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ALGAL BIOPLASTIC A SOLUTION FOR PLASTIC POLLUTION

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ABSTRACT:

The ascent of plastic production was a twentieth century phenomenon on a historical scale. The low cost of plastics and its skillfulness have paved a way for a wide range of applications. As the plastics are non-biodegradable and found to have nephrotoxic effects on human, animals and also the environment, the bioplastic came into existence. Bioplastics are perishable and can be derived from renewable biological sources. Algae function glorious feedstock for plastic production owing to its several advantages like high yield and also the ability to grow during a variety of environments. The polysaccharides from the algae are used for the bioplastic production. Seaweeds are best well known for the natural polysaccharides that may be extracted from them which are widely used, particularly in the fields of food technology, biotechnology, biological science and even drugs but not yet in the plastic industry. Since they are renewable biomass resources and are polymers made up of sugars that contain carbon, they may be used to create perishable and prime quality bioplastic. The major structural polysaccharides are alginate can be found, in the cell wall of seaweed. This used to produce a bioplastic film, which is biodegradable in nature. As for plastic products, algae is a source of valuable raw materials due to their polymers. Algae bioplastic mainly evolved as a byproduct of algae biofuel production.

KEYWORDS: *Bioplastic, perishable, algae, polysaccharides, alginate.*

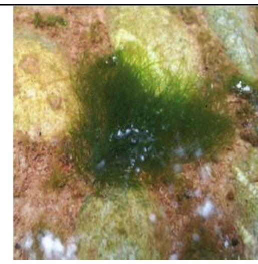
INTRODUCTION:

Plastic has been a highly valued material on earth for its utility. Plastics contribute to our health, safety and peace of mind in our day to day life. Plastics are artificial or semi-synthetic materials that are usually polymers of high molecular mass obtained from crude and fossil fuel gas. The phenomenal rise within the usage of plastics is due to their low value and higher properties that embrace flexibility, rigidness, breakableness, ability to be moulded into kinds of shapes and lighter [Rajendran, N et al, 2012]. Though these plastics are considered to be one of the greatest innovations ever, they are conjointly imposing a great calamity to the environment the wildlife and therefore the general public. Biomass-based plastics or bioplastics are a sort of plastics derived from renewable biomass resources like edible fat or cornstarch instead of the standard plastics which are made up of petroleum. Their benefits are multitudinous and one is their capability to perishable naturally within a short period of time only.

Some of these polysaccharides are Floridian starch, agar and alginate. Since they are renewable biomass resources and are polymers made up of sugars containing carbon, they might be used to produce a bioplastic [Ramani grade et al, 2013]. Humans manufacture about 34 million loads of plastic waste annually, reprocess a mere seven per cent. The remaining 93 percent finally ends up in landfills and oceans. Plastic materials that are universally employed in our daily lives are currently inflicting serious environmental problems. Millions of loads of these non-degradable plastics accumulate in the environment per year.

The environmental impact of unrelenting plastic wastes is escalating widespread world concern and disposal systems are inadequate. Burning may engender waste product pollution, appropriate landfills are restricted, and utilizing techniques for waste are typically expensive and involve high-energy consumption. Adding to that, the fossil fuel resources are finite and distributed. It is crucial to search out enduring plastic alternates, particularly in short-run packaging and disposable applications. Synthetic polymers (known as plastics) become noteworthy since the 1940s, and since then they're subbing glass, wood and alternative constructional materials, and even metals in several industrial, domestic and environmental applications [Swati Pathak et al, 2014].

Tabel 1. Types of algae

Brown algae	**Red algae**	**Green algae**
 Figure 1: Sargassum wightii	 Figure 2: Porphyra leucosticta	 Figure 3: Cladophora
Laminaria Dictyota Focus Sargassum Ectocarpus	Gelidium Porphyra Bactrachosperumum Gracilaria Polysiphonia	Cladophora rupestris Codium fragile Codium tomentosum Prasiola stipitata Ulva compressa Ulva lactuca

Commercially available varieties of marine macro algae are normally mentioned to as seaweeds. Macro algae can be classified as red algae, brown algae or green algae depending on their nutrient and chemical composition [P. Vijayabaskar et al, 2011]. Seaweed is easy to cultivate using wide arable areas of the sea. Until now, most seaweed, research dealt with component analysis because seaweed contain unique polysaccharides and carbohydrates making them suitable as dried feed, human food, fertilizer and soil amendment agent [Sung-Soo Jang et al, 2012].

