



Compendium of Innovations

By
**Joint Master Programme in
Marine Biotechnology students**



Co-funded by
the European Union

Academic Research Integration



During the ARI the students worked together on a shared and transversal research project. The projects, designed by professors of different specialisations, gave the students the opportunity to apply general academic, research and/or design skills in practice.

At the same time, the transversality has been encouraged through the collaboration from different specialisations and in different locations, adding up each student's work and thus running a truly multidisciplinary joint research project.





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Assessment of *Vibrio vulnificus* depuration on the European flat oyster *Ostrea edulis* by phage therapy and an analysis of *Vibrio* toxicology

Introduction

In order to tackle Oyster-borne food poisoning caused by the toxin-producing bacteria *Vibrio vulnificus*, current depuration consists of chemical or physical disinfection system is preferred. These method may cause chemical hazard in the treated sea food product.

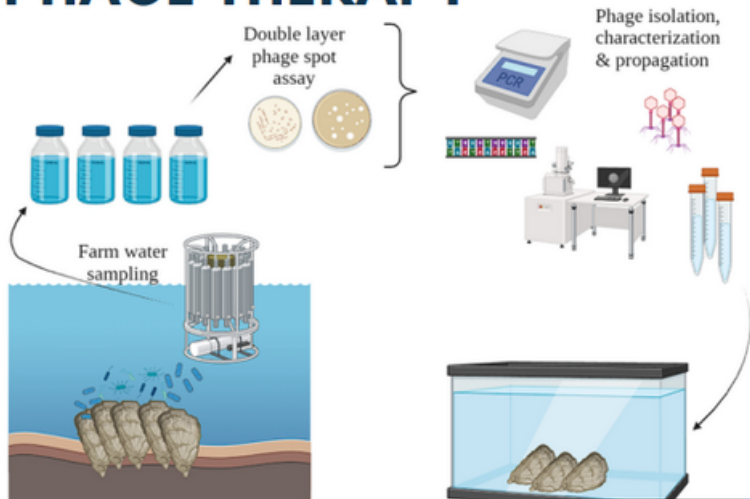
Methodology

The objective is to achieve this through the depuration of the bacteria by incorporating bacteriophage cocktails into an oyster-stocked recirculation system. The proposal encompasses the isolation of bacteriophages from the marine environment, testing the efficacy of the bacteriophage cocktail on depuration, conducting in vivo assays of bacterial toxins on roundworms, and profiling the toxins in contaminated oysters.

Conclusion

A proposed solution is using phage treatment to achieve reduction of *Vibrio* infections on *Ostrea edulis* and prevent the rise of antibacterial drug resistant *Vibrio*.

PHAGE THERAPY





Akira Harding

harding.akira@gmail.com

Find me
on LinkedIn



Collaborated in:



Foundation for the Promotion of Health and Biomedical Research of the Valencian Community (Fisabio), Spain



UNIZD. Assessment of the impact of marine aquaculture on the environment



Hellenic Centre of Marine Research, Greece

Track 4: Aquaculture Biotechnology



Marina Muñoz

marinamquintana@gmail.com

Find me
on LinkedIn



Collaborated in:



Geomar centre for ocean reseah Kiel, Germany

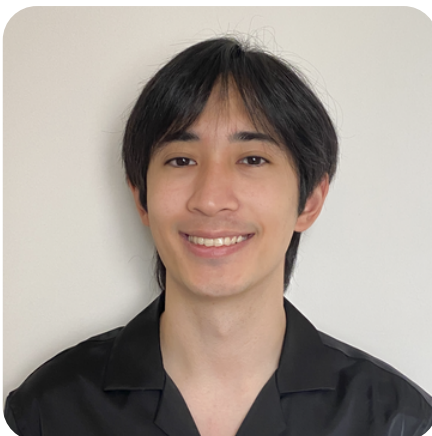


UCV. Biochemical profiling of microalgal biomass



CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

Track 1: Innovative Bioproducts for Future



David de los Reyes

davidmdreyes@gmail.com

Find me
on LinkedIn



Collaborated in:



CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal



UCV. Optimization of biomass and target compound production



Institute for Integrative Systems Biology Lab (I2sysbio), Spain

Track 2: Blue Biomass




Saana Londono


saana.londono@gmail.com


Find me
on LinkedIn



Collaborated in:

 CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

 IBMCP, Institute of Molecular and Cellular Biology of Plants, Spain

 Department of Biotechnology, UPV

Track 1: Innovative Bioproducts for Future




Christina Anna Stafyli


christinaanna.stafyl@mail.ucv.es


Find me
on LinkedIn



Collaborated in:

 CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

 Molecular Biology Lab of Agricultural University of Athens, Greece

 XanHELLA Ltd photo-bioreactors manufacturing company, United Kingdom

Track 1: Innovative Bioproducts for Future

Can a Recirculatory Aquaculture System be Optimized with Mycofiltration?

Introduction

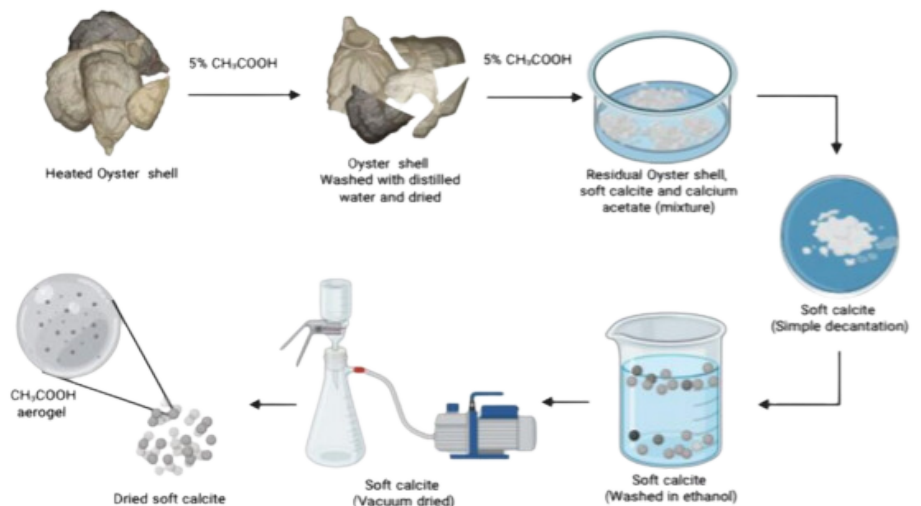
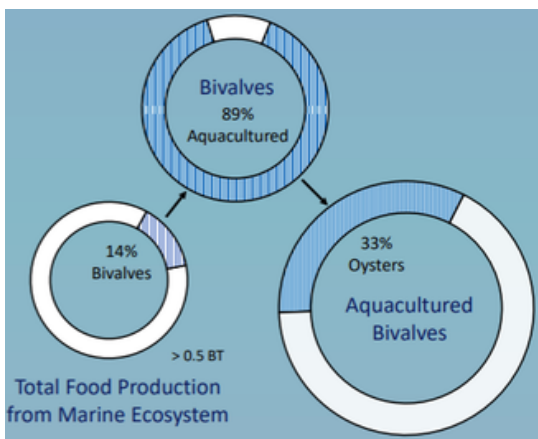
Over half a billion tonnes of food were produced from marine ecosystems in a span of 5 years. However, these numbers have been decreasing in the last few years due to tight quotas and competition for space in natural ecosystems. For this reason, researchers have been working to optimize recirculatory aquaculture systems (RAS)

Methodology

Improving the Recirculatory aquaculture systems (RAS) for marine bivalves in controlled environments, producing sorbent material from waste shells to immobilize the marine fungi (*Rhodospiridium sp.*), with additional comparative studies on fungal-assisted biofiltration systems.

Conclusion

With the results of the investigation, the industry may anticipate a significant change in RAS optimization. This could lead to the widespread use of more efficient biofilter configurations. For future research, by looking at a wide range of marine bacteria and fungi, researchers may find new microbial candidates with unique traits. This may help to find novel metabolites for better nutrient removal and antibiotic control in marine bivalve aquaculture systems.





