar. Drugs **2016**, *14*, 158; doi:10.3390/md14090158

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Food Safety Aspects of Integrated Food Systems

Article

Hierridin B Isolated from a Marine Cyanobacterium Alters VDAC1, Mitochondrial Activity, and Cell Cycle Genes on HT-29 Colon Adenocarcinoma Cells

Sara Freitas [1], Rosário Martins [1,2,3,4], Margarida Costa [1], Pedro N. Leão [1], Rui Vitorino [5,6], Vitor Vasconcelos [1,3] and Ralph Urbatzka [1,*]

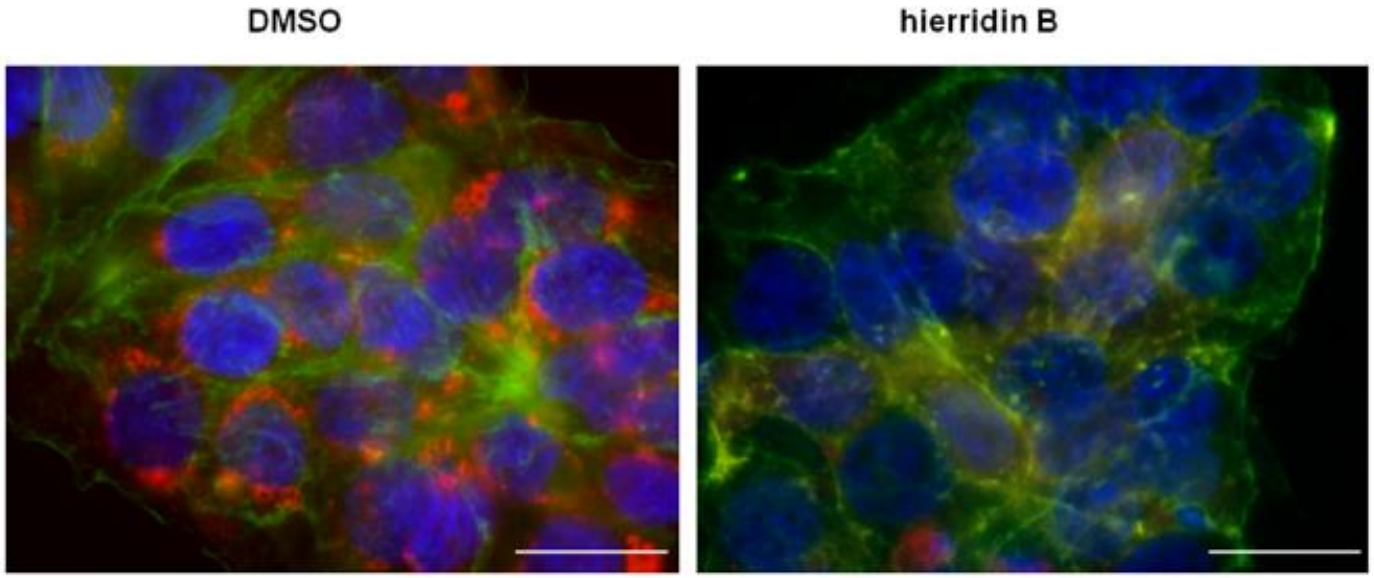

Figure 4. Overlay of three fluorescent channels (blue, nucleus, Hoechst 33342; green, cytoplasm, acti-stain 488; red, mitochondria, MitoTracker CMXROS) from HT-29 colon adenocarcinoma cells exposed to solvent control (DMSO) and hierridin B. Scale bar corresponds to 20 µm.

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PORTOAMIDES, AGAIN

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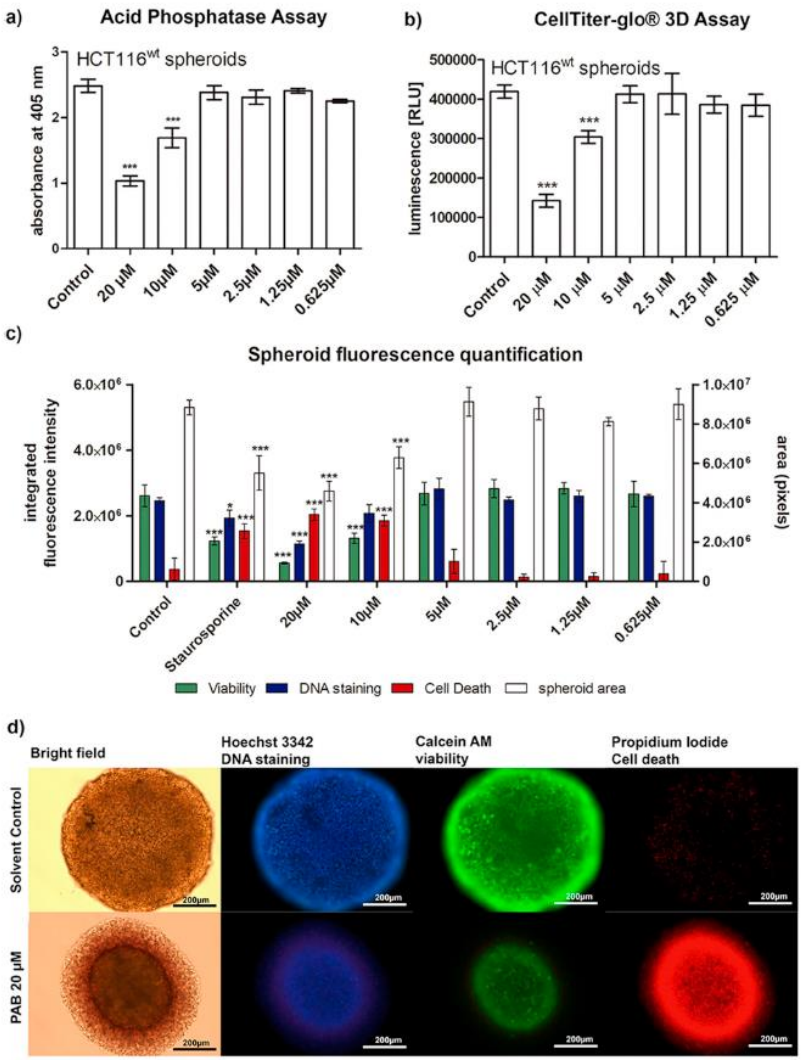

