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Editorial

Marine Resources Application Potential for Biotechnological Purposes

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1. Marine Resources Application Potential for Biotechnological Purposes

Blue biotechnology plays a major role in converting marine biomass into societal value; therefore, it is a key pillar for many marine economy developmental frameworks and sustainability strategies, such as the Blue Growth Strategy, diverse Sea Basin Strategies (e.g., Atlantic Action Plan Priority 1 and 2 and COM (2017) 183), the Marine Strategy Framework Directive, the Limassol Declaration, or even the UN Sustainable Development 2030 Agenda. However, despite the recognized biotechnological potential of marine biomass, the work is dispersed between multiple areas of applied biotechnology, resulting in few concrete examples of product development. Food and feeds, and high-revenue cosmeceutical, pharma, biomedical markets, and others, are increasingly becoming important for marine bio compounds, which hold a myriad of unexploited uses, because they have often been demonstrated to contain molecules with a plethora of bioactivities, ranging from antioxidant, anti-inflammatory, tissue-specific protection, antimicrobial, anti-tumoral, antifouling, to texturizing, among many others. Market-driven and industrially orientated research, which increases the efficiency of the marine biodiscovery pipeline and ultimately delivers realistic and measurable benefits to society, is thus paramount for sustained blue growth and contribution towards the successful market penetration of targeted biomolecules or enriched extracts for new product development, and ultimately, contribute to a myriad of the UN's Sustainable Development Goals.

2. This Special Issue

The present Special Issue covers review articles and research papers addressing the biological activities of marine resources which may present high applicability and potential for industrial purposes. From submissions, eight high-quality manuscripts were selected covering the above-mentioned topics.

The importance of marine micro- and macroalgae, yeast, and even bacteriophages in the applied biotechnology field is evident from the well-split number of manuscripts presented here.

The potential of microalgae strains as sustainable alternative sources for commercial lutein, known to help maintain normal visual function, was critically reviewed by Sushanta Saha and co-workers [1], who also address appropriate cultivation strategies and market challenges. The authors argue that microalgae can, in fact, be a competitive and sustainable natural source, presenting higher growth rates and not requiring arable land and/or a growth season, compared to marigold flowers, the predominant natural source of lutein.

Bernardo Duarte and co-workers [2] focused their work on the premise that diatoms are potential added-value biorefineries producing unique pigments, triglycerides (TAGs), and long-chain polyunsaturated fatty acids (LC-PUFAs), with potential applications for feed, food, or even biofuel industries. This manuscript describes how pigments and fatty acid production in the diatom *Phaeodactylum tricornutum* can be modulated by spectral light control during their growth and contribute towards a better cultivation of these

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organisms for biotechnological purposes, and additionally discuss how diatoms may use such mechanisms to efficiently regulate light absorption and cell buoyancy.

Mari Ruiz-Domínguez and co-workers [3] argue that the microalgae *Isochrysis galbana* offers a broad range of bioactive compounds such as carotenoids, PUFA, and antioxidants, but most of current extraction solutions use toxic solvents, which causes environmental concerns. In their work, they optimized a method for the enhanced extraction of bioactive compounds from this species, using green technology of supercritical fluid extraction and applying a Box–Behnken design, presenting this methodology as a relevant and sustainable alternative to obtain important functional ingredients to be used in food and nutraceuticals.

To obtain a sustainable alternative to fish oil and to find natural alternatives for pigments to be used in animal nutrition, Natalie Pino-Maureira and co-workers [4] propose Rhodotorula strains in their work, which were isolated from seawater, for the biosynthesis of docosahexaenoic acid (DHA) and canthaxanthin using a low-cost source of carbon. The results presented are the foundation to use sustainable and low-cost growth media, in a circular economy framework, to potentially scale the production and provide novel sources of these essential nutrients.

Two studies were submitted proposing the seaweed *Grateloupia turuturu* as a potential source of bioactive compound. This seaweed is considered an invasive species in Europe, although it is known to contain a myriad of bioactive secondary metabolites with different potentialities. Invasive species have damaging effects on the environment and, by adding value to this biomass, the harvesting industry will contribute to control and even restore impacted environments, thus turning these threats into opportunities [5].

Rafael Félix and co-workers [6] addressed the development of green and cost-effective extraction protocols to optimally obtain UV-shielding and antioxidant compounds from *G. turuturu*, using response surface methodology, and evaluated the effect of ethanol concentration, liquid–solid ratio, pH, temperature, and time to enhance bioactive compound extraction. They argue that these protocols will allow for an optimized and sustainable use of this marine resource, contributing to the potential development of natural and eco-friendly cosmeceuticals from low-cost biomass.

Grateloupia turuturu is, in fact, presented as a macroalgae with a vast array of applications due to the diversity of compounds with relevant bioactivities. Carina Félix and co-workers [7] further addressed this seaweed potential by considering antioxidant, UV absorbance, anti-enzymatic (elastase and hyaluronidase), antimicrobial, and anti-inflammatory activities, as well as photoprotection potential, and its promising uses in the cosmeceutical field. Several proposed extracts presented relevant potential, namely, antimicrobial and anti-inflammatory activities, highlighting *G. turuturu*'s potential for the further development of natural formulations for skin protection.

Extraction, harvesting and processing, and cultivation conditions, are key performers in the success of using a resource for biotechnological purposes. In their work, Glacio Araujo and co-workers [8] addressed the seaweed *Calliblepharis jubata*—an edible red seaweed and a carrageenan primary producer yet not valued by the industry—harvested from the wild, and in semi-controlled and controlled aquaculture conditions. They characterized fatty acids, carbohydrates, and carrageenan content, and argued about the differences between the biological compounds of interest from different sources, identifying the advantages for human consumption and the food industry.

Lihua Xu and co-workers [9], based on the knowledge of some viruses acting as therapeutic agents to treat infectious diseases, studied the Vibrio phage Yong-XC31 as an agent to control *Vibrio mediterranei* and prevent disease in aquaculture, controlling *Pyropia* seaweed vibriosis, and eventually other affected organisms such as corals or scallops. Characteristics and the complete genome of this phage were analyzed, and new insights are presented for the application of giant phages as an important biotechnological product.

3. The Future of Marine Resources Biotechnology

This Special Issue's manuscripts highlight the vast potential that marine resources hold, from viruses to seaweeds, and a myriad of applications from antimicrobials and cosmetics to feed and food. However, despite the increasing body of research targeting marine resources and their potential application, a market-driven framework will definitely boost the blue economy and provide increasing solutions that may further rely on the large share of unknown organisms that are yet to be discovered in our oceans. It is thus paramount to invest in the biodiscovery process but also to address the target industries and define methodologies that are easily transported to industrial-friendly setups, where sustainability based on cost-effectiveness, green processes and a circular economy is indeed a cornerstone issue for the present and the future of a marine biobased economy.

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