Kathryn Henlser

henslerk21@alumni.wlu.edu

Find me
on LinkedIn



Collaborated in:



La Rochelle Université, France



UNIZD. Experimental cultivation of shellfish in RAS conditions



Marine Research Institute - CSIC (Spanish Research Council)

Track 4: Aquaculture Biotechnology



Adilia Shakirova

adilia.shakirova.22@gmail.com

Find me
on LinkedIn



Collaborated in:



Intermedica laboratory, Portugal



UCV. Antioxidant bioactivity of microalgae extracts to preserve sunflower oil-based margarines



University of Rostock, Germany

Track 1: Innovative Bioproducts for Future



Sikder Sanchita Tasnim

sikdersanchitaju45@gmail.com

Find me
on LinkedIn



Collaborated in:



Institute of Agrifood Research and Technology



Marine Research Institute,
Klaipeda University, Lithuania



Catholic University of Valencia

Track 2: Blue Biomass



María Posada García

maria.posada.gar@gmail.com

Collaborated in:



CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal



Marine Research Institute of Klaipeda University, Klaipeda, Lithuania



Institute of Marine Research of the Spanish Research Council (IIM-CSIC), Vigo, Spain

Track 2: Blue Biomass

Antioxidant properties of *Chlamydomonas* and *Scenedesmus* for cosmetics applications

Introduction

Chlamydomonas and *Scenedesmus*, are gaining recognition as potent sources of natural antioxidants with promising applications in the cosmetics industry. Their ability to neutralize free radicals and combat oxidative stress makes them compelling ingredients for skincare products. This project seeks to comprehensively evaluate the antioxidant properties of the extracts and explore their potential for cosmetic applications.

Methodology

Biomass (*Chlamydomonas*, *Scenedesmus* isolated from tomatoe hydroponic culture and natural cultivation media, scale, solvent, vortex, sonicator, ice for cooling, centrifuge, filter (0.22 μ m), and lyophilization, rotary evaporator, Melanoma cells, MTT.

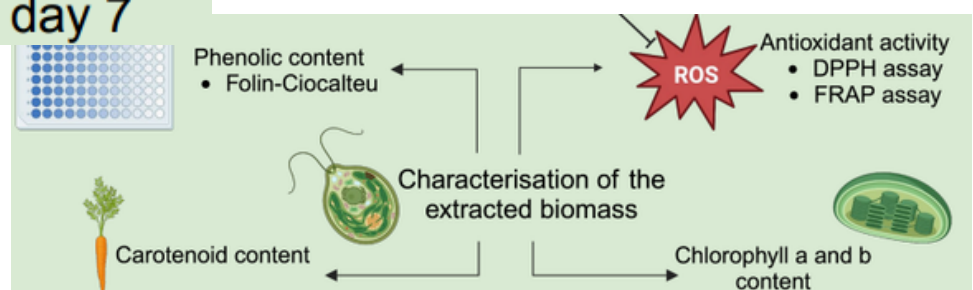
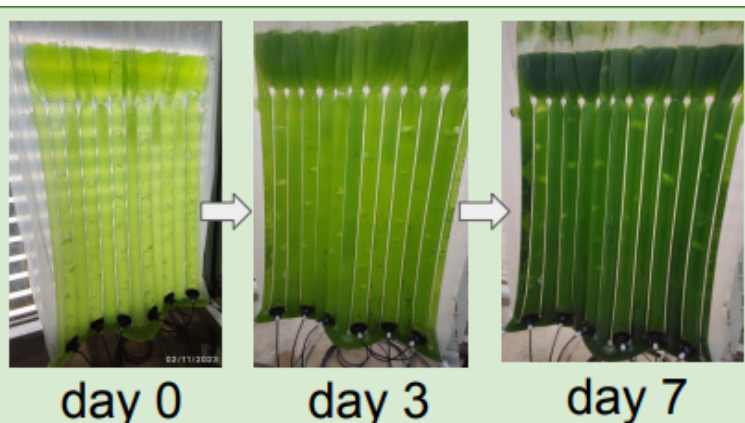
Conlusion

The custom-made PBR system lead to high biomass yield, Proposing a cheap and efficient cultivation technique.