Fig. 2. Viability of HCT116 spheroids after 48 h exposure to PAB. a) Acid Phosphatase assay resulted in an IC_{50} of 12.67 µM. b) CellTiter-glo® 3D viability assay resulted in an IC_{50} value of 15.21 µM n > 3, mean ± standard deviation; statistical differences to the control were indicated by *** = $p < 0.001$. c) Quantification of fluorescence in spheroids after 48 h of exposure to PAB. Calcein AM (green) shows activity of cellular esterases (viability), Hoechst 33342 nuclear condensation (blue) and PI (red) dead cells (cell death). Staurosporine 500 nM was used as positive control. n = 3, mean ± standard deviation. **$p < 0.01$.***$p < 0.001$. d) Microscopy images of spheroids exposed to 20 µM PAB after 48 h, followed by fluorescent staining with Hoechst 33342, Calcein AM and PI general cell death. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Toxicon 175 (2020) 49–56

Contents lists available at ScienceDirect

Toxicon

journal homepage: http://www.elsevier.com/locate/toxicon

Portoamides A and B are mitochondrial toxins and induce cytotoxicity on the proliferative cell layer of *in vitro* microtumours

Maria Lígia Sousa [a,b], Tiago Ribeiro [a,b], Vítor Vasconcelos [a,b], Stig Linder [c,d], Ralph Urbatzka [a,*]

In conclusion, PAB reduced the viability of HCT116 colon cancer cells grown as monolayer or as multicellular spheroid. PAB can penetrate the spheroids and its effects were more prominent on the outer layer. The uptake of PAB seems to be energy-independent. In both cases, PAB disturbed the energy metabolism of cells by targeting mitochondrial function suggesting that PAB act as mitochondrial toxin. However, our data clearly demonstrate that PAB affected both carcinogenic and non-carcinogenic cells and exerted systemic toxicity on zebrafish larvae. Its future application will be dependent on a targeted transfer to cancer cells, to avoid prominent side effects.

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Nutraceuticals now and in the future?

LOW PROCESSING – LOW PRICE

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Multiplex PCR: several primer pairs simultaneously
Detection of contamination in food supplements

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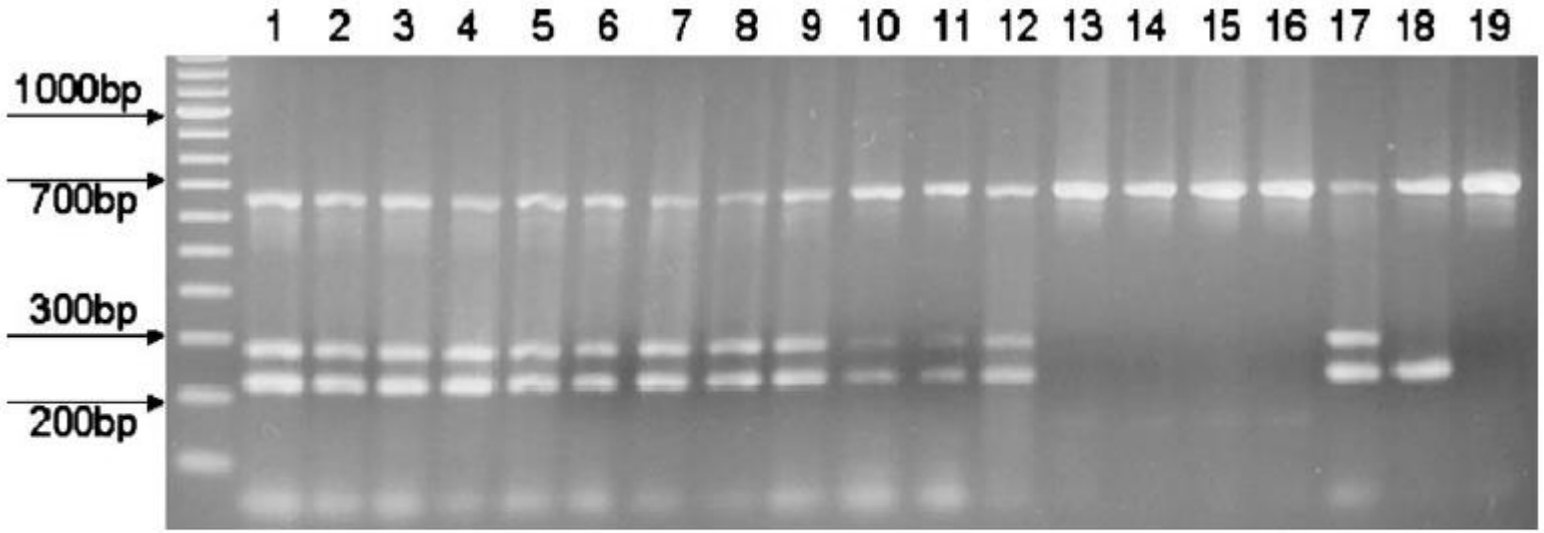
Aphanizomenon* food supplements** | ***Nostoc* and *Spirulina | **MT** MNT Cyl



