

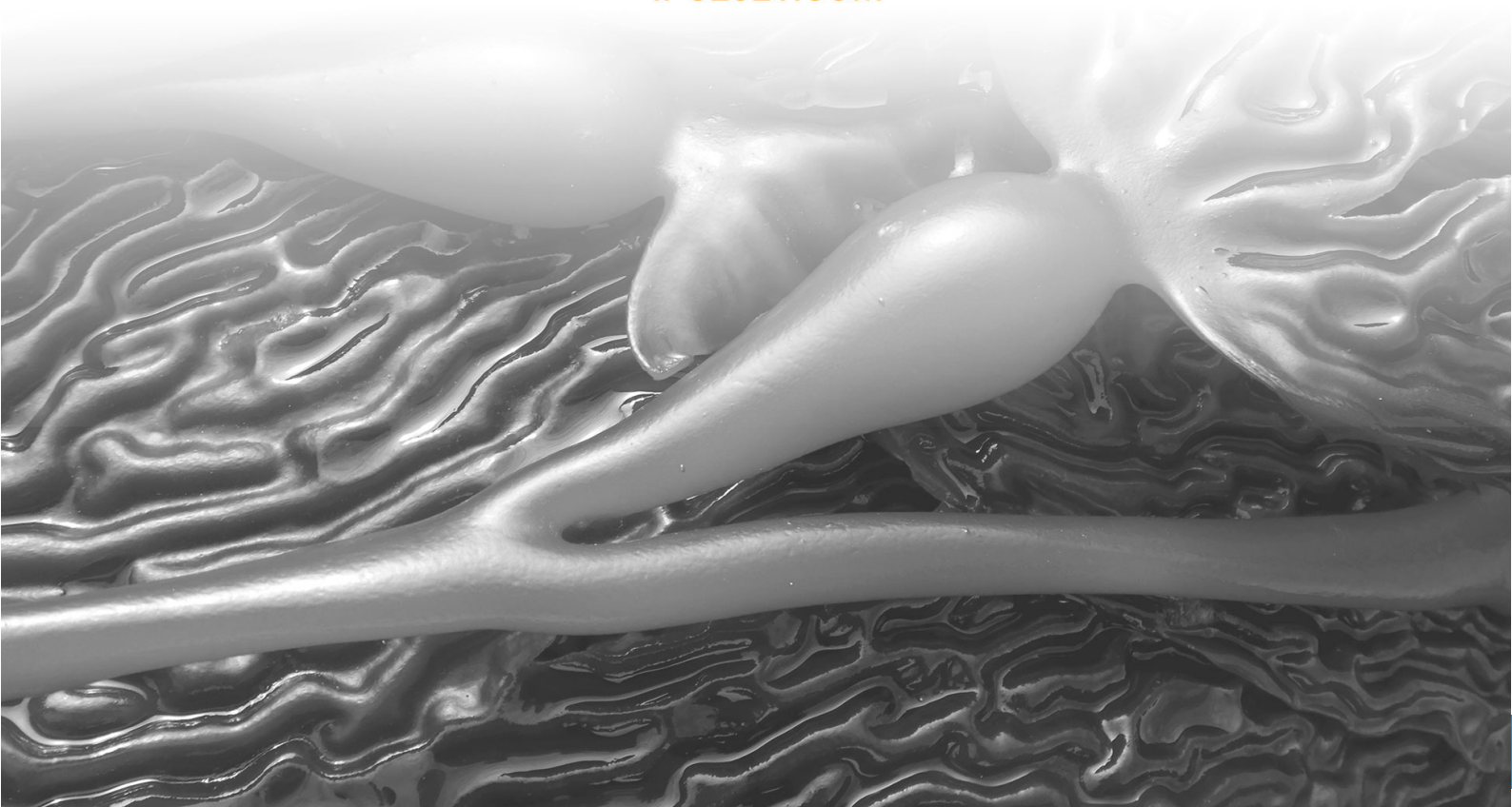


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ABSTRACTS BOOK

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E-Poster

NEW APPLICATIONS FOR *GELIDIUM CORNEUM*: ANTIMICROBIAL AND ANTIOXIDANT ACTIVITY WITHIN A BIOREFINERY CONCEPT

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There are more than four hundred endogenous seaweeds that occur in Portugal, and red seaweeds (Rhodophyta) are the most abundant. Among these, *Gelidium corneum*, common in the Atlantic coast of Portugal, is currently being collected in the wild, in S. Martinho do Porto, exclusively for the extraction of agar. During the summer season this species is harvested from the bottom of the ocean, dried and sold, representing an important economic local activity. Yet, besides agar, this species is important for its bioactivities, namely for its antioxidant and antimicrobial capacities, thus most of the biomass is currently being disregarded as an important marine resource. Therefore, to further research the potential of *G. corneum* as a source of bioactive compounds, the biomass was seasonally harvested and characterized (protein, ash, moisture), and different extracts were made (aqueous and ethanolic). These extracts were analyzed for the antioxidant potential (DDPH, ABTS, TPC and FRAP), and for antimicrobial capacity (against *Escherichia coli*, *Bacillus subtilis*, *Candida albicans*, *Saccharomyces cerevisiae* and *Staphylococcus epidermidis*). Preliminary results show that there are seasonal variations in the chemical composition of the biomass. Extracts tested also show interesting free radical scavenging capacity and antimicrobial activity against some of the strains tested. The attained results demonstrate that the biorefinery concept should be implemented to the agar industry, valuing the seaweeds' biomass so to allow its use in other industries, such as textiles or cosmetics.

Financing: This study had the support of FCT UIDB/04292/2020 and Mar2020 project LIMO DO CAIS -MAR-04.03.01-FEAMP-0101

Keywords: *Gelidium corneum*, antioxidant, antimicrobial

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POTENTIAL SOURCE OF COSMECEUTICAL BIOACTIVE(S): UNRAVELLING UVB RADIATION PROTECTIVE POTENTIAL OF BROWN ALGA *PADINA AUSTRALIS*

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Seaweed-derived biometabolites are receiving global attention as safe and potentially sustainable ingredients for skincare products. This study aimed to evaluate antioxidant and ultraviolet (UV) protective effect of ethanol and aqueous extracts of *Padina australis* from Malaysian waters. UVB protective activity was tested on an experimental model using HaCaT human keratinocytes. Since antioxidant activity is known to suppress the detrimental effects of UVB damage, the project was initiated with the attempt to evaluate the antioxidant activity of ethanol & aqueous extracts. It was surprisingly to observe that ethanol extracts exhibited a stronger antioxidant activity when compared to aqueous extracts when being examined by DPPH and reducing power activity assays. In fact, it was interesting to observe the ethanol extract was consisted with a high level of phenolics (76 mg GAE/g) and flavonoids (50 mg QE/g) which might give rise to the notion that ethanol extract is a promising candidate for us to move forward with. Further experimentation was done, in order to evaluate the protective effect extracts against UVB-induced cell damage and result shown ethanol extract was far more superior than aqueous extract with stronger a fold in term of its efficacy (400 µg/mL). In addition, Liquid Chromatography–Mass Spectrometry analysis revealed that ethanol extract consists of sugar alcohol, carbohydrate, carotenoids and fatty acids. In summary, extract/biometabolites derived from *P. australis* have shown to possess great antioxidant and promising UVB protective activity which therefore, would be deemed as a great promising candidate to be developed as a novel cosmeceutical ingredient.

Keywords: Algae, cosmeceuticals, UV-protective



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UNRAVELLING THE ANTI-NEUROINFLAMMATORY ACTIVITY OF THE MALAYSIAN RED MACROALGA *KAPPAPHYCUS MALESIANUS* IN LIPOPOLYSACCHARIDES-STIMULATED BV2 MICROGLIA

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Neuroinflammation is a hallmark for neurodegenerative diseases due to high oxidative stress produced by activated microglia and astrocytes. Overproduction of cytotoxic factors will increase oxidative stress and lead to neuronal degeneration and neuronal death. It has become increasingly evident in recent years that the biometabolites derived from seaweeds possess numerous biological activities including neuroprotective activity. *Kappaphycus malesianus* is a newly described species in Malaysia, which is an important source of raw material for carrageenan production. To the best of our knowledge, no study has been reported on the pharmacological properties of *K. malesianus*. Therefore, this study aimed to investigate the anti-neuroinflammatory activity of *K. malesianus* extracts (ethyl acetate, ethanol and methanol) on Lipopolysaccharides (LPS)-stimulated BV2 microglial cells. Cell viability assay was used to examine the cytotoxic of all *K. malesianus* extracts and it was found that methanol extract had an IC₅₀ of 6.67 ± 0.61 mg/mL, showing the least cytotoxic effect. The nitric oxide inhibition activity was determined by using Griess assay and the expression of iNOS and COX-2 was evaluated by Immunoblot analysis. All extracts reduced the nitric oxide production in concentration-dependent manner, and methanol extract demonstrated the highest nitric oxide inhibition activity. Immunoblot analysis showed that methanol extracts inhibited iNOS and COX-2 production in a dose dependent manner. Our findings indicate that *K. malesianus* possesses anti-neuroinflammatory activity by inhibiting the production of pro-inflammatory mediators.

