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Bioplastics- A Sustainable Biopolymer

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Abstract

Bioplastics have acquainted various adaptabilities with the environment. Bioplastics have brought more up-to-date difficulties to give an outline of the non-biodegradable petrochemical plastics market, including their underlined tests, common creation strategies, portrayal, and conceivable elective waste usage perspective. Thus, bioplastics is an alternative environmentally friendly sustainable polymer with attributes that can be utilized in numerous applications for commercial .

Keywords: Inexhaustible; Biodegradable; Polymerization; Petrochemical; Lactic acid; Cellulose

Abbreviations: PHA: Poly Hydroxyl Alkanoates; PHB: Poly Hydroxyl Butyrate; PLA: Poly Lactic Acid

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Introduction

Bioplastics are environmentally friendly biodegradable plastics derived from renewable biomass sources such as vegetable oil, corn/potato starch, microbes, agricultural waste, etc [1,2]. Inexhaustible sources are turning into a more reasonable and promising option for the plastics business [3]. When plastic is produced using hydrocarbons, they discharge carbon dioxide into the air, prompting a worldwide temperature alteration, and are not biodegradable [4]. Furthermore, the global industry is considering green plastics as an alternative sustainable material [5]. Bioplastics are being utilized in making shopping sacks, cutlery, bundling, mulch film, food administration items, fishing nets and so forth. They are made in a much cleaner way than any conventional plastics [6]. Also, it can be fabricated from cellulose, corn starch, plant oil, potato starch, sugarcane etc [7].

Types of Bioplastics

There are numerous types of bioplastics some are as follows:

a. Cellulosic bioplastics

b. Poly Hydroxyl Alkanoates (PHA)

c. Poly Hydroxyl Butyrate (PHB)

d. Polylactic Acid (PLA) plastic

e. Starch based plastics [8-10].

Cellulosic bioplastic

Cellulose is the most naturally occurring carbon-based polymer composed of glucose monomer units combined with β 1,4 glycosidic linkages, which empower cellulose chains to pack firmly together and structure solid between chain hydrogen bonds [11]. However, it is hard to use in bundling in its hydrophilic nature, helpless dissolvability qualities, and profoundly translucent construction [12].

Polyhydroxylalkanoates (PHA)

Poly Hydroxyl Alkanoates are linear polyesters produced in nature by microbial fermentation of sugar or starch to store carbon and energy [13]. PHA is more pliable and less flexible than different plastics, and it is additionally biodegradable [14]. These plastics are in effect generally utilized in clinical applications [15].

Polyhydroxylbutyrate (PHB)

The biopolymer poly-3-hydroxybutyrate is a polyester created by specific microorganisms fermenting glucose or corn starch [16]. Its attributes are like those of the petro plastic polypropylene and are highly heat-resistant and solvent-resistant [17]. Poly Hydroxyl Butyrate is mainly employed in industrial, biomedical and agriculture fields [18].

Polylactic Acid (PLA)

PLA is arising as one of the most magnetic materials given its excellent biodegradability, measure capacity, and biocompatibility [19]. Poly-lactic is a transparent plastic fabricated from corn or lactic acid [20]. Its qualities are like ordinary petrochemical-based mass plastics and is utilized in plastic preparing to create film, filaments, plastic compartments, cups and jugs [21]. It is the most climate cordial bioplastic available. The synthesis of PLA is a multistep reaction that begins from lactic acid formation and finishes with its polymerization [22]. Lactic acid can be acquired from sustainable sources like corn, potato, and sugar sticks [23]. The fundamental interaction is ring-opening polymerization of lactate to get high sub-atomic weight PLA [24].

Starch based plastics

Starch, made of amylose (20-30%) and amylopectin (70-80%), is primarily obtained from cereal grains like corn (maize), wheat, potato and rice and its application in biodegradable plastics are either blended in with its local granules or dissolved on an atomic level with the suitable polymer [25,26]. Amylose is potent for the film shaping capacity of starch [27]. Starch-based films display physical qualities like ordinary plastics film in that they are scentless, colorless, non-poisonous [28]. Bioplastics results in reduced carbon dioxide emissions, reduced toxic run-off generated by the oil-based alternatives and overall benefit to the rural economy [29].