Cyanobacteria DNA

Microcystin gene
Microcystis DNA

Fig. 1 Agarose gel showing the three products amplified in the multiplex PCR reaction. *Lanes 1–12* are dietary supplement samples produced from the cyanobacterium *Aphanizomenon flos-aquae*. *Lanes 13–14* are dietary supplements produced from *Nostoc flagelliforme*. *Lanes 15–16* are samples of Spirulina. *Lane 17* is a microcystin-producing strain of *Microcystis*. *Lane 18* is a nonmicrocystin-producing strain of *Microcystis*. *Lane 19* is an environmental bloom sample dominated by *Cylindrospermopsis*. *Lane 20* is a 100-bp molecular ladder

Appl Microbiol Biotechnol (2007) 73:1136–1142
DOI 10.1007/s00253-006-0565-5

APPLIED GENETICS AND MOLECULAR BIOTECHNOLOGY

Multiplex PCR for the detection of toxigenic cyanobacteria in dietary supplements produced for human consumption

Martin L. Saker · Martin Welker · Vitor M. Vasconcelos

Toxicon 150 (2018) 207–211

Contents lists available at ScienceDirect

Toxicon

journal homepage: www.elsevier.com/locate/toxicon

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Case report

Hepatotoxicity induced by paclitaxel interaction with turmeric in association with a microcystin from a contaminated dietary supplement

Maria Luísa Costa[a], José A. Rodrigues[a,b], Joana Azevedo[c], Vitor Vasconcelos[c,d,*], Eduardo Eiras[e], Maria Graça Campos[a,f]

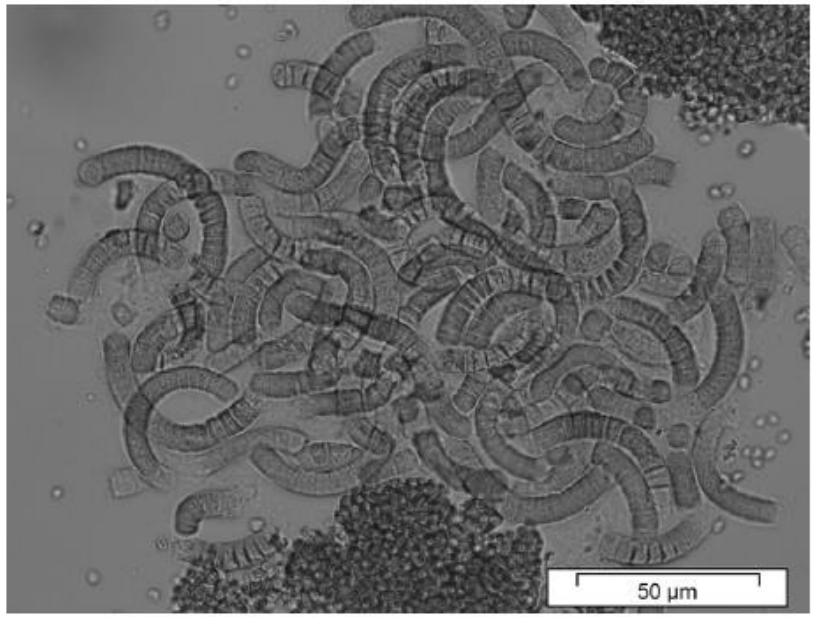

Fig. 3. *Chlorella* supplement through optic microscope.

