THE ROLE OF BIODEGRADABLE PLASTICS IN REDUCING ENVIRONMENTAL POLLUTION

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ABSTRACT

Plastic usage is increasing the number of pollutants in the environment. Plastic particles and other plastic-based pollutants are found in our environment and food chain, posing a threat to human health. While biodegradable plastics need to be an integral component of strategies to minimize plastic pollution of the environment, they have to be used and managed with specific end-of-life scenarios. From this perspective, the biodegradable plastics material focuses on creating a more sustainable and greener world with a smaller environmental imprint. This assessment should consider the entire life cycle assessment of the objectives and priorities for producing a wide range of biodegradable plastics. Biodegradable plastics can also have properties similar to traditional plastics while also delivering additional benefits due to their minimized impact on the environment in terms of carbon dioxide, as long as appropriate waste management includes such as composting, are contained. The demand for cost-effective, eco-friendly materials increases to reduce waste management and pollution issues. This study seeks to comprehensively understand biodegradable plastics production and applications research, product prospects, sustainability, sourcing and ecological imprint. Academic and industry interest in biodegradable plastics for sustainability has exploded in recent years. Researchers used the triple bottom line to analyse the sustainability of biodegradable plastics.

Key words: Biodegradable plastics, Influential factors, Life cycle assessment, Bio-based plastics, and triple bottom line

INTRODUCTION

Bioplastics has the characteristic of being either biodegradable, bio based, or exhibiting both properties. Plastics have become integral to all aspects of modern daily life. Its flexibility size, light weight, and lower cost make it a highly desirable material for a wide range of domestic and industrial applications, providing numerous benefits. However, the excessive and imprudent utilization of plastic leads to environmental degradation and has detrimental implications for human health. Plastics are produced from finite petroleum resources, the excessive use of which has resulted in the exhaustion of these natural assets. These compounds are organic in nature, and their inappropriate disposal leads to the loss of countless animals due to asphyxiation. These substances have deleterious impacts on both aquatic organisms and terrestrial creatures, as they diminish soil fertility and heighten the

likelihood of eutrophication. An inherent issue with plastics is their non-biodegradability, causing them to endure in the environment.

The extensive manufacture of disposable plastic, fueled by consumer demand, has resulted in a significant environmental hazard known as plastic pollution. This issue arises from the generation of large quantities of plastic garbage. Petroleum-derived plastics are not capable of undergoing natural decomposition, and the majority of plastic trash is either disposed of in the environment or stored in landfills. To address this issue, it is necessary to develop an alternate solution, such as the creation of biodegradable plastic. Biodegradable plastic is a type of plastic that can break down in the environment through the activity of microorganisms like bacteria, fungi, and algae. The primary benefit of utilizing biodegradable plastic lies in its capacity to undergo rapid breakdown without causing any detrimental impact on the environment. The plastic is environmentally benign and manufactured from potentially low-cost raw materials. Recycling can be seen as a progressive solution for managing plastic waste. However, its effectiveness is restricted due to the intricate composition of plastic, the various varieties of plastic, and the degradation of material quality that occurs with each recycling step. He study aims to tackle environmental concerns associated with conventional plastics, highlighting their detrimental impacts and advocating for sustainable alternatives. The text emphasizes the importance of embracing environmentally friendly materials, namely biodegradable alternatives like PLA, PHA, PHB, the starch, and cellulose. The study acknowledges the limitations of recycling and emphasizes the importance of investigating new methods to reduce the environmental consequences of traditional plastics

LITERATURE REVIEW

Shileer Sulaiman Omer [2024] The increasing environmental concerns linked to the extensive use of traditional plastics have led to a rising interest in bioplastics, mostly because of their capacity to biodegrade and their reliance on organic materials. This study examines the harmful impacts of petroleum-derived plastics on the ecosystem, animals, and human health, highlighting the pressing requirement for sustainable alternatives. The enduring characteristics of plastics, together with their role in exacerbating global warming and emission of harmful gases when burned, highlight the urgency of discovering environmentally-friendly alternatives. The research promotes the use of biodegradable materials as a practical alternative, highlighting their ability to break down through the action of microorganisms without causing harm to the environment.