High antioxidant and anti-tyrosinase activity from the extracts.

Scenedesmus water extracts are proven to be non-toxic at the anti-tyrosinase activity tested concentrations.

By conducting these comprehensive studies, we aim to establish the scientific foundation for the utilization of *Chlamydomonas* and *Scenedesmus* extracts in the development of safe, effective, and sustainable antioxidant cosmetic products.








Christina Anna Stafyli

christinaanna.stafyl@mail.ucv.es

Find me
on LinkedIn



Collaborated in:

-  CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal
-  Molecular Biology Lab of Agricultural University of Athens, Greece
-  Agricultural University of Athens, Greece

Track 1: Innovative Bioproducts for Future






Adriana Pereira Contreras Sánchez

adrianapcsanchez@gmail.com

Find me
on LinkedIn



Collaborated in:

-  Centro de Investigacion Principe Felipe, Spain
-  AUA. Microalgae biomass and extracts as sustainable sources for novel Nutra-Cosmeceuticals
-  Spiruline de la Côte Bleue
Toulouse Biotechnology Institute (TBI- INSA)

Track 1: Innovative Bioproducts for Future






Mathilde Benoit-Isart

mathildebenoitisart@gmail.com

Find me
on LinkedIn



Collaborated in:

-  Zavod za molekularnu biologiju, Croatia
-  AUA. Microalgae biomass and extracts as sustainable sources for novel Nutra-Cosmeceuticals
-  Givaudan, Pleumeur-Bodou, FRANCE

Track 1: Innovative Bioproducts for Future






Sergio Acebo Vidal

sergioacebovidal1@gmail.com

Find me
on LinkedIn



Collaborated in:

-  La Rochelle Université, France
-  AUA. In vitro toxicity assessment of bioactive molecules
-  CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

Track 1: Innovative Bioproducts for Future

Carrageenan-Based Hard-Shell Capsules Cross-Linked with Maltodextrin and Violacein for Targeted Therapy on MCF-7 Breast Cancer Cells

Introduction

Breast cancer is characterized by its diverse nature, representing a complex and heterogeneous disease. There is a necessity to formulate treatments that are immediate, highly efficient, and non-invasive. Research indicates that both carrageenan and the purple pigment violacein are effective against MCF-7 breast cancer. In this research proposal, the efficacy and stability of Carrageenan- (CRG-) and violacein based hard-shell capsules against breast cancer are to be tested.

Methodology

We aim to evaluate the efficacy and stability of these capsules as a potential oral drug delivery system. The process involves isolating and characterizing *Pseudoalteromonas luteoviolacea* for violacein production, cultivating *Kappaphycus alvarezii* for carrageenan extraction, and preparing the capsules with specific physical and chemical properties. The study will assess the anti-cancer activities of these capsules through various assays and analyses, aiming to provide a non-invasive treatment alternative for breast cancer.

Conclusion

Increasing concentrations of violacein based mixture in hard shell capsules are expected to have anti-cancer activities in MCF-7 breast cancer cells. Further work in animal model testing as alternative therapy for breast cancer could be done.





Agathi Argyrou

agathi21@gmail.com

Find me
on LinkedIn



Collaborated in:



School of Biochemistry, Faculty of Life Sciences of the University of Bristol



LRU. Caraghenans characterisation for softgel caps creation



CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

Track 1: Innovative Bioproducts for Future



Khadijat Adefaye

adrianapcsanchez@gmail.com

Find me
on LinkedIn



Collaborated in:



University of Bristol, United Kingdom



Catholic University of Valencia, Spain



University of Rostock, Germany

Track 1: Innovative Bioproducts for Future



Maqbool Ahmad

maqbool.ahmad@mail.ucv.es

Find me
on LinkedIn



Collaborated in:



CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal



Catholic University of Valencia, Spain



Viride GmbH, Germany

Track 2: Blue Biomass






Marielle Frank

mafran@mail.ucv.es

Find me
on LinkedIn



Collaborated in:

-  La Rochelle Université (LIENSs), France
-  LRU. Biological properties of bioinspired original compounds
-  CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