Application of Bioplastics

The utilization of bioplastics for shopping is as of now is extremely normal [3]. After their underlying use they can be reused and afterward biodegraded in soil [30]. Plate and compartments for organic products, vegetables, eggs, meat, bottles for soda pops and dairy items and rankle foils for leafy foods are currently made from bioplastics [30]. In addition, bioplastic is widely used in biomedical field applications and in paper coating by food industries [31].

Drawbacks of Bioplastics

Bioplastics are produced using plants like corn and maize, so land that could be utilized to develop nourishment for the world is being utilized to “develop plastic” all things being equal. If biodegradable plastic is not appropriately discarded, it prompts a wasteful breakdown of the plastic, which can deliver poisons (carbon dioxide, methane and so forth) into the climate [32].

Current Trends in Bioplastics

a) Waste chicken plumes changed over into bioplastics [33].

b) 100% plant-based bioplastic.

c) Researchers engineer qualities of plants to develop crude materials for green plastic [34].

d) New plant unsaturated fat determined plastic can be separated to diesel-like fluid fuel [35].

e) Some different options in contrast to plastics are: glass, fluid wood, jute fiber, milk protein, corn-based plastics [8].

Conclusion

The utilization of bioplastics is advanced, comprising in getting regular polymers from farming, cellulose or potato and corn starch squander. These are 100% biodegradable, safe and flexible, currently utilized in agribusiness, material industry, medication and, over all, in the compartment and bundling business sector. Biopolymers are, as of now, becoming popular worldwide.

References

1. Luengo JM, García B, Sandoval A, Naharro G, Olivera ER (2003) Bioplastics from microorganisms. Current Opinion in Microbiology 6(3): 251-260.
2. Kalia VC, Raizada N, Sonakya V (2000) Bioplastics. Journal of Scientific and Industrial Research 59(6): 433-445.
3. Peelman N, Ragaert P, Meulenaer B, Adons D, Peeters R, et al. (2013) Application of bioplastics for food packaging. Trends in Food Science & Technology 32(2): 128-141.
4. Emadian SM, Onay TT, Demirel B (2017) Biodegradation of bioplastics in natural environments. Waste Management 59: 526-536.
5. Thakur S, Chaudhary J, Sharma B, Verma A, Tamulevicius S, et al. (2018) Sustainability of bioplastics: Opportunities and challenges. Current Opinion in Green and Sustainable chemistry 13: 68-75.
6. Lackner M (2000) Bioplastics. Kirk-Othmer Encyclopedia of Chemical Technology, pp. 1-41.
7. Brodin M, Vallejos M, Opedal MT, Area MC, Chinga Carrasco G (2017) Lignocellulosics as sustainable resources for production of bioplastics–A review. Journal of Cleaner Production 162: 646-664.
8. Queiroz AU, Collares Queiroz FP (2009) Innovation and industrial trends in bioplastics. Polymer Reviews 49(2): 65-78.
9. Arikan EB, Ozsoy HD (2015) A review: Investigation of bioplastics. Journal of Civil Engineering and Architecture 9: 188-192.
10. Shah S, Matkawala F, Garg S, Nighojkar S, Nighojkar A, et al. (2020) Emerging trend of bio-plastics and its impact on society. Biotechnology Journal International 24(4): 1-10.
11. Agustin MB, Ahmmad B, Alonzo SMM, Patriana FM (2014) Bioplastic based on starch and cellulose nanocrystals from rice straw. Journal of Reinforced Plastics and Composites 33(24): 2205-2213.
12. Wang Q, Cai J, Zhang L, Xu M, Cheng H, et al. (2013) A bioplastic with high strength constructed from a cellulose hydrogel by changing the aggregated structure. Journal of Materials Chemistry A 1(22): 6678-6686.

13. Keshavarz T, Roy I (2010) Polyhydroxyalkanoates: Bioplastics with a green agenda. Current Opinion in Microbiology 13(3): 321-326.

14. Jain R, Kosta S, Tiwari A (2010) Polyhydroxyalkanoates: A way to sustainable development of bioplastics. Chronicles of Young Scientists 1(3): 10-15.

