

Eco Friendly Synthesis and Characterisation of Starch Based Bioplastics

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Abstract

Bioplastics are made from vegetable oil, corn starch, straw, sawdust, sawdust, recycled food waste, etc. They are plastic materials made from renewable energy sources such as, Some bioplastics are obtained by direct processing from natural biopolymers, including polysaccharides and proteins. This article is discussing about the preparation of bioplastics using potato starch, corn starch, Corn/agar and potato/Corn in different combinations to produce four types of bioplastics and comparing the solubility, heat resistance and biodegradability of bio- plastics to realize its characteristics to allow them to compete with the conventional plastics. The future of bioplastics shows great potential.

Key words: Heat resistance, Solubility, Degradability.

Introduction

Our society has entered the age of plastics. Although it is a recent invention, it is able to influence modern life. The growing concern about the pollution caused by dumping of plastic wastes led to the search for relatively environment friendly materials to substitute these conventional petroleum based plastics. Recently biodegradable plastics have been developed from natural polymers. Current research is focusing on how to use Natures' polymers to make plastics. Bio-plastics are biodegradable or bio-based plastics completely or partially derived from renewable biomass sources like corn and potato starch, banana peel, milk, paper waste, food waste, cheese etc. Bio-plastic is usually derived from sugar derivatives including starch, cellulose and lactic acid.

Need of the study

Bio-plastic can be sensibly developed as a solution to the massive plastic invasion on our planet. Not all bio-plastics are biodegradable but they degrade more readily than the common petroleum based plastics. Bio-plastic is commonly transformed into plates, cutlery, bottles, bags, textiles and packaging materials. It can also be used in the medical field as the implant during surgeries which will dissolve within the body thereby a second surgery for the removal of implants can be avoided. Bio-plastic is used in agriculture mainly for the preparation of mulch sheets.

Demand for plastic is insatiable. Everything from shopping bags, fast food packaging, switch boards, plastic containers etc. are made of plastics. Usually these plastic wastes end up in oceans or in landfills thereby causing pollution and significant amounts of greenhouse gasses are produced from them. Common fossil fuel based plastics are non- biodegradable and exotic materials. This can be effectively replaced by renewable, bio- degradable, eco-friendly bio- plastics.

Literature Review

The first known bioplastic was polyhydroxybutane, discovered by French scientist Maurice Lemoligue in 1926 while working on *Bacillus megaterium*. Antonio (2009) studied “innovation and industrial trends in bio-plastics”. It briefly explains how these developments occur and identifies the latest trends in technology and business. Jame Colwill and El Wright of the Society of Plastics Engineers Plastics Environment Section studied "Opportunities to store biopolymers through closed-loop recycling" in 2010. They assessed the weakness in existing research, related to recycling of biopolymers. A research paper based on “The golden bridge for nature: the new biology applied to bioplastics' ' was published by Johana

Ricones². The research focused on the possibility of modifying organisms in order to create new biosynthetic routes for the production of monomers that would fit the production of high quality polymers from renewable feedstock. Starch attracts public attention as a replacement of fossil fuel in polymer industries because it is renewable, biodegradable and non-toxic. Mariya Yuliana³ and her coworkers researched on defatted cashew nut shell starch and possibilities of deriving a plastic from it. Olivier Talon⁴ attempts to answer the question “Are bioplastics ‘green’ plastics? by life cycle assessment (LCA) methods, also examining limitations of these methods, and then by putting an additional reference framework established on the basis of the 12 principles of green chemistry. In the interests of clarity, it should be noted the term ‘bio-plastics’ is to be understood in terms of nature rather than properties.

LCA of bio- plastics is capable of providing us with interesting data in terms of evaluation of their environmental impact, there are certain limitations, the list of which could still be added to. Pragya Shailendra⁵ Rathore studied about “bio-prospects of the PHB”. Polyhydroxybutyrate is a bioplastic produced by a variety of microbial species in carbon rich and nutrient poor environments. Cheaper materials for mass production of PHB were researched and planned to reduce the production costs.

Objectives of the study

Through this work I have tried to prepare bio-plastics using potato starch, corn starch, Corn/agar and potato/Corn in different combinations to produce four types of bioplastics and compared the solubility, heat resistance and biodegradability of bioplastics to realize its characteristics to allow them to compete with the conventional plastics. The future of bioplastics shows great potential.

Methodology

For making bioplastic from corn starch, First add 2 tablespoons of cornstarch into a beaker. Then add 3-4 tablespoons of water. Mix them well. Add 1 tablespoon of glycerine and 1 tablespoon of vinegar. Stir the mixture well. Now heat the mixture and stir continuously until a sticky precipitate is formed. Spread the product on a flat surface and let it dry. Keep it for a few days and carefully detach it from the surface without tearing.

Repeat the same procedure for the preparation of other plastics. Skip adding vinegar for making (corn + agar) bio-plastic. Water plays an important role in bioplastic production. First, it acts as a solvent that dissolves the starch. The latter helps keep the starch separate when heated, and the vinegar releases acetate ions and hydrogen ions into the solution. Large cellulose molecules, such as starch, have long chains. By adding a small amount of vinegar, we can break some of the polymer chains and make the plastic less brittle. Glycerin acts as a plastic desiccant and lubricates plastics.

In order to know whether the plastics that we have made can be used as an alternative to replace the normal plastic, we conducted a few experiments.

- 1. Heat resistance test**
- 2. Solubility test**
- 3. Degradability test**

The results for the flexibility and transparency of the plastic can be obtained by visual observation.

Analysis and interpretation of data

1. Heat Resistance

The prepared bio plastic pieces were added into the water heated to 80⁰ C. All

prepared bio- plastics curls and becomes soft. On continuous stirring, it breaks down into small particles and dissolves. Among the four bioplastics prepared agar based one dissolved easily. Studies revealed that corn based bioplastic is more heat resistant when compared to other there bioplastics

2. Solubility

To test solubility, pieces of bio-plastics were kept in a beaker filled with water for about 7 days. The plastics become soft and when stirred with a glass rod is dissolved in water. Bio-plastics made from potatoes were comparatively more soluble than others.

3. Biodegradability

After one week, all the soil buried bio-plastics are in the same condition. It shows no difference in size, but there is a change in colour intensity i.e. paleness from its original colour. After 4 weeks, a few pieces of corn + agar bio-plastics left but the corn made plastic has completely decomposed. The bioplastic made from potato decomposed partially and its size decreased with numerous pores. The potato+corn based bioplastic decomposed after a period of one month.

Findings of the study

- Potato + Corn based bioplastic is least soluble in water whereas potato alone based bioplastic is highly soluble in water.
- Among the four bioplastics, corn based is the most heat resistant.
- Biodegradability studies indicate that all the bioplastics have a nearly one month shelf life.
- Bio-plastic made from corn has got superior properties compared to other three bioplastics.

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