



Application of Marine Bio-Technology on Benefaction of human: An overview

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Abstract:

Marine Biotechnology is very useful in various aspects explores the human benefit and fundamental biological progress from marine biological resource. It deals with ocean exploration in vast for development of new pharmaceutical drugs, chemical products, and enzymes and other useful products and processes. It also deals with the advancement of aquaculture and seafood safety, bioremediation, and bio fuels many others which actually helps a lot presently and will be an integral part in near future. Marine bioeconomy turns aquatic biomass into food, feed, nutraceuticals, pharmaceuticals, cosmetics, energy, packaging, clothes and much more to fulfil the needs and to increase blue bioeconomy. Blue biotechnology is the application of science and technology to living aquatic organisms for the production of knowledge, goods and services and is increasing importance day by day and becoming promising in the future. To fulfil the need of present and future generation Marine Biotechnology will play a vital role and is one of the growing and promising sectors.

Keywords: Marine Bio-Technology; Human Benefit; Pharmaceutical Drugs; Toxins; Human welfare.

I. Introduction

Marine biotechnology has been reported to a lot of definitions and explanations [1–3]. Marine biotechnology is the importance and potential application of engineering and scientific principles to the processing of materials by biological resources from the sea to provides good and service [4]. Since, the marine environment is the most biologically and chemically diverse habitat on the planet. Marine biotechnology has, in recent years, delivered also a growing number of major therapeutic products and analytical tools. Marine biotechnology may be defined as the creation of products and processes from marine organisms through the application of biotechnology, molecular and cell biology, bioinformatics and many other processes. It has been reported that many things that we use in our daily lives and are important like plastics, food and beverages, fabrics, medicines and even personal care products are mainly derived from different aquatic living organisms [4].

Now looking forward to the applications Blue Biotechnology which are very useful in various aspects. The marine environment comprises more than 70% of the earth surface and contains the most ancient and diverse form of life. The application of bio-technology in marine explores the human benefit and fundamental biological progress from marine biological resource.

It is mainly the field of science that deals with ocean exploration in vast for development of new pharmaceutical drugs, chemical products, and enzymes and other useful products and processes. It also deals with the advancement of aquaculture and seafood safety, bioremediation, and bio fuels many others which actually helps a lot presently and will be a integral part in near future.

In the view of preceding discussion, we provide a brief overview of new and emerging analytical techniques that have recently had a significant impact on our ability to exploit marine biological resources. Several techniques which have the potential to do so and which are expected to allow major inroads to be made in developing marine based medical, industrial and environmental applications are highlighted [5].

II. Marine Biotechnology applications in various fields [1-5]

Marine biotechnology is the biotechnology using aquatic organisms that is mainly "blue" for the water that these organisms live in. We already utilize many aquatic resources such as fish, shellfish, sponges and petroleum reserves to fulfil our need. Blue biotechnology goes beyond this mainly utilizing an incredible variety of organisms from Earth's oceans, lakes, rivers and streams and other water bodies for several different purposes. As per research Marine Biotechnology which is referred to as the blue biotechnology is a field that mainly make uses of marine organisms and marine bio resources for the creation of different essential products for the development of blue bio economy through the application of advanced technology, bioinformatics, molecular and cell biology.

1.Human and Environmental Health

Marine biotechnology which is playing a vital role in securing human health and environmental health mainly by developing novel drugs, antibiotics, anticancer drugs, painkiller, cosmetics and many others.

They are mainly derived directly or indirectly from marine flora and fauna. On the other hand there's emerging development of biotechnological approaches, mechanisms and applications mainly to address key environmental issues such as marine-derived antifouling strategies, marine habitat restoration, bioremediation of marine ecosystems and mainly the use of high-resolution biosensing techniques to monitor the in situ marine environments.

Many painkillers that are commonly prescribed have the side effect of drowsiness and many other. They actually tend to slow down our body in general such as our respiration. A substance called ziconotide which mainly comes from the venom of cone snails mainly prove to be a better alternative as per the research.

Ziconotide works as a painkiller when injected directly into our spinal cord actually far more powerful than morphine and also acts in specific regions of the parts of spinal cord. This means that unlike other painkillers it

doesn't actually affect our entire nervous system and doesn't cause drowsiness and is far more better than other painkillers.