Mahesh Keshav mise [2023] Plastics offer a variety of advantages or benefits, due to its flexibility it has wide applications in modern world. However, use of too much plastic can put effect on the environment and human life. Need for the production of biodegradable plastic (plastic that can be decomposed in the environment by the action of naturally occurring microbes) has been increasing day by day. There is an extensive
need to produce biodegradable plastic due to its ability to decompose itself in short period of time hence saving environment.

Taofeeq D. Moshood [2022] The purpose of this study is to investigate the contribution of biodegradable plastics to sustainability in a new and sustainable plastics economy, in which plastics perform their useful function without causing negative externalities. Biodegradable plastics are those that degrade naturally over time. With research carried out across three

diverse sustainability principles using the triple bottom line method, a multi-disciplinary strategy is a one-of-a-kind approach (social attitudes, environmental consequences, and economic characteristics). Biodegradable plastics became the initial target, as the position of plastics in the plastics system would inevitably be diminished if it could not be established for biodegradable plastics that give equivalent or improved material properties in contrast with traditional plastics.

Ghada Atiwesh [2021] Throughout their lifecycle, petroleum-based plastics are associated with many environmental problems, including greenhouse gas emissions, persistence in marine and terrestrial environments, pollution, etc. On the other hand, bioplastics form a rapidly growing class of polymeric materials that are commonly presented as alternatives to conventional petroleum-based plastics. However, bioplastics also have been linked to important environmental issues such as greenhouse gas emissions and un favorable land use change, making it necessary to evaluate the true impact of bioplastic use on the environment. Still, while many reviews discuss bioplastics, few comprehensively and simultaneously address the positives and negatives of bioplastic use for the environment. The primary focus of the present review article is to address this gap in present research.

Biodegradable Plastics

Biodegradable plastics are a kind of environmentally friendly plastic which can be deduced from renewable resources such as biomass, starch, fats and oils. Some waste materials for examples, food, agricultural and vegetable wastes, renewable feedstocks for example, biomass serve as the key sources of bioplastics which results in not any environmental pollution, no loss of fossil fuel, and ultimately no harm to mankind. A population of microbes can also be helpful to obtain biodegradable plastics from bio-wastes. Biodegradable plastics degrade inherently in the environment. This process is accomplished when microorganisms, exist in environment, metabolize and breakdown the structure of biodegradable plastics into simple compounds that are not harmful for the environment.

Potentials of biodegradable plastics

It is important to recognize that it is challenging for biodegradable plastics to biodegrade rapidly and completely in various natural environments, yet to retain their mechanical properties during their purpose-intended life span to satisfy consumers' demands. For instance, a soil-biodegradable plastic mulch film needs to remain intact enough during the early stage of the growing season to provide the intended agronomic benefits to plants, but then needs to degrade rapidly enough after till-in to ensure no lasting accumulation and negative impacts on soil and plant health. Further, additives in the biodegradable plastics should be monitored for the potential accumulation in the environment and subsequent impacts on ecosystems.

Biodegradability of Plastics in the Environment

The biodegradability standards ensure that the polymers in biodegradable plastics can be converted to CO2, CH4, or biomass, under certain conditions as specified in the standard protocols. These test conditions are usually highly favorable for biodegradation, i.e., large surface area of the plastics (plastics can be tested in powder form), and optimal moisture and temperature. As such, biodegradation standards ensure the "intrinsic" biodegradability of the plastic polymers. However, the standards do not guarantee that a certified biodegradable

plastic will actually biodegrade in a less controlled natural environment within the specified timeframe as described in biodegradability specifications.