VARIETY OF SEAWEEDS:

SEAWEED POLYSACCHARIDES

Polysaccharides made from seaweed have gained lot of attention by industrialist and investigator to expand the world trade. Seaweed contains many vital polysaccharides. The most important polysaccharides are agar, carageenan, and alginates. The minor polysaccharides comprise of fucose, cellulose, laminarin, floridean and xylan [Jayachandran venkatesan et al, 2017].

POLYSACCHARIDES OF RED SEAWEED

Of all the marine macroalgae, red algae are phylogenetically the oldest division, and that they contain sulfated galactans because main structural building block of their cell walls and intracellular matrix. Carageenan and agar are the two major polysaccharides derived from red seaweed [Bhakti Tanna et al, 2019]. Carageenan is gel is formed and viscosifying polysaccharides that are obtained by extraction of certain species of red seaweeds. Carageenan are used each in food and non-food merchandise. In terms of food industry, carageenan are used as gelling, thickening and stabilizing agent because of their glorious physical functional properties [Hafizh Muhammad Noor, 2018]. Carageenan has no nutritional value and utilized in pharmaceutical applications and experimental drugs this substance is usually used for the testing of medicament agents [J. Necas et al, 2013]**.** Agar is a linear polysaccharide ordinarily extracted from the cell walls of the marine red seaweeds. Removal of the agaropectin part of agar yields agarose [Nikita P et al, 2018]. It is an extract of red algae, solid in granular, powder type, as flakes or long strips. This mixture is widely used as a gelling agent and infrequently eaten up on its own. In its pure type, agar could be a tasteless and odourless polysaccharide [Leonel Pereira, 2018].

POLYSACCHARIDES OF GREEN SEAWEED

From an economic perspective, green seaweeds are sustainable biomass feedstocks for the food and biotech industries, together with bioremediation, integrated cultivation systems and potential biofuel production [Thomas Wichard et al, 2015]**. A** Major polysaccharide in green seaweed is ulvan. Ulvan is a cell wall polysaccharide that contributes from 9 to 36% dry weight of the biomass of Ulva and is principally composed of sulfated rhamnose, uronic acids xylose [Joel T. Kidgell et al, 2019]**.** Ulvan has been checked as antioxidant, anticoagulant, immune modulating activity, antihyperlipidemic activity, tissue engineering and drug delivery [Jayachandran Venkatesan et al., 2017]**.**

POLYSACCHARIDES OF BROWN SEAWEED

During the last decades brown seaweeds attracted much attention as a source of polysaccharides, namely alginate and sulfated polysaccharides fucoidans [Vishchuk OS et al, 2011]**.** Polysaccharides extracted from brown seaweeds play a principal role in anti tumour agents. Especially, a variety of studies discovered that polysaccharides from brown seaweed like fucoidan and laminaran, have a favourable effect against different types of cancer cells [K. K. Asanka Sanjeewa et al, 2017]. Alginate is the cell walls of the brown seaweed. They are the chain forming heteropolysaccharides created of blocks of manuronic acid and guluronic acid. Most alginate used in foods is in the form of sodium alginate. It is a naturally occurring anionic polymer and it has an application in medicine due to its biocompatibility, low toxicity, low value and gentle gelation [Kuen Yong Lee et al, 2013]**.** The structure of the cell wall of brown algae consists of an amorphous matrix of polysaccharides. It is mainly composed of fucoidan and alginate. Fucoidan composed of 5% to 10% of dry biomass of algae, depend on the species, the thallus part have been used [ludmylla cunha et al, 2016]**.**

BIOFUEL OR BIODIESEL PRODUCTION

Algae is now becoming the main source of biofuel production throughout the world. It is considered as a better source for biofuel production because it couldn't cause food problems as they are mainly including those plants which are used for food [Suliman khan et al, 2017].

BIODEGRADABLE AND NON BIODEGRADABLE PLASTICS

Bioplastics	**Synthetic plastics**
• Bioplastics can be defined as a material which can be decomposed easily by bacteria or any other natural organisms and not being part of the pollution.	• Synthetic plastics are typically organic polymer of high molecular mass and often contain other substances.
• The rate of decomposition is slow	• The rate of decomposition is fast.
• It is more expensive to create.	• It is less expensive to create.