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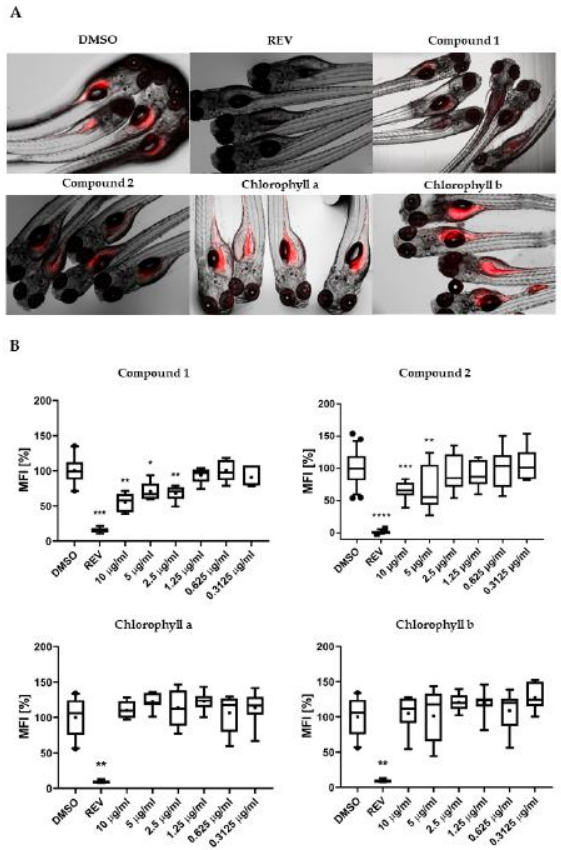

Figure 3. (**A**) Representation of the zebrafish Nile red fat metabolism assay. Strong fluorescence signal is present in zebrafish larvae from the solvent control around the yolk sac and stomach/intestine. Compounds **1** and **2** decreased the Nile red staining, in contrast to chlorophyll a and b. (**B**) Quantification of lipid-reducing activity in the zebrafish Nile red fat metabolism assay after exposure over 48 h. Solvent control was 0.1% dimethyl sulfoxide (DMSO) and positive control was 50 µM resveratrol (REV). Values are expressed as mean fluorescence intensity (MFI) relative to the DMSO group and are derived from six to eight individual larvae per treatment group. The data are represented as box-whisker plots from the fifth to 95th percentiles. Asterisks highlight significant altered fluorescence intensities that indicate changes of neutral lipid level (**** $p < 0.0001$; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$).

marine drugs *Mar. Drugs* **2019**, *17*, 229; doi:10.3390/md17040229 MDPI

Article

Chlorophyll Derivatives from Marine Cyanobacteria with Lipid-Reducing Activities

Sara Freitas [1,2,†], Natália Gonçalves Silva [1,†], Maria Lígia Sousa [1], Tiago Ribeiro [1], Filipa Rosa [1], Pedro N. Leão [1], Vitor Vasconcelos [1,2], Mariana Alves Reis [1] and Ralph Urbatzka [1,2,*]

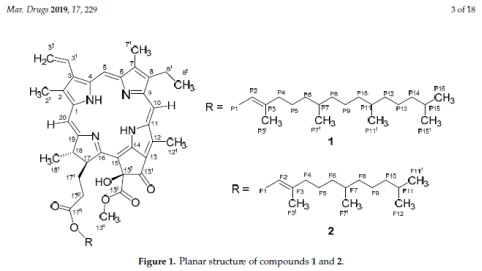

Figure 1. Planar structure of compounds **1** and **2**.

Patented knowledge

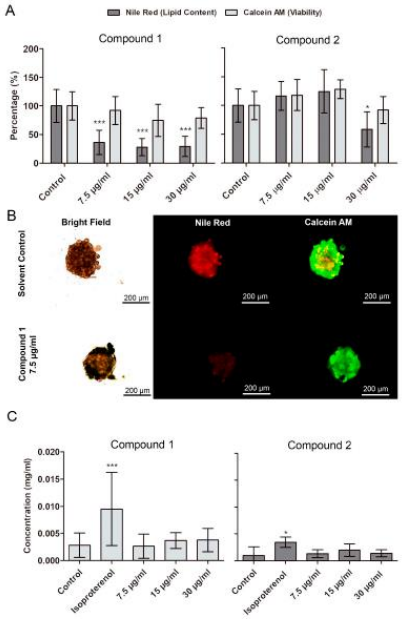

Figure 4. Quantification of lipid content (Nile red) and viability (calcein AM) in differentiated 3T3-L1 spheroids after exposure to **1** and **2** over 48 h. (**A**) Results of quantification of fluorescence by CellProfiler software (mean ± SD). (**B**) Representative images from fluorescence microscopy. Statistical differences to the solvent control were analyzed by one-way ANOVA, followed by a Dunnett's multiple comparison post-test (*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$). (**C**) Quantification of free glycerol on the medium where 3T3-L1 organoids were exposed to **1** and **2** over 48 h. Data represent means ± SD. No significant alterations on free glycerol content in the medium were observed. Kolmogorov–Smirnov test was used to test normality of the data, followed by a Dunnett's multiple comparison post-test (*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$).