Track 1: Innovative Bioproducts for Future






Yasra Fatima

yasrafatima456@gmail.com

Find me
on LinkedIn



Collaborated in:

-  Ruder Boškovic Institute
-  LRU. Enzymatic inhibitors for anticancer and antiviral activities
-  Fundación MEDINA, Spain

Track 1: Innovative Bioproducts for Future

Discovery and in vitro high throughput screening of novel HCV helicase inhibitors by a de novo drug design approach

Introduction

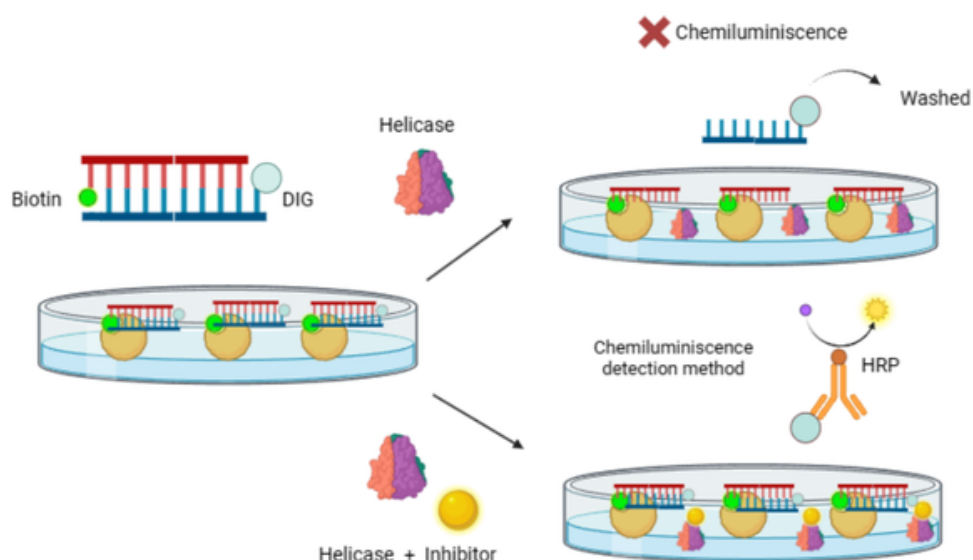
HCV infection is the second most common chronic viral infection in the world and there is no prophylactic or therapeutic vaccine available. So far the NS3 helicase has not been extensively explored as a target for inhibition of HCV replication. We propose a rational approach for the design of selective inhibitors of the HCV NS3 helicase coupled with a HTS screening method based on the unwinding activity of the enzyme.

Methodology

1. Target identification and validation
2. Binding site identification
3. Ligand based drug design
4. Molecular docking and optimization
5. Synthesis of potential inhibitors
6. In vitro high throughput screening
7. Structure-Activity relationship (SAR) refinement

Conclusion

In conclusion, our project aims to address the critical gap in HCV therapeutics by focusing on the NS3 helicase as an unexplored target. Through a rational drug design approach and the implementation of a high throughput screening method, we aspire to contribute valuable insights and potentially identify selective inhibitors of the HCV NS3 helicase, paving the way for innovative antiviral strategies.



María Amparo Vilarrasa Janini

mariaamparo.vilarras@mail.ucv.es

Collaborated in:



Marine research institute IMEDMAR - UCV



CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal



Darwin Bioprospecting Excellence S.L, Spain

Track 1: Innovative Bioproducts for Future

Sofía Schulze-Steinen Sebastián

sofia.schulze-steine@mail.ucv.es

Collaborated in:



Xanthella Ltd



AUA. Molecular Dynamics Simulation



Foundation for the Promotion of Health and Biomedical Research in the Valencian Region (FISABIO), Spain

Track 1: Innovative Bioproducts for Future

PeptaMed: Marine peptide power to treat chronic inflammation

Introduction

The skin is the largest human organ which serves as a barrier protecting us from external threats and damage. Marine natural products receive more and more attention as a remedy for treating the most threatening human diseases.