15. Albuquerque PB, Malafaia CB (2018) Perspectives on the production, structural characteristics and potential applications of bioplastics derived from polyhydroxyalkanoates. International Journal of Biological Macromolecules 107: 615-625.

16. Haddadi MH, Asadolahi R, Negahdari B (2019) The bioextraction of bioplastics with focus on polyhydroxybutyrate: A review. International Journal of Environmental Science & Technology 16(7): 3935-3948.

17. Sreedevi S, Unni KN, Sajith S, Priji P, Josh MS, et al. (2014) Bioplastics: advances in polyhydroxybutyrate research. Advances in Polymer Science, pp. 1-30.

18. Singh P, Parmar N (2011) Isolation and characterization of two novel Polyhydroxybutyrate (PHB)-producing bacteria. African journal of biotechnology 10(24): 4907-4919.

19. Kumaravel S, Hema R, Lakshmi R (2010) Production of polyhydroxybutyrate (bioplastic) and its biodegradation by Pseudomonas lemoignei and Aspergillus niger. E-journal of Chemistry 7(S1): S536-S542.

20. Aramvash A, Shahabi ZA, Aghjeh SD, Ghafari MD (2015) Statistical physical and nutrient optimization of bioplastic polyhydroxybutyrate production by Cupriavidus necator. International Journal of Environmental Science and Technology 12(7): 2307-2316.

21. Zaverl M, Seydibeyoğlu MÖ, Misra M, Mohanty A (2012) Studies on recyclability of polyhydroxybutyrate-co-valerate bioplastic: Multiple melt processing and performance evaluations. Journal of Applied Polymer Science 125(S2): E324-E331.

22. Yashavanth PR, Das M, Maiti SK (2021) Recent progress and challenges in cyanobacterial autotrophic production of Polyhydroxybutyrate (PHB), a bioplastic. Journal of Environmental Chemical Engineering 9(4):

23. Fojt J, David J, Přikryl R, Řezáčová V, Kučerík J (2020) A critical review of the overlooked challenge of determining micro-bioplastics in soil. Science of the Total Environment 745:

24. Singh S, Mohanty AK (2007) Wood fiber reinforced bacterial bioplastic composites: Fabrication and performance evaluation. Composites Science and Technology 67(9): 1753-1763.

25. Gonzalez-Gutierrez J, Partal P, Garcia-Morales M, Gallegos C (2010) Development of highly-transparent protein/starch-based bioplastics. Bioresource technology 101(6): 2007-2013.

26. Amin MR, Chowdhury MA, Kowser MA (2019) Characterization and performance analysis of composite bioplastics synthesized using titanium dioxide nanoparticles with corn starch. Heliyon 5(8):

27. Vilpoux O, Averous L (2004) Starch-based plastics. Technology, use and potentialities of Latin American starchy tubers, pp. 521-553.

28. Mose BR, Maranga SM (2011) A review on starch based nanocomposites for bioplastic materials. Journal of Materials Science and Engineering B, 1(2): 239-245.

29. Lörcks J (1998) Properties and applications of compostable starch-based plastic material. Polymer degradation and stability 59(1-3): 245-249.

30. Jabeen N, Majid I, Nayik GA (2015) Bioplastics and food packaging: A review. Cogent Food & Agriculture 1(1).

31. Byun Y, Kim YT (2014) Bioplastics for food packaging: Chemistry and physics. In: (2nd edn), Innovations in food packaging, Academic Press Publishing Company, USA, pp. 353-368.

32. Shamsuddin IM, Jafar JA, Shawai ASA, Yusuf S, Lateefah M, et al. (2017) Bioplastics as better alternative to petroplastics and their role in national sustainability: A review. Advances in Bioscience and Bioengineering 5(4): 63-70.

33. Sharma S, Gupta A, Kumar A, Kee CG, Kamyab H, et al. (2018) An efficient conversion of waste feather keratin into ecofriendly bioplastic film. Clean Technologies and Environmental Policy 20(10): 2157-2167.

34. Karan H, Funk C, Grabert M, Oey M, Hankamer B (2019) Green bioplastics as part of a circular bioeconomy. Trends in plant science 24(3): 237-249.

35. Balat M, Balat H (2010) Progress in biodiesel processing. Applied energy 87(6): 1815-1835.