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CULTURE COLLECTIONS

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ARE FUNDAMENTAL TOOLS FOR MICROBIAL **CONSERVATION, STUDY AND EXPLOITATION** TO FULLFIL UN SUSTAINABLE DEVELOPMENT GOALS

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Blue Biotechnology and Ecotoxicology Culture Collection

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LEGE-CC IN NUMBERS

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Ecotoxicology — **Bioactive compounds**

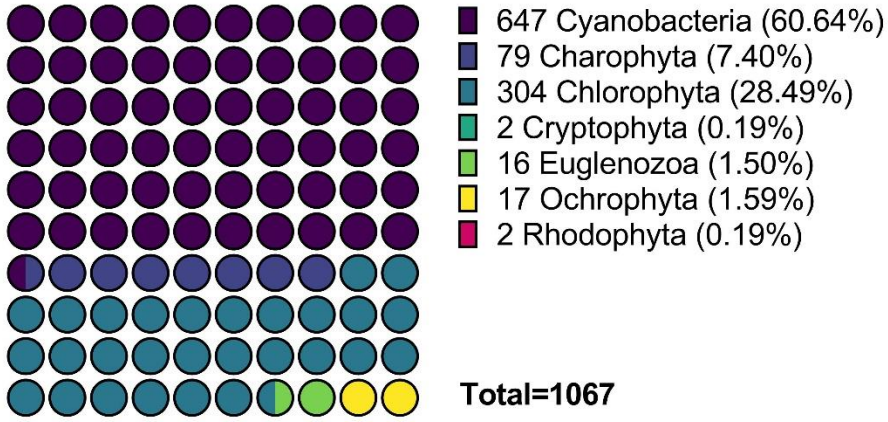
1991 — 2005 — 2006 — 2015 — 2018 — 2020

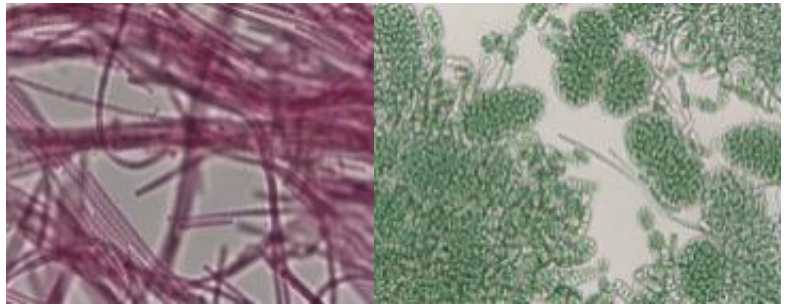
First isolates

33	Number of Strains	90	190	386	>1000

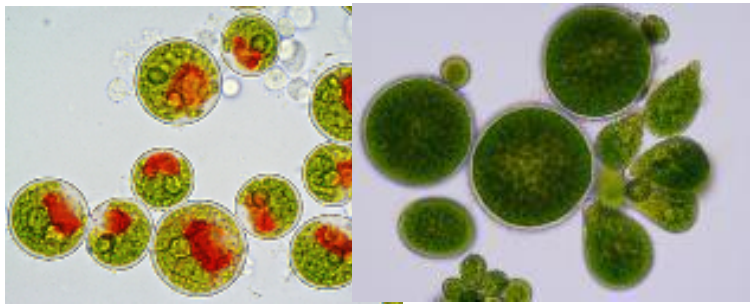
CYANOBACTERIA | **+ MICROALGAE**

Phylum





Cyanobacteria > 700



Microalgae > 400

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LEGE-CC HISTORY

Ecotoxicology

Bioactive compounds

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1991 First isolates

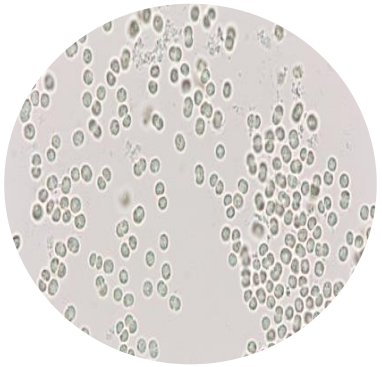
2005

2006

2015

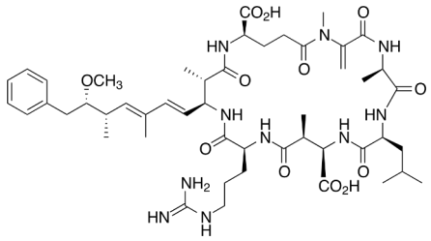
2018

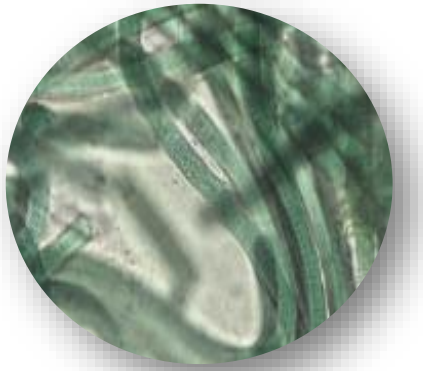
2020 Food Safety Aspects of Integrated Food Systems