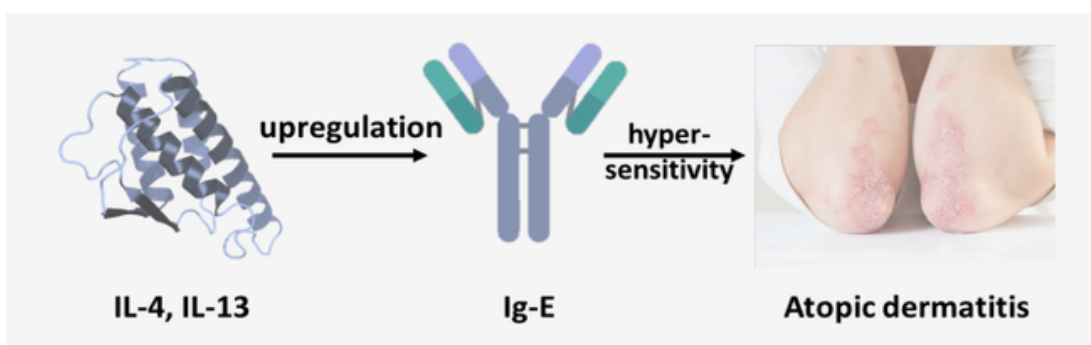
We aim to investigate the potential of marine collagen peptides in the treatment of the chronic skin condition Atopic Dermatitis (AD). Peptides can be effective inhibitors of specific proteins. We will examine the potential of fish collagen peptides as inhibitors targeting specific proteins and receptors involved in AD.

Innovation

- The current drugs mostly treat the symptoms of AD or are expensive. We will target specific proteins and their receptors that play a key role in AD.
- The collagen peptides will be obtained from fish skin waste product which is a sustainable and cheap source. We will select fish that are coming from well-managed aquaculture farms to guarantee the highest quality.

Conclusion

The proposed project establishes a workflow comprised of 1. collagen extraction and hydrolysis, 2. peptides characterization and 3. in-vitro activity confirmation for IgE gene expression silencing. The project will allow to find fish skin collagen peptides with the highest potential for treating AD and being utilised as human therapeutics.





Aida Bradauskaitė

aida.bradauskaite@mail.ucv.es

Find me
on LinkedIn



Collaborated in:



IMEDMAR-UCV; Environmental and Marine Research Institute, Spain

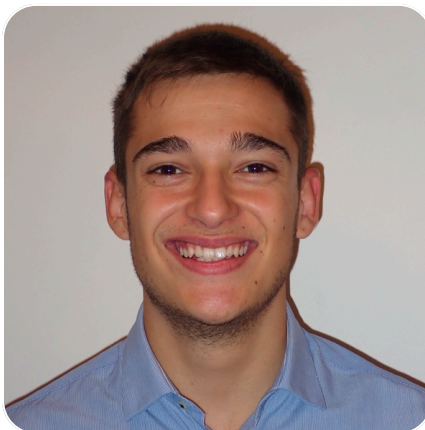


LRU. Optimization of sturgeon collagen extraction and its characterisation



Max Planck Institute for Multidisciplinary Sciences, Germany

Track 1: Innovative Bioproducts for Future



Álvaro González Cid

alvarogonzalezcid@mail.ucv.es

Find me
on LinkedIn



Collaborated in:



Príncipe Felipe Research Centre (CIPF), Spain



Andalusian Centre of Biology for Development, Spain



University of South Bohemia, Czech Republic

Track 4: Aquaculture Biotechnology



Erieta Jazaj

erietta.jazaj22@gmail.com

Collaborated in:



The Andalusian Institute of Agricultural and Fisheries Research and Training (IFAPA), Spain



Marine Research Institute of Klaipeda University, Klaipeda, Lithuania



Institute of Marine Research of the Spanish Research Council (IIM-CSIC), Spain

Track 2: Blue Biomass

Screening of marine natural products for anticancer activity from a marine bacteria and macroalgae using cell culture