Keywords: *Kappaphycus malesianus*, anti-neuroinflammatory effect, pro-inflammatory cytokines

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SEQUENTIAL EXTRACTION OF PHYCOBILIPROTEINS AND AGAR FROM AGAROPHYTON CHILENSE

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The main application currently given to *Agarophyton chilense* (Pelillo), red macroalgae, is agar extraction. Instead, phycobiliproteins (PBPs) are intracellular photoreceptor protein pigments which can be also extracted from this red macroalgae. It has been reported that PBPs have antioxidant and antitumor properties, among others, being attractive for the pharmaceutical and biotechnology industries. PBPs are divided into three main groups: Phycoerythrin, Phycocyanin and Allophycocyanin, which are composed of two main subunits, alpha and beta, and in some cases gamma, with molecular weights in the range between 16 to 20 kDa. The main aim of this research is to provide an added value product from *Agarophyton chilense*, by means of the sequential extraction of PBPs and agar from the residual matter, after PBPs extraction. To carry out our purpose, *Agarophyton chilense* was incubated with PBS buffer and proteins were precipitated with ammonium sulfate. PBPs were purified from dialyzed protein fractions using anion-exchange chromatography. Agar was extracted after alkali treatment and neutralization of algae residue. Results demonstrate that it is feasible to recover agar from the residual matter after PBPs extraction. The recovery of PBPs from crude extract was ca. 10% and agar yield from dry algae was approximately 25%. Additionally, no differences were found in agar quality (gel force) from samples treated with and without a previous PBPs extraction step.

Financing: Centre for Biotechnology and Bioengineering (CeBiB) FB-0001 and Fondecyt Grant Number 1180794

Keywords: *Agarophyton chilense*, phycobiliproteins, agar extraction



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AN INVESTIGATION ON GROWTH PERFORMANCE AND NANO-BIOTECHNOLOGICAL EXPLOITATION OF *HALAMPHORA SUBTURGIDA* (HUSTEDT) LEVKOV

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A marine pennate diatom *Halamphora suburgida* (Hustedt) Levkov was isolated from Eastern India and its growth performance was investigated based on biochemical parameters at different nitrate concentrations. Maximum value of chlorophyll ($14.95 \pm 0.04 \mu\text{g/ml}$), fucoxanthin ($25.70 \pm 0.03 \mu\text{g/ml}$), total carotenoids ($26.92 \pm 0.05 \mu\text{g/ml}$) and protein ($87.49 \pm 0.06 \text{ mg/g}$) contents were recorded when subjected to double nitrate ($1,764 \mu\text{M}$) as compared to control ($882 \mu\text{M}$) and half nitrogen concentration ($441 \mu\text{M}$) after 12 days of growth period. Furthermore, for nano-biotechnological exploitation of *H. suburgida*, acid-digested nano-siliceous frustule powder was used for making Metal-oxide Semiconductor (MOS) capacitor employing vapor-liquid-solid (VLS) method. Fabricated MOS capacitor were tested by measuring leakage current ($\sim 43 \pm 8 \times 10^{-11} \text{ A } \mu\text{m}^{-2}$ at $+2 \text{ V}$), capacitance-voltage, constant current ($0.1 \mu\text{A}$), and voltage stress (at -2 V). Processed nanoporous frustules were again subjected to silver solution (9 mM) at pH 4. The resultant biosynthesized conjugate nanodendrites were characterized using conventional methods. Electron photomicrographs provided mechanistic view with the formation of isotropic hybrid nanospheres (20 nm) internally and continued to develop anisotropic nanocrystals with time. The nanodendrites externally formed on the siliceous frustules acting as a template, were characterized by the distinct trunk (100 nm in width, $1\text{-}2 \mu\text{m}$ in length) with branches on either side ($200\text{-}220 \text{ nm}$ in length, $70\text{-}100 \text{ nm}$ in width). Both the externally derived hybrid nanodendrites and internally synthesized nanospheres possessed superior stability with zeta potential value of -35.7 mV and -24.8 mV respectively.

Keywords: Diatom, growth performance, nano-conjugate

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EXPLORATION OF CYANOBACTERIA AS NANOIRON BIOFACTORY AND ITS APPLICATION IN CR (VI) REMOVAL

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The present study is focused on green synthesis of nanoiron using different Cyanobacterial strains like *Leptolyngbya valderiana* (Gomont) Anagnostidis & Komárek, *Lyngbya birgei* G.M.Smith, *Arthrospira platensis* Gomont, *Anabaena spherica* Bornet & Flahault, *Tolypothrix* sp. Kützing ex Bornet & Flahault etc. followed by potential strain selection for Cr (VI) removal process. Biotransformation of Fe³⁺ to Fe⁰ was recorded at intracellular and extracellular levels by active cyanobacterial culture within 4 days of incubation in 0.01M FeCl₃ in an ecofriendly way. Synthesized nanoiron particles by the biomasses were characterized using UV-Vis spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Dynamic Light Scattering (DLS), Fourier Transform Infrared spectroscopy (FTIR), X-Ray Diffraction (XRD). Synthesized particles were monodisperse in nature, having a size range of 20-50nm x 7-12nm with spindle shaped structure. Quantifications were done and *L. valderiana* has been selected as the highest productive strain (40-60 mg/g biomass). Free as well as cyanobacterial biomass loaded with nanoirons were used as nanosorbents and tested for their Cr(VI) removal potency against 5-20mg/L Cr (VI) solutions at different dosages (2-10g/L) with varied incubation times (1-48h). Reaction kinetics along with adsorption isotherm analysis showed that biomass loaded nanoiron was following chemisorption process satisfying Freundlich isotherm whereas free nanoirons (intracellular and extracellular) were followed physisorption process satisfying Langmuir isotherm for Cr (VI) removal from solution. It has been found that biomass loaded nanoirons

had higher adsorption capacity (0.0439 L/mg) and thus more efficient in Cr (VI) removal than that of their free form.

Keywords: Cyanobacteria, nanoiron, Cr (VI) removal



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GRACILARIA MANILAENSIS YAMAMOTO & TRONO EXTRACTS IN ATTENUATION OF LIPOPOLYSACCHARIDE-STIMULATED NEUROINFLAMMATION IN BV2 MICROGLIA

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Lipopolysaccharide (LPS)-stimulated BV2 microglia is known as a stable model for anti-neuroinflammatory activity studies. *Gracilaria manilaensis* is an agarophyte commonly cultivated in Malaysia which has received increasing attention for its antioxidant and neuroprotective activities. This study aimed to investigate how *G. manilaensis* extracts attenuate the neuroinflammatory activities in LPS-stimulated BV2 microglia. Hot aqueous, methanol and ethanol extracts were prepared from the *G. manilaensis* sampled at Kuala Muda, Kedah, Malaysia. BV2 microglial cells were treated with extracts for 2 h and then stimulated with LPS O55:B5 16 – 24 hr. Nitric oxide production and cell viability were measured by Griess assay and dimethylthioltetrazolium bromide (MTT) assay respectively. Inflammatory mediators expression were analysed by the Western blot. pro-inflammatory cytokines expressions were analysed by Enzyme-linked immunosorbent assay (ELISA). The profile of possible biocompounds was analysed by Liquid chromatography-mass spectrometry analysis (LCMS) with Q-TOF. Methanol and ethanol extracts showed significant anti-nitric oxide activity ($p \leq 0.05$) without interrupting the cell viability. Ethanol extract was selected for protein expression study as it poised the strongest anti-nitric oxide activity. iNOS expression of LPS-stimulated BV2 microglia was downregulated with no effect on β -actin expression and COX-2. Further ethanol extract inhibits interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF- α) production in LPS-stimulated BV2. LCMS analysis detected 2-hydroxyhexadecanoic acid, Cyrneine A and Eplerenone with anti-neuroinflammatory activity in ethanol extract. Our findings indicate that ethanol extract has the highest anti- neuroinflammatory activity which was closely linked with iNOS, IL-6 and TNF- α abrogation.