• After degradation, they can be used to produce biogas, manure, fertilisers and compost.	• As their degradation rate is slow and the separation and recycling are not easy.
• Bioplastic substances are not harmful to the environment	• Synthetic plastic substances are harmful to the environment.
• They are non-toxic, non-pollutants, eco-friendly to the environment.	• They are toxic and pollutant to the environment
• The natural agents involved in the degradation are air, water, microorganisms, sunlight, soil,etc.	• It causes pollution and is harmful to living being.
• Examples: Polybutylene succinate (PBS), Polycaprolactone (PCL), Polybutyrate adipate terephthalate (PBAT) and polyvinyl alcohol (pvoh/pva).	• Examples: e-waste, plastics, plastic bottles, cans, artificial or man-made polymers, metallic wastes, etc.
• Bioplastic items decompose and break down naturally.	• Synthetic plastic waste takes up large quantities of waste and it is potentially damaging to the environment.
• Bioplastics are not collected but they are used in short time.	• Synthetic plastics are often collected.

Table 2. difference between bioplastic and synthetic plastic

AGGREGATION OF PLASTICS IN THE NATURAL ENVIRONMENT

Normally, plastics are a polymeric material which can be moulded and shaped by the use of heat and pressure. It is also found in combination with other special properties and it can be made into many products. The tough and lightweight beverage bottles made up of polyethylene terephthalate (PET), flexible garden hoses made up of polyvinyl chloride (PVC), insulating food containers made of foamed polystyrene etc. Large quantities of plastics have aggregated in the natural environment and in landfills. Improperly discarded plastics are also contaminating the wide area of natural terrestrial, freshwater and marine habitats [Richard C. Thompson, 2009]. Also the usage of plastics leads to water, soil and air pollution. It will lead to imbalance of the ecosystem of the earth. The plastics made of polymers can take hundreds or even thousands of years to break down so the environmental damage is for a long period. The plastic interact with the water and creates the Styrene trimer, Bisphenol A and a byproduct of polystyrene. Bisphenol A (BPA) is the most known monomeric of polycarbonated plastics. BPA increases the risk of Breast cancer, Prostate cancer, Pains, Metabolic disorders, etc [Ram Proshad et al, 2018]**.** BPA is used to make plastic beverage containers, dinnerware, protective linings of food cans and toys, can increase or decrease endocrine activity in human and cause health effects. At the high level of exposure, Bisphenol A consider as a hazard because it mimics the female hormone oestrogen [Noopur Mathur et al, 2014]**.** The plastic waste like plastic bags, bottles etc are drawn to the sea and ocean by rivers. They are deposited in the ocean and the sea. They are polluted and disturb the ecosystem of the sea and ocean. In the water the plastic degradation is slow because of the lowered temperature and limited UV penetration, so that the plastic debris persists and aggregated [Gabriel Erni-Cassola et al, 2019]. Fishing nets are the commercial issue. Even though fishing is necessary for the economy and supply of food in many regions, the nets are made of plastic. So when the net is submerged into the water, they leak some toxins. They also break and pollute the water. In the marine environment, the plastic debris affects the marine life. Land and ocean are the major sources of plastic that enters into the environment, with domestic industrial and fishing activities are the important contributors [Wai Chin LI et al, 2016].

CONCLUSION

Algal bioplastics plays a vital role as environmental friendly, biodegradable when compared to synthetic plastic [Sayeda M. Abdo et al, 2019]C Sulfated polysaccharides from the algae namely agar, carageenan, alginates, etc have many applications for the environment as they have biological and physiochemical properties [Ludmylla Cunha et al, 2016]**.** This biodegradable plastic is cost effective and eco-friendly compared to conventional plastics. The technological routes for the production of algal based bioplastic are still under the research phase [Rubecca Robert et al, 2019].