Introduction

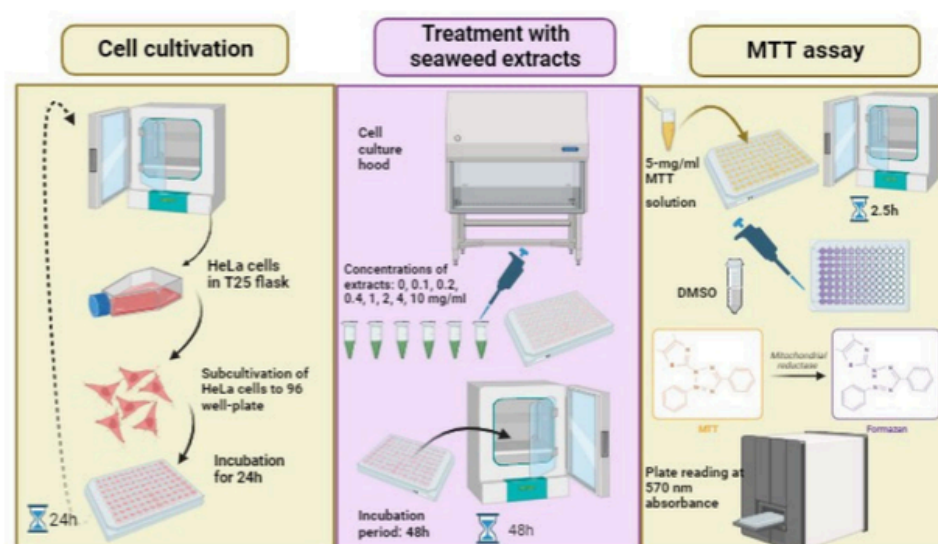
Oxidative stress, defined as a loss of balance between antioxidants and oxidants, often in favour of the latter (Sies, 2020), plays a crucial role in chronic diseases such as cancer. Research for new antioxidant compounds can advance anticancer drug discovery. The sea is a vast source for organisms able to produce a wide array of chemically diverse, natural compounds with extraordinary bioactivities. Here, bacteria and macroalgae are examined as potential producers of valuable anticancer compounds.

Methodology

1. Culturing *Chromobacterium violaceum* for violacein production
2. Extraction of polyphenols & pigments from marine macroalgae
3. Extract treatment for antitumoral screening on HeLa cells

Conclusion

- *Chromobacterium violaceum* extract shows decreasing absorbance, hinting at potential cytotoxicity;
- Seaweed extracts vary: *Fucus* lacks cytotoxicity, contrary to its high antioxidant activity, while *Codium vermilara* impacts cell survival with a lower IC₅₀;
- *Sphaerococcus* extract is highly cytotoxic although it has minimal antioxidant activity at low concentrations, indicating the need for further exploration of toxicity, possibly on *C. elegans*.






David de los Reyes


davidmdlreyes@gmail.com


Find me
on LinkedIn



Collaborated in:

 Institute of Agrifood Research and Technology, IRTA, Spain

 Institute for Integrative Systems Biology Lab (I2sysbio), Spain

 CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

Track 2: Blue Biomass




Nicola Di Simone


nicola.disimone@mail.ucv.es

Find me
on LinkedIn



Collaborated in:

 UCV. Screening of macroalgae biomass for antioxidant new compounds

 CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Portugal

Track 1: Innovative Bioproducts for Future



Celina Kolanovic

celinakolanovic@hotmail.com

Find me
on LinkedIn



Collaborated in:

