MARINE BIOTECHNOLOGY

* Marine biotechnology is the use of biotechnology, molecular and cell biology, and bioinformatics to produce goods and methods from marine creatures. It is a branch of research that deals with ocean exploration for the creation of novel chemicals, enzymes, medicinal medications, and other goods and processes. Along with other topics, it also addresses the development of aquaculture, seafood safety, bioremediation, and biofuels. (ISAA, n.d.)

APPLICATIONS OF MARINE BIOTECHNOLOGY

1. Pharmaceuticals and medical applications: Marine species have demonstrated considerable potential as a source of novel bioactive chemicals. Drugs made from marine sources are being developed to treat neurological problems, cancer, and infectious and inflammatory diseases.

EXAMPLE:

When researchers were examining the defense mechanisms of marine life, they found that the organisms had a wide arsenal of chemical defenses. Holothurin, a toxin from the Bahamian sea cucumber (Actynopyga agassizi), was isolated by Ross Nigrelli from the New York Zoological Society in the 1950s and demonstrated anti-tumor efficacy in mice. Although holothurin was never made commercially available, the number of potential bioactive compounds from the ocean shot through the roof, and more are being found every year. (ISAA, n.d.)

A screenshot of a computer

Description automatically generated with low confidence

* Sea Sponge and Corals, Scientists discovered that these marine organisms has a chemical that breaks down the shield that protects bacteria from certain antibiotics. The chemical found in these organisms is used as a helper drug to antibiotics to combat bacteria and to avoid the destruction of the marine ecosystem, with the help of technology they make copies of these chemicals in a laboratory. (https://oceantoday.noaa.gov/medicinesfromthesea/welcome.html)

1. Aquaculture and Fisheries: Marine biotechnology is essential for enhancing the practices of aquaculture and fisheries. To increase productivity and sustainability in the aquaculture and fishing industries, it is used to produce enhanced feed formulations, disease diagnostics, selective breeding procedures, and bioremediation approaches.

For example:

* Numerous fish do not naturally reproduce when kept in captivity. Fish gonadotropin, a class of hormones that promote reproduction, was once extracted, and purified from unprocessed preparations made from thousands of pituitary glands such method is not sustainable and requires thousands of fish in order get a crude extract. At the moment, recombinant DNA technology allows for the laboratory production of enormous amounts of highly pure gonadotropin. (ISAA, n.d.)
* INDOOR WATER TANKS MIMICKING THE NATURAL HABITAT OF THE FISH, FLOATING PENS KEEPING PREDATORS AWAY WHILE KEEPING THE FISH IN, IMPROVED FEEDS TO CONTROL THE FOOD AND NUTRITION GOING IN AND CONTROLLING THE WASTE COMING OUT. (https://oceantoday.noaa.gov/medicinesfromthesea/welcome.html)

1. Nutraceuticals and Functional Foods: Marine biotechnology is used to create nutraceuticals and functional foods that are enhanced with bioactive substances originating from marine species. These substances have shown antioxidant, anti-inflammatory, and anti-aging capabilities, which may have positive effects on health.

Example:

* Fish oil - Fish oil is crucial for human health and the production of fish feed from an economic standpoint. As the aquaculture business grew, so did the demand for fish oil because it is a significant source of lipids in aquafeeds. Nearly 90% of the world's fish oil is produced by the aquaculture sector. Other fish oil sources are required to meet the rising demand. Scientists at Rothamsted Research created genetically modified camelina oilseed plants that synthesize omega-3 fish oils in their seeds. It is well recognized that omega-3 fish oils are advantageous for human nutrition. The potential for GM camelina to provide humans with wholesome fish oil is exciting. (ISAA, n.d.)

1. Biomaterials and Bioplastics: Marine organisms provide a rich supply of biomaterials for the creation of biodegradable polymers, tissue engineering scaffolds, materials for wound healing, and medication delivery systems. Such biomaterials with special qualities can be found and extracted with the aid of marine biotechnology.