Fundamentals of biodegradable plastics

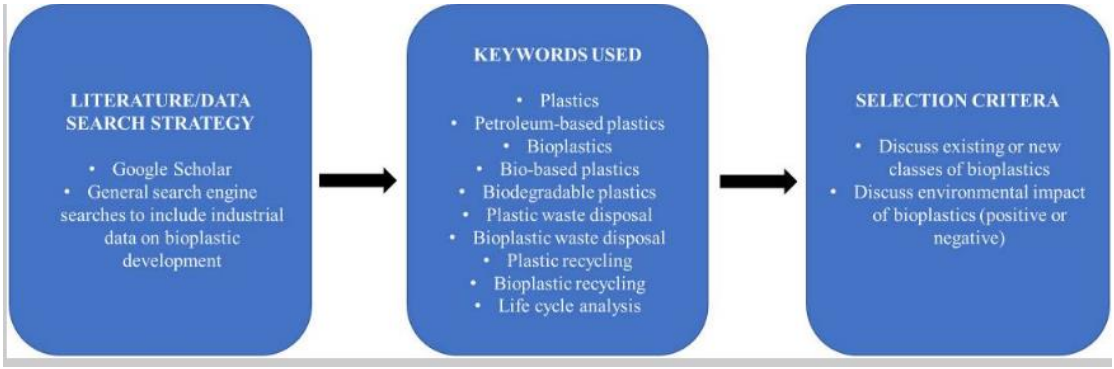
Biodegradable plastics is a term which raises questions among a lot of consumers. For many, the prefix "bio" seems to suggest ecological advantages compared to conventional plastics; others interpret biodegradable as a readiness of these materials to degrade in the open environment or in garden composting. In addition, distinguishing biodegradable plastics from bio-based plastics is challenging. While it can be confusing to find ones way in the world of these new materials, the severe consequence can be improper treatment of products made of biodegradable plastics, potentially leading to increased inputs into the environment.

Processing of biodegradable plastics

Processing of biobased non-biodegradable plastics and fossil based biodegradable plastics is similar to processing of conventional plastics and can be done on the same processing equipment. This can also be said for the processing of biobased biodegradable plastics, but there are some potential aspects that have to be taken into account owing to their renewable origin. These aspects include moisture, flow anomalies (wall slipping), thermal degradation and batch-to-batch variations. Biobased biodegradable plastics tend to be hygroscopic, so moisture can cause various problems, for example uncontrolled reduction of viscosity, undesired foaming and acceleration of thermal degradation or hydrolysis.

METHODOLOGY

Bioplastics, bio-based plastics, biodegradable plastics, plastic waste disposal, and bioplastic waste disposal, plastic recycling, bioplastic recycling, life cycle analysis (Figure 1). Industrial research data, such as primary data available on company websites, was not excluded from this review as such data provide information about the competitive, cutting-edge research and development in the field of bioplastic development. To specifically meet the objectives of the present review, only those studies that discussed existing or new classes of bioplastics, and/or their impact on the environment (positive or negative) were included.



The first of these sections, titled 'Plastics and the environment', discusses conventional plastics, their degradability, and their impact on the environment. The second section introduces bioplastics such as a way to replace conventional plastics and discusses some of the most important as well as recently developed bioplastics currently in commercial use or industrial testing. The third section elucidates the debate about whether bioplastics or not are good for the environment, presenting both the positive and negative effects of these materials on the environment.

CONCLUSION

Biodegradable plastics have come to the light after the adverse and destructive effects of plastic pollution on environment have become unavoidable. The emergence of biodegradable plastics is a prerequisite for the sustainable and safe environment. Globally, their contribution in conserving and protecting the environment is significant.

Biodegradable plastics can be used to replace conventional plastics to improve the environment while also ensuring the long-term availability of petroleum resources. Biodegradable plastics have shown to be quite useful in irradiating medical devices and food. Many issues might be handled, and a green environment could be preserved for a long time, thanks to the manufacture of biodegradable plastics. The main difficulties that must be effectively solved are the high production costs and low performance of some biodegradable plastics, which require more study to prevent competing with other environmental effects.

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