Keywords: *Gracilaria manilaensis*, LPS-stimulated BV2 microglia, neuroinflammation

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SCREENING OF DIATOMS FOR THEIR EFFICACY TO SYNTHESIZE GOLD-SILICA AND SILVER-SILICA NANOCONJUGATES

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The main objective of nanobiotechnology is to synthesize non-toxic metal nanoparticles which consider “biological systems” as a potential, eco-friendly source. The metal-silica nanocomposites are very useful in medical applications especially in photothermal therapy and multimodal imaging for cancer detection. Diatoms are well known as “Natural silica-nanofactories” and considered as efficient bioreagent for biogenesis of metal-silica nanocomposites. In the present communication a screening program has been completed in relation to bioconversion of gold-silica and silver-silica nanoconjugates from auric chloride and silver nitrate solutions respectively exploiting different diatoms like *Melosira lineatae*, *Phaeodactylum tricornutum*, *Nanofrustulum shiloi*, *Navicula korzeniowskii*, *Gedaniella mutabilis*. Each of the selected diatoms was exposed to HAuCl_4 and AgNO_3 solution separately for 72 h. The biosynthesized nanoconjugates were extracted from the nanoparticle loaded biomass using nanoparticle capping agent, sodium citrate solution. The nanoconjugates were characterized using Uv-Vis spectroscopy, Energy-dispersive X-ray (EDAX) analysis, scanning (SEM) and transmission (TEM) electron microscopy. In Uv-vis spectroscopy, gold-silica and silver-silica suspension showed the characteristic absorption bands ~ 530 nm and ~ 420 nm respectively. Energy-dispersive X-ray (EDAX) analysis confirmed the presence of Au/Ag and SiO_2 nanoparticles in a composite form. The SEM study revealed that composite particles were deposited on the siliceous frustules of diatom cells. The TEM analysis confirmed the synthesis of different shaped metal-silica nanoconjugates with variable size ranges. It can be concluded that diatoms are good potential source for the rapid biosynthesis of biocompatible metal-silica nanoconjugates due to their high growth rate and high metal uptake capacity.

Keywords: Diatoms, biogenesis, nanoconjugates



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PHYCOREMEDIATION OF TANNERY WASTE USING CYANOBACTERIA AS BIOREAGENT AND EXPLOITATION OF SPENT BIOMASS AS BIOFERTILIZER

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Economically feasible Cyanobacteria-based remediation of Tannery waste water was carried out along with application of spent biomass as biofertilizer for crop plants. Tannery wastewater carry heavy pollution load due to high organic and inorganic substances. Characterization of this water from inlet point source showed high level of BOD (1234.33 mg/L), COD (1706.64 mg/L), TDS (6984 mg/L), Sulfide (140.8 mg/L) and Ammonia (134.5 mg/L). From the present investigation it was found that from tannery wastewater Cyanobacteria efficiently removed toxic metals in one hand and nutrient loads on the other. In this investigation both marine and freshwater strains *Leptolyngbya* and *Arthrospira* were grown in diluted tannery wastewater. Both of them were found to be potent in removing BOD, COD and Ammonia by 90%, 96% and 84% respectively. Dissolved Oxygen increased by 10 folds. The growth performances of exposed biomass were measured in terms of dry weight. The ability of spent biomass to improvise plant growth was demonstrated for both dicotyledonous (*Cicer arietinum*) and monocotyledonous (*Oryza sativa*) plants. The N (nitrogen), P (Phosphorus), and K (Potassium) contents were recorded from Soil, Soil mixed with Chemical Fertilizer (SCF), and Soil mixed with Cyanobacterial Biomass (SCB). Results showed, SCB raised N, P, K contents in both shoots and roots. An increase in root length, shoot length and dry weight were also noticed. Germination rate and vigour index were improved. These results of SCB were almost comparable to the chemical fertilizer therefore spent cyanobacterial biomass would be very effective in organic cultivation.

Financing: Applied for IPC fund for Delegates; Applied for Global Seaweed Star Capacity Building Fund
Keywords: Cyanobacteria, biofertilizer, wastewater

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POTENTIAL FOR LIPIDS PRODUCTION OF BENTHIC DIATOMS FROM THE COASTAL ZONE OF THE POMERANIAN BAY (BALTIC SEA)

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The aim of this study was to determine the potential of the selected Baltic Sea diatom taxa for the production of lipids and to determine their theoretical biogeographical zones in the Baltic Sea. Growth kinetics, biomass productivity and lipid content were tested for: *Halamphora cf. hybrida*, *Navicula korzeniewskii*, *Navicula gregaria*, *Nitzschia supralitorea*, *Stauroforma* sp. 1 and sp. 2. For diatoms cultivation, f/2 medium was used with different salt concentration (3, 5, 7 and 10‰). Malassez counting chamber was used for cell counting and growth rate determination. Diatoms strains were kept in a cultivation chamber at a temperature of 20°C, day:night cycle (12:12 h), with a PAR value of 100 molxm²xs². Harvesting of biomass took place on the 14th day of the experiment. Collected biomass was dried and weighed. Lipid fraction was extracted by the continuous extraction method using methanol:chloroform (2:1) as organic solvents. The highest growth rate was observed in *N. gregaria*, and the lowest in *H. cf. hybrida*. The largest amount of biomass was collected from *N. gregaria* (0.0159 g, 10‰ medium), and the smallest from *Stauroforma* sp. 2 (0.0003 g, 5‰ medium). The largest amount of the lipid fraction was obtained from *N. gregaria* (92.97% dry mass volume, 5‰ medium), and the smallest amount was obtained from *Stauroforma* sp. 2 (26.59% dry mass volume, 7‰ medium). Diatoms isolated from the Pomeranian Bay have features which allows them to be considered as potentially useful in the biofuel context (fast growth rate, high productivity of biomass and crude oil, wide salinity tolerance).

Keywords: Diatomology, bioprospecting, biofuels





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EFFECTS OF SALINITY AND TEMPERATURE ON BIOMASS ACCUMULATION IN THE MARINE DIATOM *GEDANIELLA FLAVOVIRENS*

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Chitosan was found in the marine diatom *Gedaniella flavovirens*, hence the species could have a biotechnological potential. We conducted ecophysiological experiments, focused on the temperature and salinity effects on *Gedaniella flavovirens* growth. A series of three experiments were conducted on this strain, beginning with determination of growth kinetic parameters. The strain was cultivated for 22 days under the following conditions (further - standard condition): temperature 17-21°C, light intensity 100 $\mu\text{mol s}^{-1} \text{m}^{-2}$ and 12:12 day:night light cycle, in a f/2 medium with 7‰ salinity. Biomass was harvested on 2nd, 4th, 8th, 16th, 18th and 22nd day of experiment, centrifuged, dried and weighed. A growth curve was determined and growth kinetic parameters (time of exponential growth (t_{exp} =6 days), time of maximal growth (t_{max} =16 days) and growth rate (μ_{max} =0,38 d⁻¹, R^2 =0,77) were estimated. Secondly, experiment was conducted on the strain in f/2 medium with different salt concentrations of 0, 1, 3, 7, 10, 15 and 20 g/L under standard conditions. Thirdly, the strain was again cultivated in standard f/2 medium under a range of temperatures at 15, 20, 25 and 30°C. After 16 days (t_{max} for this strain) of cultivation, the biomass from the second and third experiment was harvested, centrifuged, dried and weighed. Student's t-test analysis showed that there was no significant increase in biomass accumulation with salt enriched medium (at 10, 15 and 20 g/L salt) and under higher temperature (25°C and 30°C). The lowest growth was achieved at 0, 1 and 3 g/L salt and 15°C temperature (t-test, α =0,05).

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Keywords: Ecophysiological experiments, diatom culturing, diatom bioproducts

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ANTIOXIDANT PROPERTIES AND ELEMENT LEVELS OF TWO COMMERCIAL *ARTHROSPIRA* STRAINS

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This study aimed to determine the total phenolic, flavonoid contents, mineral contents of *Arthrospira platensis* and *Arthrospira maxima*, and the effects of extraction solvents on their free radical scavenging activities. Water, phosphate buffer (pH 7.5), ethanol, acetone, and ethyl acetate were used for extraction. DPPH free radical-scavenging assay was used to determine the best extraction solvent for antioxidant activity. The total phenolic and total flavonoid contents of groups were measured according to Djeridane et al. (2006) and Quettier-Deleu et al. (2000). The element compositions of examples were determined analyzed via ICP-AES (Nordisk Metodikkomiteé for Næringsmidler, 2007). The highest antioxidant activity was determined in phosphate buffer for *A. platensis* and water for *A. platensis* with low IC₅₀ values. The lowest flavonoid content in *A. platensis* was determined used acetone and phosphate-buffer groups ($p \leq 0.05$). The highest flavonoid content was found in water used as solvents in *A. maxima* ($p \leq 0.05$). The highest value of total phenolic content was found in the phosphate buffer group for *A. platensis* and the acetone group for *A. maxima* ($p \leq 0.05$). According to the element evaluations, it was determined that all values were below the limits of the FAO (Food and Agriculture Organization) and WHO (World Health Organization) for human consumption. However, it was determined that the Na content of *A. platensis* was higher than that of *A. maxima*, while the P, K, and Fe values were low.