Microcystis aeruginosa
LEGE 91094

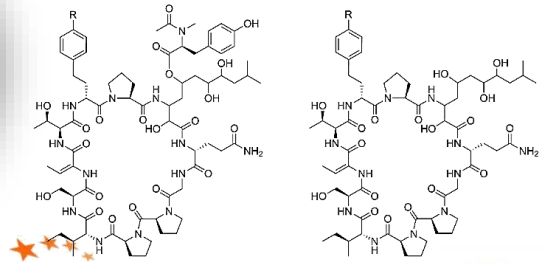
Microcystin





Phormidium sp.
LEGE 05292

Portoamides



WFCC World Federation for Culture Collections

EMBRC EUROPEAN MARINE BIOLOGICAL RESOURCE CENTRE

ECCO European Culture Collections Organization

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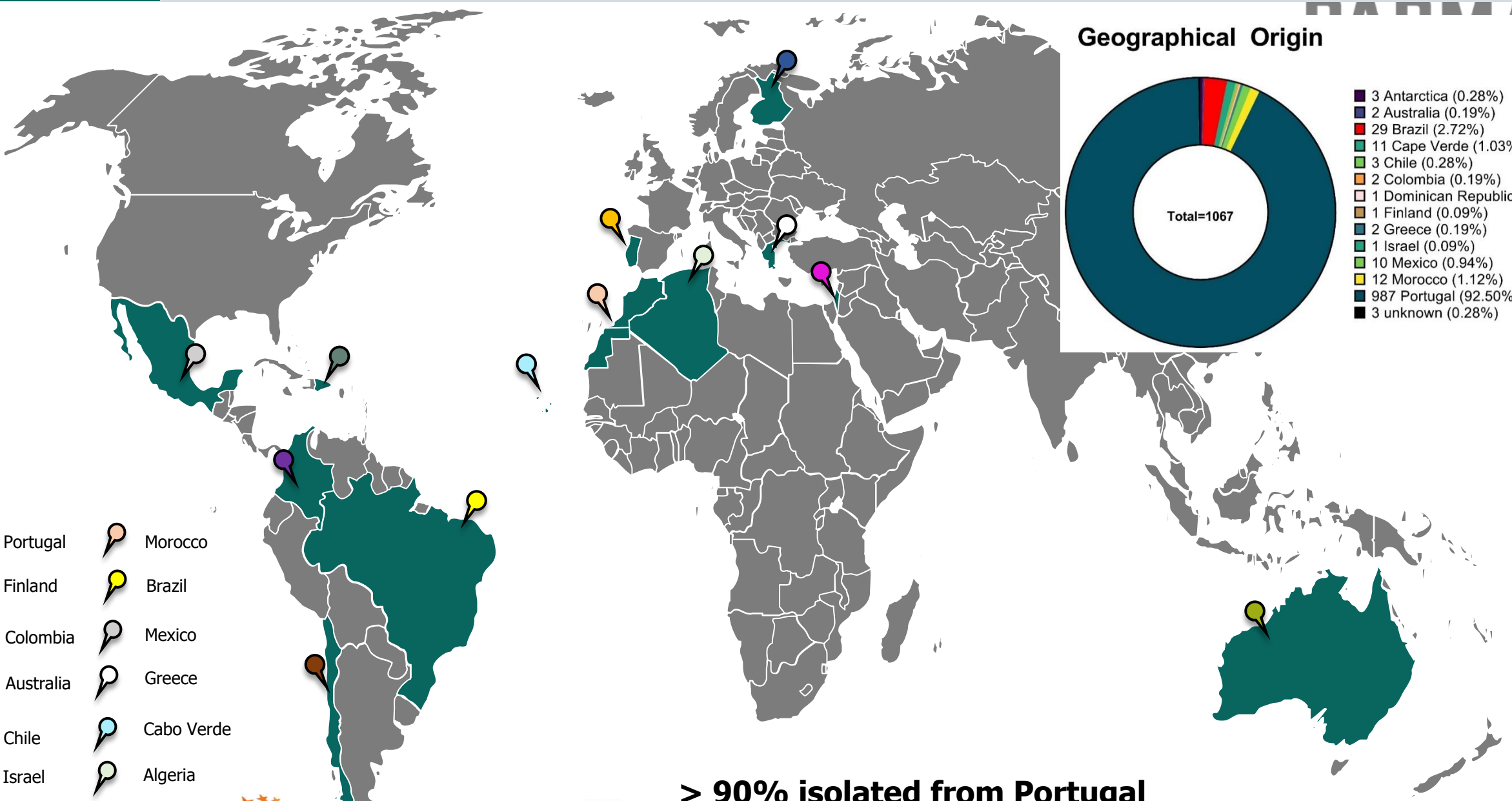
MIRRI MICROBIAL RESOURCE RESEARCH INFRASTRUCTURE