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REFERENCE

1. Bhakthi tanna and avinash mishra (2019), nutraceutical potential of seaweed polysaccharides: structure, bioactivity, safety and toxicity. Comprehensive reviews in food science and food safety 1541-4337. doi: 10.1111/1541-4337.12441.
2. Gabriel Emi-cassola, Vinko Zadjelovic, Matthew I. Gibson, Joseph A. Christe-Oleza (2019), Distribution of plastic polymer types in the marine environment; A mera-analysis. Journal of hazardous materials 691-698.doi: 10.1016/j.jhazmat.2019.02.067.
3. Hafizh Muhammad noor (2018), potential of carageenan in food and medical application. Indonesial scholars alliance 2580-9296.doi: index,php/ghmj/article/view/188/163.
4. Jayachandran Venkatesan, Sukumaran Anil, Se-Kwon Kim (2017), Introduction to Seaweed Polysaccharides. Isolation, biological and biomedical applications 1-9.doi: 10.1016/B978-0-12-809816-5.00001-3.
5. Joel T. kidgell et al (2019), Ulvan: A Systematic review of extraction, composition and function. ScienceDirect 101-422.doi: 10.1016/j.algal.2019.101422.
6. J. Necas, L. Bartosikova (2013) Carageenan: a review. Veterinarni medicinal 187-205. Vri.cz/docz/vetmed/58-4-187.
7. Kuen Yong Lee and David J. Mooney (2013), Alginate: properties and biomedical applications. PubMed Central 37(1):106-126.doi: 10.1016/j.progpolymsci,2011.06.003.
8. K. K. Asanka sanjeewa et al (2017), The potential of brown algae polysaccharides for the development of anticancer agents: An update on anticancer effects reported for fucoidan and laminarian. Sciencedirect 451-459. doi: 10.1016/j.cabpol.2017.09.005.
9. Ludmylla cunha, ana grenha (2016) sulfated seaweed polysaccharides as multifunctional materials in drug delivery applications. MDPI 8005-139. doi: 10.3390/md14030042.
10. Leonel Pereira (2018) Biological and therapeutic properties of the seaweed polysaccharides. International biological review 2572-7168.doi: 10.18103/ibr.v2i2.1762.
11. Noopur mathur, N. Mathur, A. Singh (2014), Toxigenic effects of plastics on human health. Internation journal of chemical science 12(3), 1044-1052.doi: tsijournal.com/article/2014-1044-1052.

12. Olesya S. Vischuk et al (2011), Sulfated polysaccharides from brown seaweeds Saccharina japonica and undaria pinnatofida:isolation, structural characteristics and antitumor activity. Science direct 2769-2776. doi: 10.1016/j.carees.2011.09.034.
13. P. Vijayabaskar and V. Shiyamala (2011), Antibacterial Activities of Brown Marine Algae (Sargassum wightii and Turbinaria ornata) from the Gulf of Mannar Biosphere Reserve. Advances in biological research 5(2), 99-102.doi:researchgate.net/publication 267835315.
14. Rajendran N , Sharanya Puppala, Sneha Raj M, Ruth Angeeleena B, and Rajam C (2012), Seaweeds can be a new source for bioplastics. Journal of pharmacy research 1476-1479. www.researchgate.net/publication/258495452
15. Ramani grade, m. siva tulasi, v. aruna bhai (2013) Seaweeds: a novel bio material. International Journal of pharmacy and pharmaceutical sciences 0975-1491.doi: innovareacademics.in/journal/ijpps/Vol5Suppl2/6880.
16. Ram prashad et al (2018), Toxic effects of plastic on human health and environment: A consequences of health risk assessment in Bangladesh. International journal of health 6(1) 1-5.doi: 10.14419/ijh.v6il.8655.
17. Rolf U. Halden (2010), Plastics and health risks. Annual review of public health 31:179-194.doi: 10.1146/annurev.publhealth.012809.103714.
18. Rebecca Robert, Priya Iyer (2019), Isolation of PHB (Poly-b-Hydroxybutyrate) from Pseudoneochloris marina. International journal of recent scientific research 32580-32586. doi: 10.24327/ijrsr.2019.1005.3501.
19. Thomas wichard et al (2015) The green seaweed ulva: a model system to study morphogenesis. Frontiers in plant science 00072.doi: 10.3389/fpls.2015.00072.
20. Sayeda M. Abdo, Gamila H. Ali (2019), Analysis of polyhydroxybutyrate and bioplastic production from microalgae. Bulletin of the National Research Centre 43-97. doi: 10.1186/s42269-019-0135-5.
21. Suliman khan et al (2017), Biodiesel production from algae to overcome the energy crisis. Hayati journal of biosciences 163-167. doi: 10.1016/j.hjb.2017.10.003.
22. Sung-Soo Jang, Yoshihito Shirai, Motoharu Uchida and Minato Wakisaka (2012) Production of mono sugar from acid hydrolysis of seaweed. African Journal of biotechnology 1953-1963.doi: 10.5897/AJB10.1681.
23. Swati Pathak, CLR Sneha, Blessy Baby Mathew (2014), Bioplastics: Its Timeline Based Scenario & Challenges. Journal of polymer and biopolymer physics chemistry 2(4), 84-90.doi: 10.12691/jpbpc-2-4-5.
24. Wai chin LI et al (2016) Plastic Waste in the marine environment: A review of sources, occurrence and effects. Science of the total environment 333-349. doi: 10.1016/j.scitotenv.2016.05.084.