Keywords: *Arthrospira*, antioxidant properties, minerals



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ANTIMICROBIAL ACTIVITY OF MACROALGAL EXTRACTS AGAINST SEVERAL *LISTERIA MONOCYTOGENES* STRAINS FOR THE APPLICATION IN FOOD PRODUCTION

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Macroalgae are a source of compounds used for a long time in human affairs; some algal species are more used than others, as they possess molecules with antibacterial, antiviral, antifungal and immunostimulant activity. These molecules are often extracted from algal species which are invasive and, therefore, their use is also advisable in the perspective of environmental management, to eliminate large unwanted biomasses. In the present research, we evaluated the antimicrobial activity of *Asparagopsis* extracts against different *Listeria monocytogenes* strains. Ethanolic extracts prepared from lyophilized algal material were tested against 6 different strains of *Listeria monocytogenes*: 3 ATCC (13932, 7644, 1911) and 3 wilds isolates from food matrix. A mean value of 22 ± 5 mm was reported for all the strains with the disk-diffusion assay (disk 6 mm) of the extracted compound. Furthermore, the Minimal Inhibiting Concentration (MIC) and Minimal Bactericidal Concentration (MBC) were performed by microdilution method. A value of 0.05% was established for all strains both for MIC and MBC. These results represent a very promising finding for the application of *Asparagopsis* extracts in food production as natural preservatives against *Listeria monocytogenes*.

Keywords: *Asparagopsis*, antibacterial activity, *Listeria monocytogenes*

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UTILIZATION OF GREEN SEAWEED WASTE FROM ALGAL BLOOMS USING A TERRESTRIAL FUNGI FOR PRODUCTION OF PROTEIN-ENRICHED FEEDS

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Single-cell protein (SCP) corresponds to edible unicellular microorganisms grown on biomass to be used as an ingredient for protein-rich foods. Green algae biomass of *Ulva rigida* harvested from marine eutrophicated coastal areas is a lignin-free cellulosic-rich waste with a good nutritional profile and a high potential for feeds production. Because of *Ulva rigida* cellulose contents, a saccharification step prior to microbial fermentation is required. *Trichoderma reesei* RUT-C30 is a terrestrial fungi that hyper secretes cellulases, which could be used for transforming waste biomass from different sources into protein. Therefore, the aim of our work is to transform *Ulva rigida* from 'green tides' affecting sea coasts into SCP using the cellulolytic fungi *T. reesei* RUT-C30 for saccharification and fermentation of *Ulva rigida* in a single step. For this purpose, the fungi *T. reesei* RUT-C30 was grown in liquid cultures using *Ulva rigida* as the single carbon source for 11 days at 30 °C. Dry biomass, protein contents and reducing sugars were studied to characterize cultures, and the nutritional profile of the fermented product was characterized by proximal analysis and amino-acid composition. We found that *T. reesei* RUT-C30 was able to grow using *Ulva rigida* as carbon source, producing the same amount of biomass and proteins after 72 h of culturing, when compared to fungal fermentation in 2% glucose after 48 h. In addition, the fermented product resulted in an increase in protein contents and essential amino acids, when compared to raw seaweed. Financing: Fondecyt Grant 1180794 and CeBiB Basal Grant FB-0001.

Keywords: *Ulva rigida* seaweed, *Trichoderma reesei*, Single-Cell Protein (SCP)



SYM15: Applied Phycology – Research and Innovation

E-Poster

COMPARATIVE CHARACTERIZATION OF *TETRASELMIS CHUII*, *CHAETOCEROS CALCITRANS* AND *ISOCHRYISIS GALBANA* STRAINS AS SOURCES OF FOOD SUPPLEMENTS

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Species of the genera *Tetraselmis* (Chlorophyta), *Isochrysis* (Haptophyta) and *Chaetoceros* (Bacillariophyta) have been traditionally used as a valuable nutritional source in aquaculture for their high fatty acids content. In recent years, several microalgae have been incorporated also in food products. Here we evaluated the potential of five microalgal strains to produce polyunsaturated fatty acids (PUFA) with interest for their use as nutraceuticals. Two strains of *Tetraselmis chuii* were freshly isolated from Guanabara Bay in Brazil (TCBG-1 and TCBG-2). The other strains: *T. chuii* (CCAP 8/6), *Chaetoceros calcitrans* (ICMAN-CSIC) and *Isochrysis galbana* (ICMAN-CSIC) were acquired from collections. All strains varied in their PUFA content with culture age. Total fatty acid content (% dry weight) ranged from a minimal 9.3 % DW to 32.18% DW. The biomass productivity obtained from the 3 strains of *T. chuii* was greater than those of the other strains tested and the yield by cell fatty acids and PUFA was 10 times higher than in *I. galbana* and *C. calcitrans*. All strains produced significant quantities of specific omega-3-fatty acids with interest as nutraceuticals and PUFA production ranged from 36 % to 71 % of total fatty acids. Particularly, strain TCBG-1 produced arachidonic acid (ARA) and EPA at the exponential growth phase, while TCBG-2 produced DHA at exponential and EPA at the late exponential growth phases. A two-stage growth system using co-cultures of these two Brazilian *T. chuii* strains in photobioreactors is proposed as an optimal model for PUFA production.

Financing: We are grateful to the mobility internship of Fundación Carolina (G. Moser) and project FICOEXPLORA (RTI2018-101272-B-I00), Spanish National Research Plan.

Keywords: Polyunsaturated fatty acids (PUFA), eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA)

SYM15: Applied Phycology – Research and Innovation

E-Poster

EFFECT OF SALT CONCENTRATION AND COMPOSITION ON THE RHEOLOGICAL AND MECHANICAL PROPERTIES OF K/I-CARRAGEENAN GELS: OPTIMIZATION USING RESPONSE SURFACE METHODOLOGY

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Carrageenans are sulphated polysaccharides of red seaweed used as gelling, thickening and stabilizing agents by the food industry. Particularly, κ /i-carrageenan gels show unique properties and have received increased interest in recent years. Gelation occurs in the presence of cations, typically potassium in κ - and calcium in i-carrageenan. The aims of this study were to 1) analyse the effect of cation concentration and composition on the rheology, texture and syneresis of food grade κ /i-carrageenan gels, and 2) optimize the structural properties of these gels. Response surface methodology (RSM), small composite design (SCD) was used to evaluate the effects of three factors (carrageenan concentration, salt concentration, and KCl fraction in a mixture of KCl and CaCl_2) on the following responses: elastic modulus at 1 Hz (G'), hardness (H), rupture strength (R) and syneresis (S). Regression analyses indicated that the quadratic model was the most appropriate to explain all responses. Carrageenan concentration positively affected G' , H and R, while salt concentration negatively influenced these responses, indicating that higher carrageenan and lower salt concentrations improved gel firmness. Higher KCl fractions also resulted in increased H and R. Syneresis was reduced with the increase of carrageenan concentration and KCl fraction, while it was augmented by high salt concentrations. To optimize the structural properties of the gels, G' , H and R were maximized and S was minimized, achieving a global desirability of 0.895 with the following combination of factors: carrageenan concentration = 1.74% (w/w), salt concentration = 0.07 M and $\text{KCl} / (\text{KCl} + \text{CaCl}_2) = 0.85$.

Financing: PIP-CONICET: 112-2015 01-00510

Keywords: Carrageenan gels, rheology, texture



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E-Poster

HAEMATOCOCCUS PLUVIALIS STRAIN FOR SUSTAINING PROFITABLE AGRICULTURAL PRODUCTION

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Agricultural land degradation and natural resource depletion are accelerated by population growth. To overcome this challenge, an intensive search for alternative sources is needed. Microalgae are considered one of the most promising sustainable sources for the production of a high variety of molecules, such as valuable unsaturated fatty acids, proteins, vitamins, and carotenoid secondary metabolites. *Haematococcus pluvialis* (Chlorophyceae, Volvocales) is a freshwater unicellular green microalga and is the richest source of astaxanthin, a natural carotenoid considered one of the strongest antioxidants in nature. Carotenoids are precursors of essential phytohormones required for plant growth and development. Strigolactone and abscisic acid are especially important for plants in response to environmental stresses, both are plant hormones derived from β -carotene. The carotenoid biosynthesis pathway of *H. pluvialis* has been genetically modified to overproduce β -carotene. The endogenous phytoene desaturase coding sequence has been codon-optimized and overexpressed in the chloroplast of *H. pluvialis*. Genetically engineered strains and non-transformed *H. pluvialis* biomass were used as biostimulants for the growth of *Arabidopsis thaliana*. Microalgal extracts in the form of seed primer were able to trigger faster germination and enhance shoot and root length compared to the untreated seeds. Thus, *H. pluvialis* and carotenoid overproducer strain extracts represent a potentially sustainable alternative as an environmental-friendly biostimulant for promoting ecological agriculture.