Example:

* A new source of biodegradable synthetic polymers with a variety of beneficial industrial qualities is being offered by oyster shells. These polymers are employed in agricultural and water treatment processes. According to Donlar Corporation of Bed Ford Park, Illinois, the potential market for these goods could be worth millions of dollars. (S, n.d.)
* Scientists from California makes a compostable, biodegradable replacement for a common plastic made out of seaweeds. This innovation can help us fight worldwide waste and help fight Climate change (https://swaythefuture.com/)

1. Environmental Monitoring and Bioremediation: Marine biotechnology aids in the evaluation of marine ecosystems and the environmental monitoring thereof. To identify and monitor contaminants, dangerous algal blooms, and the general health of marine habitats, biosensors, molecular tools, and DNA-based approaches are being developed. Marine organisms are also utilized in bioremediation to remove pollutants including heavy metal contamination and oil spills.

The use of bioremediation to solve issues with aquaculture and marine habitats has considerable promise. This procedure can aid in the management of aquaculture and seafood processing, the control of harmful chemical leaching from the soil, the removal of sewage and chemical waste, the recovery of minerals like manganese, and the control of oil spills. Traditional biotechnological methods have been established by researchers at Louisiana State University in the United States to metabolize harmful contaminants such PCBs (Poly Chloro Biphenyls), PAHs, and creosote. Additionally, they have had experience bio-treating and reusing old marine timbers and pilings that were taken from marine installations including ports and structures for oil extraction. Their research has produced fresh strategies for removing harmful substances including creosote, copper, chromium, arsenic, and others from treated wood in order to encourage wood recycling. (S, n.d.)

1. Energy Production: Marine biotechnology has the potential to be used in the production of renewable energy. It includes utilizing energy from ocean currents, waves, and tides as well as producing biofuels from marine microorganisms like algae.

EXAMPLES:

One economically viable option to cut back on the use of fossil fuels is through the production of biofuels from microalgae. Microalgae are thought to be better sources of biofuels than higher plants because of their high oil content, ease of propagation (they can be grown in brackish or salt water, not utilizing resources used by conventional agriculture), residual biomass after oil extraction that can be used as feed or fertilizer or fermented to produce ethanol or methane, and controllable biochemical composition. (ISAA, n.d.)

Global Algae Innovations uses algae to produce fuel that can be used for engines that we have today. Algae is easy to grow as it only requires carbon dioxide and a good amount of sunshine. Algae also captures CO2 directly which helps us avoid these greenhouse gases goint to the atmosphere and for every 3,000 acres of algae farm saves 120,000 acres of forest from being destroyed. (https://www.globalgae.com/about)

PROS AND CONS OF MARINE BIOTECHNOLOGY

PROS

* Exploration of biodiversity: Marine biotechnology enables the exploration and study of the vast biodiversity that exists in the oceans. New organisms, genes, and substances may be discovered as a result, with potential uses in industry, agriculture, and medicine.
* Sustainable resource utilization: Developing sustainable ways for the extraction and use of marine resources, such as marine organisms and their byproducts, is possible with the help of marine biotechnology. This could lessen the strain on land-based resources and aid in the growth of the blue economy.
* Finding new drugs: The marine environment is a rich source of bioactive substances with potential uses in medicine. The discovery, isolation, and development of novel medications and treatments for a range of illnesses and medical conditions are made possible by marine biotechnology.
* Monitoring and preserving the environment: Marine biotechnology offers methods and instruments for keeping track of and evaluating the condition of marine ecosystems. Effective conservation and management techniques can be facilitated by its assistance in the early detection of pollution, hazardous algal blooms, and other concerns.

CONS

* Environmental impact: If improperly regulated, some marine biotechnology activities, such the gathering of marine species or the extraction of resources, may have detrimental effects on marine ecosystems. Potential issues include overexploitation, habitat degradation, and disruption to marine life.
* Regulatory challenges: Due to the complexity of marine ecosystems and the possible hazards connected with the introduction of genetically modified organisms or novel substances, the development and marketing of marine biotechnology products frequently encounter regulatory obstacles.
* Ethical considerations:  Concerning the utilization of marine animals and their genetic resources, marine biotechnology presents ethical issues. Particularly when indigenous people are involved, issues with intellectual property rights, benefit-sharing, and cultural heritage can come up.
* Limited infrastructure and knowledge: Compared to terrestrial biotechnology, marine biotechnology is still mostly unexplored, and it is unclear how many marine organisms could be used. Furthermore, establishing the infrastructure needed for maritime research and development at far-off or deep-sea locations can be expensive and difficult.
  + Only 5% of the ocean has been surveyed and mapped by humans, which may come as a shock. The rest, particularly its depths, is still a mystery. (Fava, 2022)