2. Food Supply

It is very essential to secure the food supply as due to the growing demand of high quality and healthy products from fisheries and many aquacultures and to fulfilling demand of high population. Due to the high nutritious value of marine derived food products they are actually an important and essential part of diet in many parts of the world.

Marine-derived food products and nutraceuticals are actually an integral part of human nutrition diet in many parts of the world. For instance, the omega-3 fatty acids derived from fish oil, marine algae and phytoplankton play very important role in the human diet and human physiology and helps to maintain human health and thus seafoods should be included in the diet to maintain a healthy lifestyle.

Other nutraceuticals that are mainly developed from the marine environment are bioactive peptides, fish proteins, seaweeds, macroalgae, microalgae, amino acids etc. It is thus one of the most conspicuous applications of marine biotechnology is securing the food supply for its importance and need.

3. Alternative Energy Source

Marine environment is mainly a sustainable source of bioenergy which is ensuring the alternative sources of energy and which will be very useful. Production of biofuel from microalgae is quite promising nowadays. Algal biomass which can be grown in artificial ponds or bioreactors without competing with crops. Algal biomass is mainly the actual amount of algae in a water body at a given time. There are many advantages to algal biomass based biofuels but also a lot of challenges associated are being faced most of which have been part of recent reviews of many experiments and studies.

It is an extensive field of research in today's world. Many studies have suggested that actually seaweeds would be suitable feedstocks for biorefineries. Seaweed which also called marine macroalgae have a potential to be a valuable feedstock for biorefinery. So depending upon seaweed type it is very much possible to extract different natural pigments, antioxidants, fatty acids, oils, high value biological components and other substances which can be potentially used in an industrial production system and is mainly a great energy source and are thus becoming beneficiary for its uses day by day.

4. Industrial Biotechnology

These sectors is one of largest beneficiary sector because some products such as nutraceuticals, medicines and pharmaceuticals that are consumed by human beings mainly comes from different industrial biotech sector through the source of marine biotechnology using aquatic plants and animals.

Proteins, enzymes, biopolymers, bio-adhesives and biomaterials are mainly produced on a large scale from the marine aquatic ecosystem through different process. Examples of marine biotechnology products are mainly Green Fluorescent Protein from jellyfish and luciferase enzyme from *Vibrio* fishery both are actually being used

in molecular biology as reporter proteins. Similarly like Shrimp alkaline phosphatase and other marine derived enzymes with heat labile properties are actually used in various molecular applications such as PCR.

5. Transgenic fish

A transgenic fish is actually a genetically modified fish whose DNA has been altered using different genetic engineering techniques. Gene delivery to marine animals and organisms is mainly one of the most significant applications of marine biotechnology. The basic purpose of transgenesis in fish is actually to enhance their quality, growth, resistance and well productivity. They are mainly kept as pets or in aquafarming for food production by modifying the expression of growth hormone for their beneficiary. They are actually developed as indicators of environmental pollutants in aquatic habitat which is of great importance. Genetically modified fish are mainly used in scientific research and many studies concerning various purposes like enhancing the traits of commercially available fish mainly to produce important proteins which are important for developing non-mammalian animal models and for functional genomics studies. Salmon is an example of the US FDA approved GM animal for human consumption. Other common examples of GM fish are Atlantic salmon, tilapia, common carp, rainbow trout, mud loach etc. However actually many controversies regarding the research have come up regarding ethical concerns, ecological concerns and economic concerns given that GM techniques and GM organisms submit mainly to Intellectual Property law.

6. Aquaculture

Recently one of the fastest growing food production industries is Aquaculture. In the last 3 to 4 decades mainly the spectacular growth of industry took place vastly. It was actually started in different parts of Asia, China.

Aquaculture which is also known as aquafarming is the controlled cultivation of aquatic organisms such as fish, algae and other organisms of values such as aquatic plants (e.g. lotus). Aquaculture mainly involves cultivating of freshwater and saltwater populations under much controlled or semi-natural conditions and can actually be contrasted with commercial fishing which is the harvesting of wild fish.

According to the Food and Agriculture Organization (FAO) aquaculture is mainly understood to mean the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants which are used for different purposes.