Financing: Lab. Genética e Inmunología Molecular-PUCV

Keywords: *H. pluvialis*, β -carotene, biostimulant

SYM15: Applied Phycology – Research and Innovation

E-Poster

NUTRITIONAL ANALYSIS OF THE NATIVE NEW ZEALAND SEAWEED SPECIES *MACROCYSTIS PYRIFERA*

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The marine environment represents a vast, relatively untapped resource for sustainable bio-compound sourcing. Global population growth has put considerable pressure on food production, specifically, the present need for protein to supply global requirements has increased 5-fold since 1961. *Macrocystis pyrifera* is a native species of brown seaweed in New Zealand, Australia and is also found, on the west coast of the US, South America, and South Africa. In comparison to other brown seaweeds such as *Laminaria digitata*, *Macrocystis pyrifera* has not been studied in as much detail for its potential to produce bioproducts. Previously reported *Macrocystis pyrifera* protein content values range from 9-17% depending on location and environmental factors including the season of harvest. Protein sourced from seaweed can contain all essential amino acids, which account for almost half of the total amino acids and the protein profile of some species is similar to that of egg protein. Initial nutritional analysis using AOAC standard protocols of wild harvested *Macrocystis pyrifera* from Tory Channel, in the South Island of New Zealand, found dry weight % values of 12.2% crude protein, 30% total dietary fibre, and 1.9% total lipid. Further analysis of fatty acid profiles detected essential fatty acids, and the highest content was found for arachidonic acid (AA) at 9% followed by eicosapentaenoic acid (EPA) at 6.5%, linoleic acid (LA) was 6.1%, and alpha linoleic acid (ALA), was 4.4%. Further analysis of the protein including amino acid profile and the carbohydrates, such as total polysaccharides and degree of sulphation is being carried out.

Financing: Research Leaders 2025 programme co-funded by Teagasc and the European Union's Horizon 2020 and Marie Skłodowska-Curie grant agreement number 754380

Keywords: Nutritional, analysis, *Macrocystis pyrifera*



SYM15: Applied Phycology – Research and Innovation

E-Poster

USING CHIMERIC KELP PRODUCTION AS NATURE-BASED SOLUTIONS (NBS) FOR ECOSYSTEMIC SERVICES RESTORATION

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Climate change is pushing kelp dominant habitat-forming species into decline, with negative effects in many aspects such as adaptability and biodiversity. Therefore, kelp cultivation for aquaculture, restocking or ecosystem restoration could be effective actions in climate change mitigation as Nature-based Solutions. However, lack of consideration for genetic diversity, such as using just one or non-native strains, could reduce population adaptability. Here, we selected strains of *Lessonia spicata* and built chimeras (Patent N°2017-1827) to evaluate their relationship with fitness and resilience capabilities at different scales, including in-laboratory or hatchery, and transplantation to field at pilot scales. Additionally, we quantified natural chimera frequency, and their relationship with the role of chemicals and invertebrates in ecosystem services. Building chimeras increased local genetic diversity fivefold, together with survival rates (1.2 to 3 times), biomass (1.2-1.6 times), and the number of axes (7-10 times) compared to homogeneous individuals. Additionally, experiments showed chimeric recruits to be more robust and resilient than homogeneous individuals under stressful temperature conditions (18°C). In natural populations, 47-67% of plants were chimeras, which showed higher levels of photosynthetic pigments (Chl a, Chl c, and Carotenoids), compared to homogeneous plants, but did not affect phenols and alginic acid yield. They also exhibited greater invertebrate richness and abundance. Considering kelp's foundational role in natural ecosystems, the use of chimeras can enhance the health of the affected population by anthropogenic disturbance or climatic change, as well as produce a diverse range of services on which human wellbeing depends, as an example of a Nature-based Solution.

Financing: FONDEF ID17I10080 - ID20I10167

Keywords: Chimera, kelp, ecosystem services

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E-Poster

EVALUATION OF THE FUNCTIONAL PROPERTIES OF *POLYSACCHARIDES* PRESENT IN SEAWEEDS FROM VERACRUZ-BOCA DEL RÍO, MEXICO

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Algae are organisms widely studied for their diversity of bioactive compounds, among these are the polysaccharides they contain. For this reason, in the present work, the content of dietary fiber was determined, as well as its functional properties in coastal algae from the Port of Veracruz. For this study, *Ulva lactuca*, *Hypnea cervicornis*, *Hypnea musciformis*, *Gracilaria bursa-pastoris* and *Padina gymnospora*, collected in Veracruz, Mexico, were analyzed. They were washed and taken to constant weight in a drying oven at 60 °C. The method proposed by AOAC (2000) was used for their analysis of soluble (SDF), insoluble (IDF) and total (TDF) dietary fiber. The determination of swelling capacity, water retention and oil retention were followed the methodology of Gómez-Ordoñez (2013). The results show an abundant FDT content having a range of 34.4-66.7 g/100 g of dry algae, highlighting red algae. SDF and IDF content varied between 9.6-25.4 g/100 g and 24.4-46.6 g/100 g of dry seaweed, respectively, highlighting *H. cervicornis* and *G. bursa-pastoris* in SDF and IDF. The ratio of SDF/IDF was found to be 0.4-0.84 g/g, highlighting *P. gymnospora* and *G. bursa-pastori*. For the functional properties, it was found a good capacity of water retention (9.71-12.4 g/g) which provides a potential capture of hydrosoluble substances, on the other hand, oil retention showed a potential of hydrophobic substances capture (0.64-2.35 g/g). It is concluded that algae found in the Gulf of Mexico present attractive functional properties as a source of functional ingredients.

Financing: We are grateful to the National Technological Institute of Mexico (TECNM) for its financial support with project 9039.20-P

Keywords: Dietary fiber, functional properties, seaweed





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E-Poster

BIOREFINERY APPROACH APPLIED TO THE BIOMASS OF THE DIATOMS *STAUROSIRELLA PINNATA* AND *PHAEODACTYLUM TRICORNUTUM*

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Biorefinery approach, which relies on sequential extraction of multiple products from a single biomass, allows for cost and impact reduction of microalgal biotechnology although application to diatom biomass is still limited. In this work, a cascade extraction was applied to a native diatom strain of *Staurosirella pinnata* and to the model organism *Phaeodactylum tricornutum*. Biomass of the two strains was intensively cultivated in indoor, 30 l photobioreactors and extracted to obtain i) crude extracts, ii) lipids, iii) biomethane. The products were thus characterized and tested for their biomedical and energetic potential. Nuclear Magnetic Resonance (NMR) analysis of hydrophilic fractions of the crude extracts identified 52 metabolites while their bioactivity tests on human melanoma and keratinocytes cell lines revealed that *S. pinnata* extract exhibit a strong and selective cytotoxic activity on melanoma, whereas *P. tricornutum* extract showed significant cell death levels only at the highest doses. Gas Chromatography and Mass Spectrometry (GC-MS) analysis of lipidic extracts from the residual biomass evidenced that cis-9-hexadecenoic and eicosapentaenoic acids were the most abundant fatty acids in *S. pinnata*, while eicosapentaenoic, docosanoic and hexadecanoic acids, prevailed in *P. tricornutum*. We tested the metabolic effect of the diatoms' lipids on insulin resistance and obesity treating human Brown Adipose Tissue (BAT) cells. Western Blot and rtPCR analysis revealed that *P. tricornutum* extract modulated the thermogenesis pathway of BAT, prospecting an anti-diabetic activity. Finally, the exhausted biomass of the two diatoms was evaluated for its Biochemical Methane Potential pointing to a suitable substrate for biomethane production.

Keywords: Microalgae, diatom, biorefinery

SYM15: Applied Phycology – Research and Innovation

E-Poster

ANALYSIS OF GROWTH AND EXOPOLYSACCHARIDES PRODUCTION OF THERMAL CYANOBACTERIUM *PHORMIDIUM* SP. ETS05

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Phormidium sp. ETS05, a filamentous cyanobacterium, is the most abundant species identified among the microbiota that grows on the Euganean Thermal District (Italy) during the mud maturation process (Gris, 2020). This traditional method carried out by spas combines virgin clay and thermal water at 40 °C, obtaining after two months a therapeutic mud. The efficacy of the mud in healing the chronic pain of arthrorheumatic pathologies is related to heat, presence of electrolytes, and presence of bioactive molecules produced by the microbiota. Monogalactosyldiacylglycerol and digalactosyldiacyl glycerol extracted from *Phormidium* sp. ETS05 have been tested in vitro and in vivo for their anti-inflammatory activity (Bruno, 2005; Ulivi 2011). Recently, having observed a conspicuous presence of mucilaginous substances forming the microbial mats, exopolysaccharides (EPS) obtained from *Phormidium* sp. ETS05 were investigated and have been demonstrated to have anti-inflammatory activity in vivo (Zampieri, 2020). The cyanobacterium was cultivated at different light intensities using a lab-scale photobioreactor to evaluate which was its optimal growth condition. EPS production for each condition was measured, to understand which condition leads to higher EPS productivity. We observed higher biomass growth at 50 $\mu\text{mol m}^{-2} \text{s}^{-1}$, while EPS were more abundant at 100 $\mu\text{mol m}^{-2} \text{s}^{-1}$. From literature, information on EPS assembly and export pathways in cyanobacteria are limited. Putative genes of a Wzy-dependent pathway identified in *Phormidium* sp. ETS05 genome were investigated and correlated to light intensities tested. Further analysis will widen our knowledge on this aspect, leading to the possibility of biotechnologically boost EPS production.

