APPLICATION OF FOOD AND AGRO PROCESSING INDUSTRIAL WASTE IN BIODEGRADABLE ECO-FRIENDLY BIOPLASTIC PRODUCTION

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Introduction

Plastic pollution is a serious environmental and health problem which is increasing day by day. The chemical properties of plastics have made it very useful and durable, however it is also responsible for non-decomposable and non-biodegradable and leading to various problems. Almost all types of plastics are directly or indirectly dumped in the landfills, making them stay there for decades and slowly polluting the environment. Plastic pollution being the worldwide challenge, led to the ongoing research field dealing with finding plastic related problems. To overcome the plastic pollution various techniques and technologies came in existence among which production of biodegradable plastic is most common which aims to produce bio-based plastics which won't cause any negative impact on environment like traditional petroleum-based plastics. Agricultural wastes are the rich sources of various bioactive compounds. This property of agricultural waste provides a platform to utilize them to produce various value-added products such as biogas, biofuel, bioplastics and many more. Polysaccharides, being the most abundant macromolecules in flora and fauna, is one of the most suitable raw materials for bioplastics in the form of starch, which is not only renewable and sustainable but is also plentiful and cheap. Starch also has favorable thermoplastic properties and is biodegradable. Aim of our project is to utilize the waste rice husk as a cellulose material along with cooked waste rice as a starch to produce environmentally friendly biodegradable plastic. The materials we are using are eco-friendly, cost effective, and easily available and are promising candidates to overcome the detrimental effects of conventional plastic.

Objective

1. Extraction of cellulose from organic wastes.

2. Extraction of cellulose from agricultural wastes.
3. To produce bio-plastic using the extracted cellulose and starch along with some binders.
4. To produce a bio based and biodegradable plastics which won't have negative impact on environment.

Methodology

Materials & Methods:

Based on the idea to produce biodegradable plastic, we will be using agricultural waste which gets easily decomposed with the help of microorganisms. Since we are focusing on biodegradable property, microbes will be able to break the bond between the adjacent units of starch and cellulose and making them linear and later then will utilize those units as their source of food.

Three types of starch will be used, from banana peels, rice and corn. Reinforcement will be done using waste products as fillers, like potato peel powder and rice husk.

Extraction of Cellulose from rice husk: Collected rice husk will be washed, dried and grinded to 2mm size. Next it will be allowed to undergo alkali treatment followed by acid hydrolysis and bleaching. The cellulose obtained will be dried.

Extraction of starch from cooked waste rice: The collected waste cooked rice will be mixed with water and smashed properly to obtain a slurry. With the help of chemical treatment starch will be isolated from rice.

Preparation of bioplastic: Specific ratio of starch and cellulose will be mixed in presence of required chemical for the process of polymerization allowing it to give the property of flexibility and required hardness. Two different plasticizers Glycerol and Sorbitol have been utilized separately and in a 1:1 combination and later as an anti-fungal agent we add Copper Sulphate to the complete mixture will be agitated and dried by giving desired shape by pouring into mold[1,2].

Chemicals and fillers preparations: Ethanol, Analytical grade Glacial Acetic acid, Sorbitol, Glycerol 5 ml of acetic acid was poured carefully into 95 ml distilled water and stirred properly. The obtained bioplastic will be tested for the physical and chemical tests with the properties of bioplastics.

PROTOTYPE

A trial experiment was performed utilizing the banana peel for the production of biobased plastic. The results were very much effective to work further by including other substrates with an aim to enhance the quality and properties of the biodegradable plastic.

The bioplastic obtained in trial experiment is attached below.

Results:

Starch Extraction from rice.

Rice was soaked in water until it absorbed water, followed by grinding the rice. The grinded rice was filtered using muslin cloth. The extract was poured in a tray and was allowed to dry by covering with aluminium foil. After two days when the starch got dried, it was grinded to obtain the starch powder.

Biochemical Test for Starch

Iodine reagent was added to the sample starch to confirm the presence of starch. The colour of the solution turned to blue-black indicating the presence of starch.

Cellulose Extraction from Rice husk

Rice husk was washed, dried and grinded into powder. Delignification of rice husk was done with the help of NaOH treatment followed by three-hour heating at 80^{o}C. Next, the mixture was filtered and precipitate was washed with distilled water. The residue was allowed to react with NaOCl for 1 hour at 80oC and stirred continuously. The sediment was then left for an hour and cellulose was obtained[3].

Innovation

In this project, we intend to utilize organic and agricultural waste for the production of biodegradable plastics. India is known to generate around 62 million tonnes of wastes per year. Earlier which was simply dumped in the landfills, but we have taken an initiative to utilize this waste and convert them into value added product.

Scope of Future Work

During the completion of the project, once we find that our methodology has the potential to replace the traditional plastic, which have caused tremendous harmful effects to our environment and ourselves, it can be implemented for different applications slowly replacing the traditional plastics. If proven durable, and decomposable within lesser duration can be used to produce single use bio-plastic or even can be used as containers for liquids.

References

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