This is mainly classified in two parts basis of their uses - Food Aquaculture and Business Aquaculture.

7. Food Aquaculture

All animals need to eat and all farmed animals need to be feed. Aquaculture represents a efficient method to convert feed to edible protein. Much research at NOAA has reported of reducing of fishmeal and fish oil use in aquaculture feeds to maintain the important human health and to take care of the benefits of seafood consumption. The remarkable progress is developing day by day and alternatives have reduced the use of wild fish.

The oceans are considered limitless and are mainly thought to harbour enough fish to fulfil the need of increasing human population. However, the demands of a growing population particularly in economically poorer countries use sustainable yield of the seas in different ways. At the same time as fishing has become more industrialised

and production of fish and shellfish farming is growing rapidly for their beneficial. But aquaculture has come under great criticism as environmentalists fear that it would mainly cause significant environmental problems and further impact wild species that are already being threatened. Many human activities already affect many animals. In fact a study shows that the ecological threat of aquaculture is much lower than continuing to supply the majority of fish protein from wild capture.

8. Business Aquaculture

Aquaculture which is the farming of fish, shellfish, aquatic plants and other organisms can be an interesting field for someone who is willing to invest the time needed to thoroughly learn the product and start business of their own. Operating a fish farm requires a good deal of physical labour to construct and maintain an ideal habitats and knowledge of the species feeding habits and breeding patterns and getting overview idea of this.

III. Different Types of Aquacultures

1. Mariculture

It is a type of aquaculture that mainly needs seawater. This type of aquaculture is done either in the ocean or a segmented part of the ocean or in ponds that mainly contains seawater as that is the basic need of this aquaculture. Molluscs, shellfish, prawn and seaweed are the marine organisms that especially bred in such parts of the oceans. One of the important parts of mariculture is the seaweeds these seaweeds and species are mainly used in high quality cosmetics production and different jewellery manufacturing industries and are giving economic support to many lives. For instance, collagen that is extracted from seaweed is used in some of the facial creams whereas pearls that are hand-picked from molluscs are turned into stunning and charming fashionable accessories and many lives are dependent on this profession [3].

2. Fish Farming

It is one of the basic types of aquacultures. This process mainly includes the careful breeding of fish. It can be done in any freshwater preferably seawater as this is important for the whole process. This method of breeding helps in providing a source for food and consumption for many lives. The process of fish farming actually needs proper water conditions and temperatures and are mainly comparatively easier. There is no requirement of a larger space for this type of farming as the breeding species such as tilapia are way too small [5].

3. Algaculture

Algaculture actually involves the farming of algae. Algae are microbial organisms with resemblance to animal and plant characteristics. For economic viability they are harvested in huge and large numbers. Algae are used for various purposes and are very important and useful. An example of such application is the source of energy for smartphones which are of great use nowadays. Exxon mobile is working towards developing them as a new energy source [6].

4. Open-net pen and Cage Systems

Open-net pen and Cage systems are another type of aquaculture which are mainly carried in freshwater lakes as their basic need is freshwater. Net cages of between 6 and 60 cubic feet are implanted in the fresh water with the fish attached inside the net. With a high absorption of fish in the pens water environments become purified from various chemicals wastes or parasites. The fishes in the net cages also entice predacious animals and bigger fish which get trapped in the nets and are used for various purposes.

Benefits of Aquaculture [2-8]

Rich source of micronutrients and animal protein

Fish fulfils the day to today necessity of animal protein to more than 1 billion people around the world with essential resources, which is a product of aquaculture and is a great source of protein for humans which are very important to maintain healthy lifestyle.

Fish also contain other necessary nutrients that should be included in our diets.

3. A nurturer of biodiversity and ecosystem

Aquaculture in this technique mainly involves taking care of the population of aquatic plants and animals and other organisms. The techniques of aquaculture have resulted in many discovery ways in which diverse aquatic organisms and plants can exist naturally and is one of the most beneficiary. Thus, aquaculture helps in decreasing environmental waste and helping to make the proper functioning of the ecosystem which will be helpful for every life.