 Institute of Ruđer Bošković- Zagreb, Croatia

 Universidad Catolica de Valencia, IBMCP (UPV-CSIC)- Valencia, Spain

Track 1: Innovative Bioproducts for Future



2022-2024



Joint Master Programme in Marine Biotechnology students



Akira
Harding



Marina
Muñoz



David
de los Reyes



Saana
Londono



Christina Anna
Stafyli



Adilia
Shakirova



Kathryn
Henlser



Sikder
Sanchita Tasnim



María
Posada García



Adriana Pereira
Contreras Sánchez



Mathilde
Benoit-Isart



Sergio
Acebo Vida



Khadijat
Adefaye



Agathi
Argyrou



María
Vilarrasa



Maqbool
Ahmad



Marielle
Frank



Yasra
Fatima



Aida
Bradauskaitė



Sofia
Schulze-Steinen



Álvaro
González Cid



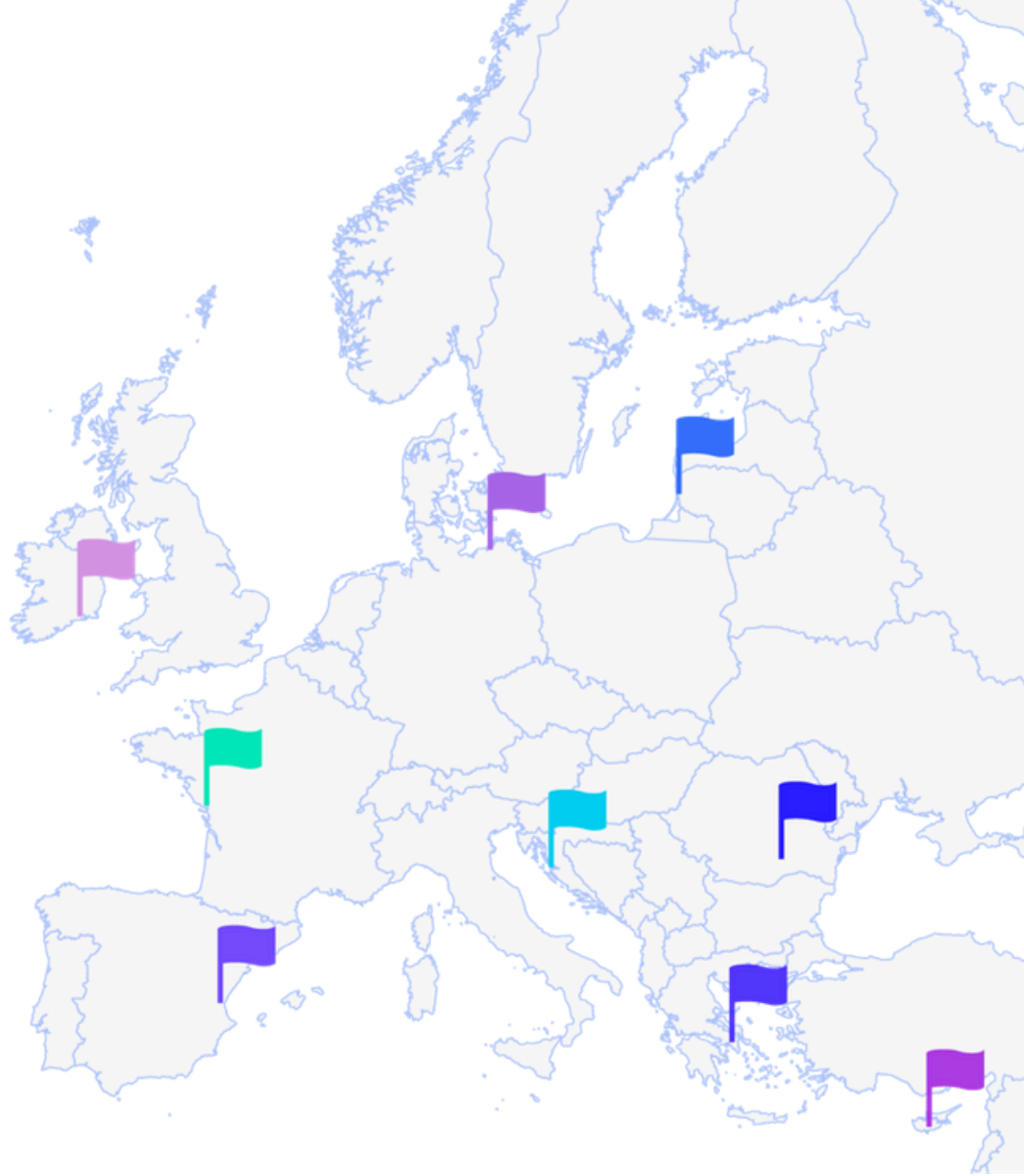
Erieta
Jazaj



Nicola
Di Simone



Celina
Kolanovic



Joint Master Programme in Marine Biotechnology



Mail admission.mb@eu-conexus.eu

Website eu-conexus.eu



@eu_conexus