CATTOLICA del Sacro Cuore

STRAIN ORIGIN



Geographical Origin

> 90% isolated from Portugal

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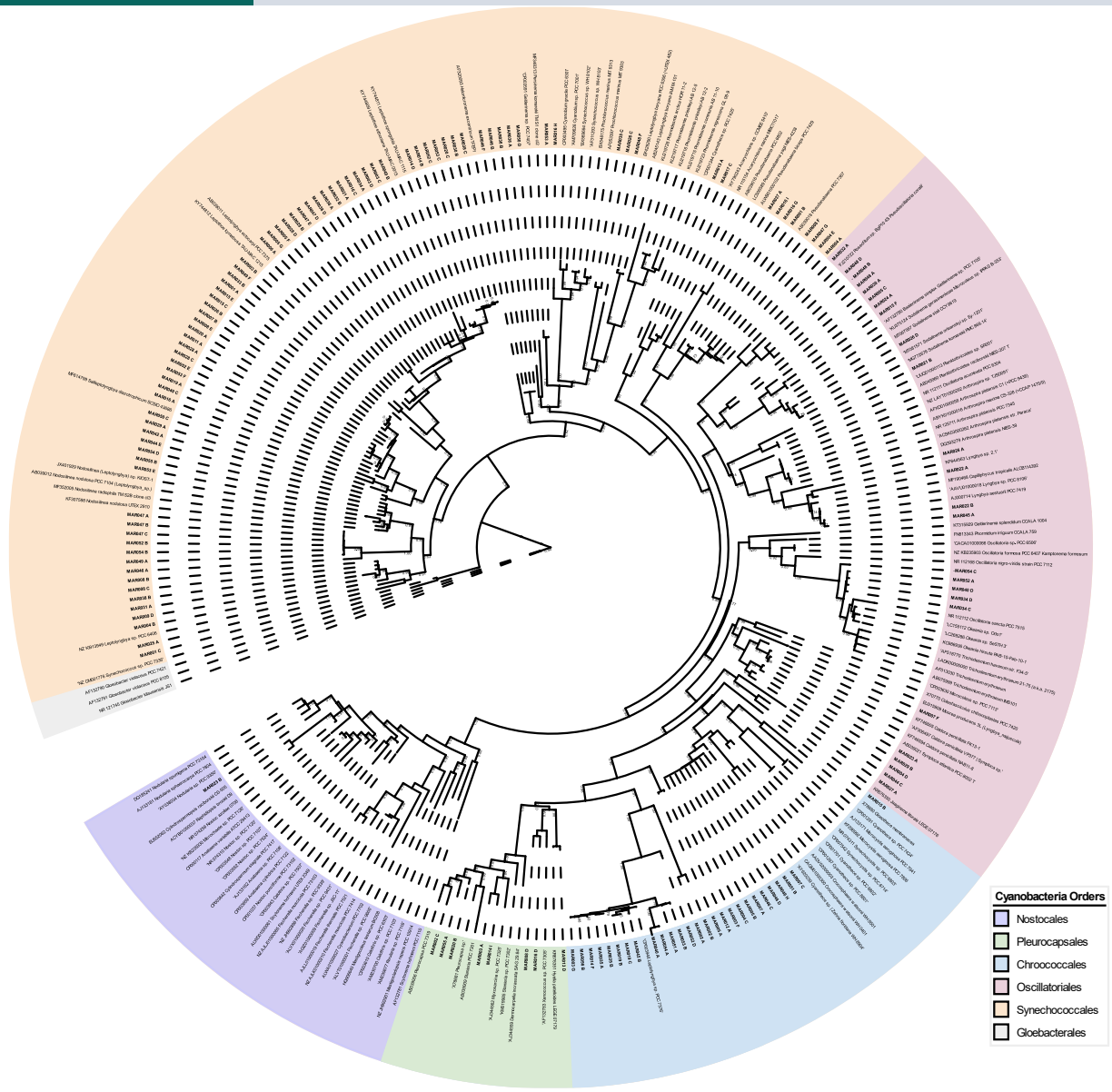
LEGE-CC CURRENT OVERVIEW



Cyanobacteria representing almost all the orders of the group

Metabolites in LEGE Strains

- Portoamides
- Hierridin B and C
- Bartolosides
- Dehydroabietic acid
- 13²-hydroxy-pheofarnesin a
- 13²-hydroxy-pheophytin
- Desmamides A-C
- Chlorosphaerolactylates A–D
- Microginins
- Nocuolactylates
- Nocuolin A

Toxin Producers

Microcystin
Anatoxin
Cylindrospermopsin
BMAA

EPS Producers

exopolysaccharides

> 50

Draft Genomes

> 50

Patents

5

Journal Articles

>200

> 700 cyanobacteria
> 400 microalgae

Type Strains

LEGE CC Facilities

Blue Biotechnology and Ecotoxicology Culture Collection (LEGE-CC)

Collection Room

Temperature - 19ºC

Photoperiod - 12/12h ligth/dark cycles

Light intensity - 10-30 µmol photons m^{-2} s^{-1}

legeCC Blue Biotechnology and Ecotoxicology Culture Collection

Isolation Room

Temperature - 22-24ºC

Incubator - 3-70ºC

Photoperiod - 14/10h ligth/dark cycles

Light intensity - 10-30 µmol photons m^{-2} s^{-1}

Culture Room (Biomass Cultivation)