4. Employment Opportunities

Aquaculture also brings various career opportunities in different ways. As an emerging field of career, aqua farming will create ample job opportunities for good amount of people. Future Aquaculture Expectations: Due to emerging high demands of aquatic products by the consumers this industry will promisingly expand fast in the years to come. Main prioritised for future aquaculture are Domestication, Seed Production, Species Selection, Selective Breeding, Bacterial Role, Health Control, Ecology, Marine Resources, Fish oil and fishmeal, Stock Enhancement Program. The aquaculture is an emerging industry for fish farming and conserving biodiversity. The market will grow and create various opportunities in near future vastly and it will also fulfil many demands.

5. Bio fuel and Bio refineries

Alternative source of energy is needed in the near future to supply in the petroleum based industries and to fulfil the great demands. Development in biorefineries will create great opportunities in various sectors and will help in creating sustainable society in near future.

Unlike other renewable energy sources, biomass can be converted directly into liquid fuels, called "biofuels," which will help to meet the transportation fuel needs which is in high demand nowadays. The two most common types of biofuels in use today are ethanol and biodiesel, both of which represent the first generation of biofuel

technology. The ocean is mainly an untapped, potentially sustainable source of bioenergy. There are many examples of the production of bio-energy from marine organisms, but the production of biofuel from microalgae present the most promising way to produce the energy.

Many researches are nowadays carried on the topic of Development and demonstration of viable renewable energy products and processes, notably through the use of marine algae.

Due to the high demand for fuels and the subsequent impact of global warming issues the establishment of alternative environment friendly energy is a prime concern to the scientific communities and many research nowadays and their main focus is to save the ecosystem. Thereby, renewable energy in the form of biofuel is gaining research momentum and finding its way into the energy processing for development and consumption to meet the excess demand. Biofuel is potentially thought as one of the greatest sources of renewable energy and is use currently unlike fossil fuels such as natural gas.

A biorefinery is a refinery that converts biomass to energy which is a good source of energy. The most important energy products which can be produced in biorefineries are **gaseous biofuels (biogas, syngas, hydrogen, biomethane)** solid biofuels (pellets, lignin, charcoal) and liquid biofuels for transportation (bioethanol, biodiesel, FT-fuels, bio-oil) which are in great demand nowadays.

Biodiesel mainly involves **direct replacement for petroleum diesel** and can be used in any diesel engine without any kind of modifications. The use of biodiesel can reduce a diesel engine's overall emissions up to 75 percent which is actually very helpful. It can also reduce engine wear and tear and help a diesel vehicle last longer due to its naturally high lubricity and is more beneficiary and thus for these they are also becoming a part of great demand.

6. Bio sensing

It is a high resolution technique helps in monitoring the in-situ environment. It mainly detects Harmful Algal Blooms, water quality and human health risks.

A biosensor is a system or device that mainly detects the presence of biological and chemical species by monitoring. A biosensor is composed of a sensing element and a transducer which actually helps in monitoring [2,9].

7. Microalgae fiber optic biosensors

These types of biosensors are mainly used for the detection of pesticides in marine water by monitoring. The technique mainly supports upon the photosynthetic properties of Chlorophyceae microalgae. These type

of organisms are immobilized into a porous silicon layer that acts as a recognition element. The pesticide enables the photosynthesis process of the microalgae and consequently helps in O₂ production. When the device comes in contact with water the O₂ production is mainly monitored. The fluctuations or the absence of O₂ are actually the indications of the presence of pesticides helping in detecting [3,10].

8. Automated online optical bio sensing systems (AOBS)

One of the consequences of global warming nowadays is mainly the rise of cyanobacterial blooms. Cyanobacterial blooms generally proceed with the production of cyanotoxins that can actually be very harmful for humans. New method that is online optical biosensing systems are developed for the rapid and fast detection [4,11].

9. Biosensors to detect marine toxins in seafood

Everyday more and more toxins are piling up mainly in our food and shellfish for example accumulation of phytotoxin in the digestive glands. These toxins are actually harmless for shellfish but very toxic for human health and harmful. DSP (Diarrhetic Shellfish Poisoning), PSP (Paralytic Shellfish Poisoning) are only a few of the diseases that are correlated with phytotoxins. There is an increasing demand for cheap and correct screening methods nowadays to detect these toxins and biosensors are able to fulfil these demands fulfil the demand [4, 6, 12].