Keywords: Thermal cyanobacteria, exopolysaccharides



SYM15: Applied Phycology – Research and Innovation

E-Poster

RNA-SEQ ANALYSIS OF DIFFERENTIALLY EXPRESSED GENES IN *SOLANUM LYCOPERSICON* L. IN RESPONSE TO *SARGASSUM* BIOSTIMULANT

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Seaweeds have been used in the industry for several purposes for several decades across the world. Seaweeds contain a number of plant growth-stimulating compounds. Seaweed Liquid Extract (SLE) is used as a nutrient supplement or biofertilizer in agriculture to increase plant growth and yield. Puerto Rico tourism and coastal environment is severely affected by the abundance of seaweed, *Sargassum fluitans*, on its coastal areas. We hypothesized that the waste of *Sargassum fluitans* collected from the coastal areas of Puerto Rico can be utilized to locally produce eco-friendly biofertilizer. We measured the effect of varying concentrations of *S. fluitans* SLE on growth of tomato seedlings. Ectopic application of 5% SLE increased the shoot length when compared with controls indicating a potential role of SLE in plant growth and development. We further assessed if the bacterial microbial communities are affected with varying concentrations of SLE. Our preliminary data suggests that application of SLE changes the bacterial communities of the host plant treated with SLE and consequently SLE may enhance the growth of the plant by controlling the association of microbial communities. We studied the changes in gene expression of tomato plants after they were treated with SLEs. Our results show that genes associated with growth and development were significantly up-regulated in plants treated with SLEs. In future, the use of bio-fertilizers from seaweed would provide an ecofriendly alternative method of keeping the coasts of Puerto Rico clean by converting the waste into wealth.

Financing: The research work has been funded by National Science Foundation HSI-STEM grant (Award No. 1928792) awarded to Alok Arun

Keywords: Seaweeds, biofertilizer, RNA-seq

SYM15: Applied Phycology – Research and Innovation

E-Poster

MINERAL AND HEAVY METAL CONTENT OF DRIED SEAWEEDS FROM THE CHILEAN COAST AND HEALTH RISK ASSESMENT TO HUMAN CONSUMPTION

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Seaweeds are a rich source of minerals and functional compounds, but they can also accumulate toxic heavy metal ions. This study investigated the concentration of macroelements (Na, K, Ca, Mg, P), microelements (Fe, Mn, Zn, Mo, Se) and heavy metals (total As, Cd, Pb, Hg, Cu, Cr, Al) in 10 species of Chilean seaweeds and estimated the possible health risk upon ingestion by hazard index (HI). A wide range of element concentrations were observed between the species analyzed. Among seaweed groups, brown seaweeds (*Lessonia trabeculata*, *Lessonia berteroana*, *Lessonia spicata*, *Macrocystis* sp., and *Durvillaea incurvata*), showed higher mean concentrations of Na, Ca, P, and Cr, whereas red seaweeds (*Agarophyton chilense*, *Sarcodiotheca gaudichaudii*, *Chondracanthus chamissoi*, and *Cryptonemia* sp.) had higher contents of K, Mn and Zn. The green seaweed *Ulva* sp. had the highest content of Mg. In the case of main heavy metals, the highest mean contents of total As (between 15.0 and 35.6 mg Kg⁻¹) and Cd (between 2.4 and 6.2 mg Kg⁻¹) were observed in brown seaweeds. No variation among seaweed groups was observed in the level of Hg (between 0.009 and 0.02 mg Kg⁻¹) whereas Pb content was below the detection limit (<0.01 µg Kg⁻¹). The health risk assessment indicated that HI at mean level was less than the threshold of 1. It indicated that consumption of the Chilean seaweed species poses a low risk for humans with regard to heavy metals including in the analysis.

Financing: CORFO Cod. 16BPER-66977; ANID - PAI 79160069; Fondo Postdoctorado Universidad Católica del Norte N°001

Keywords: Northern Chile, raw seaweed, value-added



SYM15: Applied Phycology – Research and Innovation

E-Poster

CHEMICAL AND MICROSTRUCTURAL CHARACTERIZATION OF THREE SPECIES OF SEAWEED FROM TWO LOCALITIES FROM VERACRUZ, MEXICO

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Seaweed is an important source of compounds, distributed throughout their tissues, which can be studied using histochemical and microscopy techniques. This aim was to characterize chemical composition and microstructure and evaluated the localization and distribution of carbohydrates and proteins, besides quantified those considered toxic minerals in the tissue of *U. lactuca* (UL), *S. cymosum* (SC), *G. subpectinata* (GS). The chemical composition was determined and microstructural analysis was carried out by optical microscopy, image analysis, scanning electron microscopy and atomic absorption spectrometry. Through histochemical techniques, carbohydrates and proteins were evidenced using Schiff and Coomassie Blue reagents, respectively and determining the shape and size of the cells of SC and GS cortex tissues, and UL blade, as well as the distribution and density of the protein bodies (PB), and was observed that the largest size shown by the cells and PB corresponded to those of cortex SC and blade UL. In GS, the PB had a greater area and density. The chemical composition of the three species showed values between 44-73% of carbohydrates, 13-45% ashes, 5-16% of proteins, and minerals (Cu, Cd, Cr, Ni, Pb, Zn, and Hg) did not reach the toxicity limits. The used techniques showed similarity in the obtained data in the seaweed tissue.

Keywords: Protein bodies, histochemical and microscopy techniques



SYM16: OTHER

Oral presentation

TRACING THE EVOLUTION OF SILICA SCALES IN THE FRESHWATER GENUS *SYNURA* (STRAMENOPILES)

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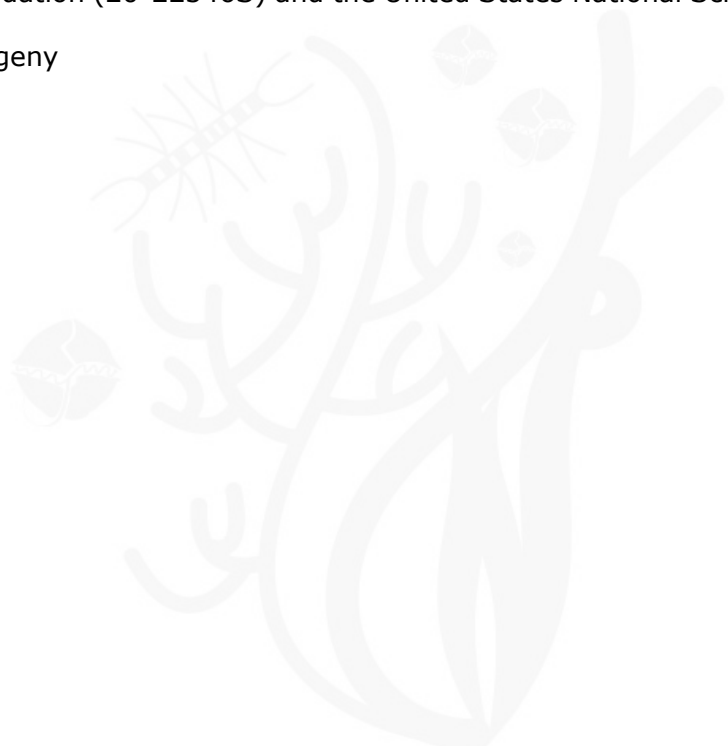
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A high degree of morphological variability is expressed between the ornately sculptured siliceous scales formed by species in the chrysophycean genus, *Synura*. In this study, we aimed to uncover the general principles and trends underlying the evolution of scale morphology in this genus. We assessed the relationships among thirty extant *Synura* species using a robust molecular analysis that included six genes, coupled with morphological characterization of the species-specific scales. The analysis was further enriched with addition of morphological information from fossil specimens, and by including the unique and rare modern species, *Synura punctulosa*. We inferred the phylogenetic position of the morphologically unique *S. punctulosa*, to be an ancient *Synura* lineage related to *S. splendida* in the section Curtispinae. Some morphological traits, including development of a keel or a labyrinth ribbing pattern on the scale appeared once in evolution, whereas other structures, such as a hexagonal meshwork pattern, originated independently several times over geologic time. We further uncovered numerous construction principles governing scale morphology and evolution, as follows: 1) scale roundness and pore diameter decreased during evolution; 2) elongated scales became strengthened by a higher number of struts or ribs; 3) as a consequence of scale biogenesis, scales with spines possessed smaller basal holes than scales with a keel and; 4) the keel area was proportional to scale area, indicating its potential value in strengthening the scale against breakage.