Temperature - 22-24ºC

Photoperiod - 16/8h ligth/dark cycles

Light intensity - 10-100 µmol photons m^{-2} s^{-1}

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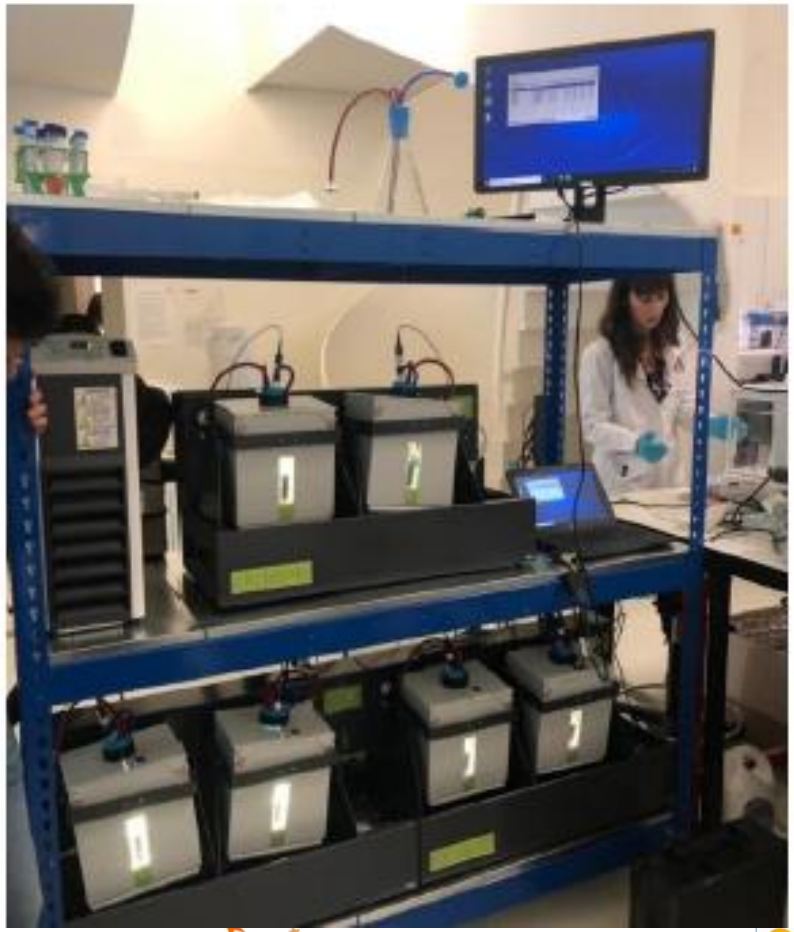
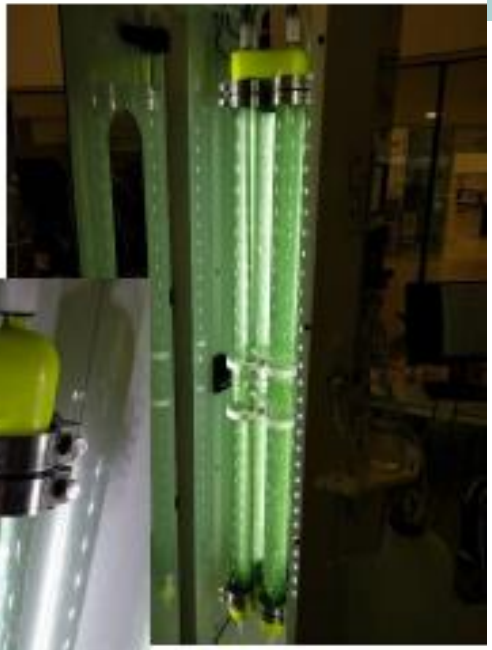
Photobioreactors

Blue Biotechnology and Ecotoxicology Culture Collection (LEGE-CC)

Algem® - 2L
(each Photobioreactor)



LUCY – 16L



Conferência


Allmicroalgae – Pataias, Portugal

Take home messages

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Food Safety Aspects of Integrated Food Systems

-Cyanobacteria blooms and their impact are far from decreasing worldwide.

-Cyanotoxins affect mammals in a more severe way than co-existing organisms.

-Bloom material and Culture collections are excellent resources and their potential is far from being used.

-Chemotyping of cyanobacteria and gene mining allow the discovery of hundreds of new bioactive compounds.

-Need to understand ecological role of cyanobacteria secondary metabolites.

-Potential applications in biotechnology are very promising.

Thank you

Vitor Vasconcelos

vmvascon@fc.up.pt

U.PORTO

ValorMar
Valorização integral dos recursos marinhos

BlueBio Future

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Centro Interdisciplinar de Investigação Marinha e Ambiental

ALGAVALOR

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Interreg España - Portugal

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European Commission

PORTUGAL 2020

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