10. Marine Biopolymer

It is one of the active research field as these are mainly some of the most abundant naturally occurring polymers produced by living organisms.

Marine biopolymer based nanomaterials are actually one of the most active research areas in recent decades for its applications and usage. They are interesting biomaterials for clinical applications because of their good biocompatibility, biodegradability, inexpensiveness, abundance, stability, ease of surface modification and nontoxic nature thus fulfilling so many needs.

Marine environment has been recognized as a valuable and important source of bioactive polymers with industrial potential and need. New nanoparticles which are in development are mainly coated with marine polymers to combine the therapeutic and diagnostic applications because of the strongly enhanced absorption and scattering in near-infrared (NIR) regions. It gives a promising hope to diagnosing many difficult diseases such as cancer [6, 7,13].

IV. Conclusion

The Blue or Marine Biotechnology actually enables various solutions for ocean productivity and sustainability without harming the marine environment. It provides many social and economic benefits.

Most of the earth surface that is (more than 70%) is covered with water which is mainly the ocean and other parts with lands thus making aquatic ecosystem much larger in terms of biosphere giving a high chance to protect the environment through the use of aquatic animals and plants and thus helping in growth of blue bioeconomy.

The richness of marine biodiversity and genetic diversity have provided with potential biotechnological applications which are mainly related to bioprospecting, drug discovery, environmental remediation, increasing seafood supply, safety and developing new resources and industrial processes which are very helpful and important.

The global blue biotech market is mainly segregated and parted on the basis of Product as Pharma Products like medicines, Enzymes, Biopolymers and Bulk Chemicals. Based on Application the global Blue Biotechnology

market is segmented mainly in Genomics, Bio-Engineering, Vaccine Development, Drug Discovery that are used in labs and hospital.

Thus it has wide application in the field of life science, healthcare and environment. Blue biotechnology feels like a trending field because it's supple, adaptive, and continuously moving forward and becoming promising day by day.

References

1. Regan D. L, 1998, Marine biotechnology and the use of arid zones. 11:377-381.
2. Colwell R. R, 1983, Biotechnology in the marine sciences. Science, 222:19-24.
3. Zilinskas R. A, 1995, The Global Challenge of Marine Biotechnology a Status Report on the United States, Japan, Australia, and Norway. College Park, MD: Maryland Sea Grant College.
4. Duis K and Coors A, 2016, Micro plastics in the aquatic and terrestrial environment: sources (with a specific focus on personal care products), fate and effects, Environmental Science Europe, 28:2
5. Burgess J. G: 2012, New and emerging analytical techniques for marine biotechnology, Curr. Opin. Biotechnol. 23: 29
6. Steele R.E, David C.N, Technau U.2011, A genomic view of 500 million years of cnidarian evolution. Trends Genet.;27(1):7–13.
7. Bosch T.C.G, Klimovich A, Domazet-Lozo T, Grunder S, Holstein T.W, Jekely G, 2017. Back to the basics: Cnidarians start to fre. Trends Neurosci. ;40(2):92–105
8. Bayer, F. M. 1981. Key to the genera of Octocorallia exclusive of the Pennatulacea (Coelenterata: Anthozoa), with diagnoses of new taxa. Proceedings of the Biological Society of Washington 94(3): 902–947.
9. Cairns, S. D. and D. G. Fautin. 2009. Cnidaria: Introduction, Biodiversity 315–319.
10. D.L. and D.K. Camp (eds.), Gulf of Mexico—Origins, Waters, and Biota. Biodiversity. Texas A&M University Press, College Station, Texas.
11. Blunt J.W, Copp B.R, Keyzers R.A, Munro M.H, Prinsep M.R (2013) Marine natural products. Nat Prod Rep 30(2):237–323
12. Liao Q, Feng Y, Yang B, Lee SM-Y (2019) Cnidarian peptide neurotoxins: a new source of various ion channel modulators or blockers against central nervous systems disease. Drug Discov Today 24(1):189–197
13. Ovchinnikova T.V et al (2006) Aurelin, a novel antimicrobial peptide from jellyfish *Aurelia aurita* with structural features of defensins and channel-blocking toxins. Biochem Biophys Res Commun 348(2):514–523