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Keywords: Chrysophytes, morphology, phylogeny





SYM16: OTHER

Oral presentation

STAR WARS: PHENOLOGY OF *NITELLOPSIS OBTUSA* (STARRY STONEWORT) IN TWO MICHIGAN, USA DROWNED RIVER MOUTH LAKES

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Invasive species have been introduced into new areas through anthropogenic interactions causing economic, environmental, and social impacts because of their unique ecological engineering strategies, including: aggressive competition, habitat degradation and declines in native species. This study is focused on the growth of a newly introduced aquatic invasive species, *Nitellopsis obtusa* (starry stonewort). *Nitellopsis obtusa* is a dioecious freshwater green macroalga from the Characeae family native to Eurasia, but relatively uncommon in much of its native range. Considered invasive in North America, *N. obtusa* is a rapid colonizer that spreads through an asexual reproductive bulbil and is capable of outcompeting other aquatic macrophytes/macroalgae by creating large monotypic meadows. The focus of this study is to document the timing of the peak biomass of *Nitellopsis obtusa* in Pentwater and Muskegon Lakes in Michigan, USA and relate this peak to light, temperature, and the biomass of other species present. For biomass sampling, six quadrats were placed randomly at each site (0–3 m depth) and all macrophytes/macroalgae in each quadrat were destructively harvested by snorkeling, sorted by species, and subsequently dried and weighed to obtain a growth curve. Preliminary results indicate *N. obtusa* peaked at different times at each site. The relationship between the growth curves of *N. obtusa* and abiotic/biotic factors will be discussed. These results may allow us to better understand the factors that influence the growth of *N. obtusa* and therefore, assist in the management of this invasive species. Keywords: Macroalga, aquatic invasive species, biomass growth

SYM16: OTHER

Oral presentation

ENDOSYMBIONT-CONTAINING DIATOMS FROM RHOPALODIACEAE FAMILY AS INDICATORS OF CHANGES IN NUTRIENT CONDITIONS OF LOWLAND RESERVOIRS

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Increasing phosphorus load upon aquatic ecosystems leads to a decline in nitrogen-to-phosphorus-ratio. Under such conditions competitive edge is acquired by nitrogen-fixing algae, such as planktonic heterocyst-forming Cyanobacteria (Bulgakov, Levich, 1999). As regards benthic and epiphytic communities, diatoms from *Rhopalodiaceae* family may develop under low N:P-ratio (Trapp et al., 2012). It is because their cells contain nitrogen-fixing endosymbionts tracing their origin to Cyanobacteria from *Cyanothece* genus and providing diatoms with nitrogen compounds (Nakayama et al., 2010). The aim of the research was to test the hypothesis that *Rhopalodiaceae* diatoms gain competitive advantage in epiphytic communities of the Dnieper water reservoirs under current N:P-ratio reduction. For this purpose, we plotted the cumulative biomass of *Rhopalodiaceae* diatoms in epiphytic communities on common reed against the N:P-ratio data, published by the Ukrainian State Water Resources Agency. The relationship between these parameters was inverse logarithmic with $R^2 = 0.41$ for the *Rhopalodiaceae* algae's absolute biomass and $R^2 = 0.50$ for their share in the total epiphytic algae biomass. That is, when the N:P-ratio reduces, species from *Rhopalodiaceae* family with endosymbionts gain a competitive edge in epiphytic communities. For example, when N:P-ratio is above 15, the biomass of *Rhopalodiaceae* diatoms makes up $0.083 \text{ mg} \times 10 \text{ cm}^{-2}$ (<1% of the total biomass). When N:P-ratio is equal to 4, their biomass reaches $2.325 \text{ mg} \times 10 \text{ cm}^{-2}$ (13%). Thus, an increase in biomass of *Rhopalodiaceae* algae may serve as a reliable biological indicator of low N:P-ratio. This pattern may have a practical application for assessing aquatic ecosystems' water quality.

Keywords: *Rhopalodiaceae*, endosymbionts, nitrogen-to-phosphorus ratio



SYM16: OTHER

E-Poster

DINOTOMS AND ITS EVOLUTIONARY RELATION WITH ECOLOGY AND SYSTEMATICS

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Durinskia baltica is a dinotom dinophyta with a wide ecological distribution that has undergone a complicated taxonomic history based on morphology that does not seem to be related entirely to populations' different eco-physiological characteristics reported around the world. For this reason, molecular approaches are useful to understand these taxonomic and ecological overlaps. Based on the phylogenetic inferences obtained from the 18S rRNA ribosomal gene of a Mexican freshwater strain of *Durinskia baltica* and the *rbcL* gene of its endosymbiont nucleus, we performed a relative time analysis with sequences of dinotomes and their hosts from marine and freshwater environments. The construction of each time tree used two-time constraints as calibration. The resulting host time trees were consistent with those estimated for endosymbionts. Sequence divergence times that identified species from freshwater environments were more recent than those from saline environments. Results show that the genetic information and the history of the endosymbionts are essential keys to understand the ecology and the evolutionary line of dinotomes since their eco-physiological differences are not only explained with the type of habitat but with the evolutionary history of the endosymbiont given the possibility of serial endosymbiosis in at least some of the species of this genus. For this reason, it is necessary to extensively document and adjust the dimensions of the ecology, physiology, and genetics of dinotomes, within the framework of their systematics.

Keywords: Dinophyte, endosymbionts, timetrees

SYM16: OTHER

E-Poster

FROM COMMERCIAL SAND DIGGING TO DIATOMS "HOTSPOT"

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The artificial sandpit lake "Peskara" is located between the two saline lakes, Lake Velika Rusanda and Lake Mala Rusanda, in the protected zone of Rusanda Nature Park (Vojvodina, Serbia). The lake was created by human activity for the exploitation of sand. The depression (on average 4.4 m deep, around 205 m long, and 107 m wide) was filled with water that can be classified into sodium bicarbonate chemical type. Over time a stable diatom community developed. During observations of the samples collected from the sand and reed during 2019 and 2020, 111 diatom taxa belonging to 37 genera were recorded. 14 diatom taxa and one genus (*Seminavis*) were noted for the first time for the diatom flora of Serbia. Fresh alkaline waters with elevated concentrations of electrolytes (1860–1950 $\mu\text{S}/\text{cm}$) enabled the development of freshwater diatoms (e.g. *Achnantheidium minutissimum*, *Gomphonema parvulum*) but also diatoms characteristic for brackish and coastal waters, such as *Bacillaria paxillifera*, *Entomoneis costata*, *Haslea duerrenbergiana*, *Pleurosigma salinarum*, *Staurophora brantii*, *Seminavis strigosa*, etc. Many of these species have not been found in saline lakes and ponds in the Vojvodina province, which makes "Peskara" a significant "hotspot" from the aspect of diatom biodiversity. This artificial sandpit lake requires more detailed research in order to obtain a certain degree of legal protection and to prevent possible backfilling and habitat loss for many diatom species.

Keywords: Diatoms, artificial sandpit lake, subsaline water



SYM16: OTHER

E-Poster

ALGAL COMPOSITION OF *KYPHOSUS VAIGIENSIS* (PERCIFORMES, KYPHOSIDAE) DIET IN SUBTROPICAL ROCKY REEFS OF THE GULF OF CALIFORNIA, MEXICO

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Rocky reefs of the Gulf of California are covered during spring by luxuriant *Sargassum* beds that disappear in summer. Therefore, the organisms that feed on it must find another alternative food source. The brassy chub *Kyphosus vaigiensis* is a circumtropical fish species associated with rocky reefs that feeds mainly on *Sargassum*. This study describes the diet of *K. vaigiensis* from stomach content analyses of 62 organisms captured off Santa Rosalía (Punta Gorda and Los Frailes) on the western coast of the Gulf of California, Baja California Sur, México during May and September 2015, coinciding with the maximum and minimum *Sargassum* biomass. The Prey-Specific Index of Relative Importance (%PSIRI) was calculated using the percentages of frequency of occurrence, specific abundance, and weight of each identified item in stomach contents. A total of 30 macroalgal taxa were identified, of which 19 were from the Phylum *Rhodophyta*, seven from *Ochrophyta*, and four from *Chlorophyta*. Of these components, 14 were found in May and 22 in September. The main diet components (%PSIRI > 10%) were *Sargassum* and *Padina* in May, while the red seaweeds *Gracilaria*, *Grateloupia*, *Prionitis*, and *Chondracanthus* were predominant during September. These results showed that *K. vaigiensis* diet changes seasonally with seaweed availability. However, the species seems to have a preference for *Sargassum*, probably because the genus is a vital component of the rocky reefs in both localities and *K. vaigiensis* has the necessary adaptations for its assimilation.

Financing: CONACyT project CB2012-179327

Keywords: Brassy chub, herbivorous, Santa Rosalía



SYM16: OTHER

E-Poster

MACROALGAE IN THE DIET OF THREE SEA URCHIN SPECIES IN SUBTROPICAL ROCKY REEFS OF THE GULF OF CALIFORNIA

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Sea urchins graze abundantly on seaweeds in rocky reefs. They also consume invertebrate species and could be facultative omnivores depending on the availability of macroalgae. In the Gulf of California, the three species, *Eucidaris thouarsii*, *Echinometra vanbrunti*, and *Triploneustes depressus*, coexist in *Sargassum* beds. This study determines their diet by stomach content analysis and calculated the prey-specific index of relative importance (PSIIR%). The organisms were collected in three *Sargassum* beds off Santa Rosalía, Baja California Sur, México, on May and October 2013, coinciding with *Sargassum* highest and lowest biomass. Although sea urchin species feed mainly on red and brown macroalgae, the relative importance of the macroalgae genus in the diet was different. The main items (>10%PSIRI) of *E. thouarsii* were the red articulated coralline *Amphiroa*, brown alga *Sargassum*, and the invertebrate group Briozoa. *E. vanbrunti* main prey were red coralline algae, red alga *Chondracanthus*, brown algae *Padina*, *Clutelia* and *Sargassum*, and the green algae *Cladophora* and *Caulerpa*. While *T. depressus* main items were *Padina*, *Sargassum* and *Amphiroa*. This study found that *E. vanbrunti* and *T. depressus* are fundamentally herbivorous while *E. thouarsii* could consume invertebrates in times when algae are not abundant.

Financing: CONACyT project CB2012-179327

Keywords: Stomach content, *Sargassum* beds, herbivores





SYM16: OTHER

E-Poster

PREDICTING MACROALGAL SPECIES DISTRIBUTIONS ALONG THE THAI-MALAY PENINSULA

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Seaweed ecosystems provide many essential and valuable ecosystem services in coastal waters. Understanding the environmental variables affecting their large-scale distribution is challenging but crucial for the proper management and conservation of macroalgae. The aim of this study is to predict the potential distribution of the green alga *Halimeda macroloba* Decaisne and the brown algae *Padina boryana* Thivy, *Sargassum plagiophyllum* C.Ag. and *Sargassum polycystum* C.Ag. along the Thai-Malay Peninsula. Occurrence data was obtained from field observations and literature. Five species distribution models were developed for each species based on sea surface temperature, sea surface salinity, pH, dissolved oxygen, chlorophyll-a concentration, and bathymetry. The results suggested potential suitable habitats for *H. macroloba* along the coasts of the Gulf of Thailand and the Malacca Strait. The models predicted suitable habitats for *P. boryana* along the entire west coast (Andaman Sea and Malacca Strait) and the entire coast of the Gulf of Thailand. Suitable habitats of *S. plagiophyllum* and *S. polycystum* were clearly separated, with *S. plagiophyllum* potentially occurring along the west coast of Thailand and extending into Malaysia and Myanmar, while *S. polycystum* potential habitats occur only along the east coast of Thailand and Malaysia. The importance of the environmental variables differed between the models and species. Using a modeling approach, the potential suitable and unsuitable distributional areas of these species were defined, as well as the variables affecting them. These findings provide encouragement for its use in future climate-related studies as well as sustainable conservation and management.

Financing: RDG613002, TRF Thailand Research Fund

Keywords: Species distribution modelling, geographic distribution, coastal ecosystem



SYM16: OTHER

E-Poster

BENTHIC MACROALGAE FROM THE SISAL REEFS, YUCATAN, MEXICO

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Reefs are ecosystems that provide multiple ecosystem services, and the macroalgae as a primary group help to a better understanding of these areas. The Sisal Reefs are located on the shores of the Campeche bank under the influence of the Gulf of Mexico. There are few phycological studies on this area, specifically the Sisal reefs. In order to contribute to the study of macroalgae inhabiting Yucatan, the first taxonomic list of these reef banks was made. Sisal Reefs are made up of three shallow banks: Bajo Diez, Madagascar, and Serpientes. Sampling was done through SCUBA diving at 2-4 stations per site. The samples were preserved in 4% formalin and identified at the lowest taxonomic level. With the data, a matrix of presence-absence of species per station and site, the frequency of species per station, and a similarity analysis (UPGM) with the Bray-Curtis index was performed. The three reefs have 123 species (28 Phaeophyceae, 43 Chlorophyta, and 52 Rhodophyta) and the most frequent taxa between the sites were *Aspargopsis taxiformis*. There is a greater similarity between sample stations than between sites. The richness of Arrecifes de Sisal is much greater than previous reports from the Banco de Campeche. Sisal reefs have diverse substrates, which translates into great diversity like the reef areas of the Mexican Caribbean. These reefs can function as reservoirs of diversity and allow species to disperse, so it is vital to conduct more studies to understand the Spatio-temporal dynamics of these ecosystems.

Keywords: Reefs, macroalgae, richness





SYM16: OTHER

E-Poster

A SURVEY OF THE DISTRIBUTION OF STRUCTURAL COLOUR IN THE RED ALGAE (RHODOPHYTA)

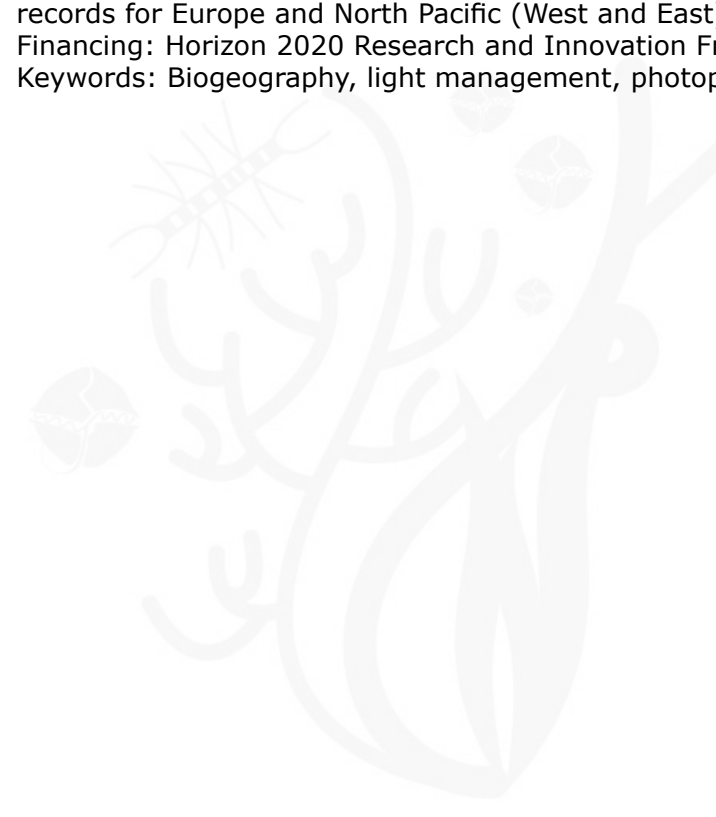
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Structural colour occurs across a wide range of seaweed species (red, green and brown macroalgae). Unlike pigmentation, which is based on chemical composition, structural colour results from the physical organisation of the surface layers at the nano- or mesoscale. These structures cause interference in the reflected light, the physics behind the iridescent features observed in many organisms. Structural colour has been extensively studied in terrestrial organisms, but there is still much to discover about the phenomenon in marine algae. Previous studies show that two of the mechanisms responsible for structural colouration in nature have been found among iridescent seaweeds: multi-layered structures and iridescent bodies. The phenomenon is a key component of the seaweed's interaction with sunlight and is considered a potential photoprotection mechanism against harmful light intensities. As a first step in a project aimed at understanding the role of structural colour for light management in macroalgae, we are carrying out a review of the geographical, ecological and phylogenetic distribution of structural colour mechanisms within the Rhodophyta. Initial results hint at a strong concentration of species within three taxonomic orders: Ceramiales (seven families), Gigartinales (four families), Rhodymeniales (five families). Observation records show a larger concentration of iridescent red algae in the Southern hemisphere: Caribbean Islands, South America, South Africa, Middle-East, and Australasia; and some records for Europe and North Pacific (West and East).

Financing: Horizon 2020 Research and Innovation Framework ITN "BEEP"

Keywords: Biogeography, light management, photoprotection



SYM16: OTHER

E-Poster

ROCKY REEF MACROALGAE OF THE NORTH COAST OF YUCATAN, MEXICO

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The study of macroalgae in reef environments in Yucatán has been limited to coral reefs of the Bank of Campeche such as Arrecife Alacranes, however, there are many rocky reef banks near the north coast of Yucatán that have not been studied. The present work focuses on three rocky reefs: Sisal, Chicxulub and Río Lagartos. This is the first description of the composition and richness of the benthic macroalgae communities. The samples were made at different times, (winter 2012, 2013, summer 2017 and 2019) using autonomous diving (SCUBA) and general collections were made at different points of the reef area. The specimens were pressed, and preserved in 4% formaldehyde, the vouchers were deposited in the Alfredo Barrera Marín herbarium collection at UADY. 87 species are reported, and the largest number of species is the Phylum Chlorophyta (38) followed by the Rhodophyta (30) and the Phaeophyceae (Ochrophyta) (19). The *Caulerpa* and *Udotea* genera are those with the highest number of species. Nine new records were found for the State and of these, *Sargassum pteropleuron*, *Platoma gelatinosum* and *Nemacystus howei* are new records for the Peninsula. The number of species reported in this area is higher than what has been found in the coastal area, which is consistent with previous studies, which have shown that the greatest diversity of algae occurs in reef environments. Therefore, it is important to continue studying these environments since they are very important centers of diversity that are home to very diverse communities of flora and fauna.

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Keywords: Diversity, rocky reefs, macroalg

