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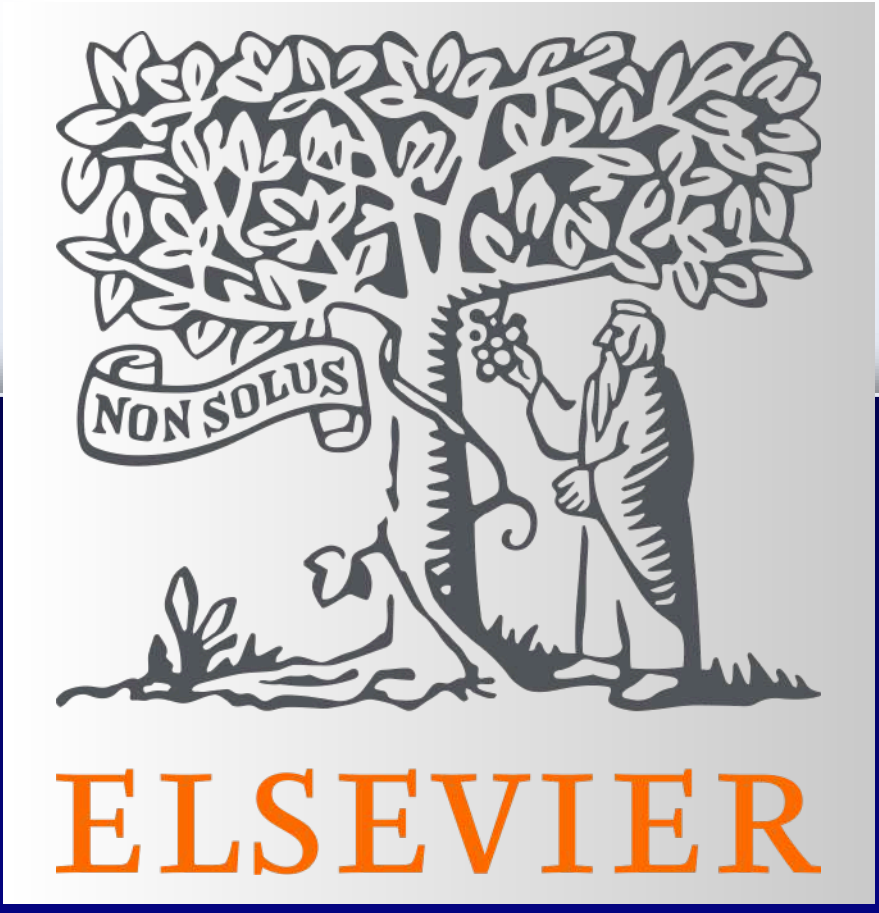

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Synthesis and Characterization of Starch Based Bioplastics Using Raw Papaya

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Abstract:

Here we present green production of bioplastics from waste peel i.e Papaya fruit peel, using composite of rice and corn starch with different amount of fillers. As the demand of plastic is increasing day by day, consequently pollution is increasing. There is urgent need to switch to bioplastics.

Keywords: Bioplastics, Peel, Plasticizer, Pollution

1. Introduction

Plastics are a wide range of synthetic or semi-synthetic materials that use polymers as a main ingredient. Their plasticity makes it possible for plastics to be molded, extruded or compressed into solid objects of various shapes. This adaptability, plus a wide range of other properties, such as being lightweight, durable, flexible, and inexpensive to produce, has led to its widespread use (Tanja et al., 2020). Plastics typically are made through human industrial systems. Today maximum quantity of modern plastics are derived from fossil energy like natural gas or petro products however, recent industrial methods use variants made from renewable materials, such as corn or cotton derivatives.

9.2 billion tons of plastic are estimated to have been made between 1950 and 2017. More than half this plastic has been produced since 2004. In 2020, 400 million tonnes of plastic were produced. If global trends on plastic demand continue, it is estimated that by 2050 annual global plastic production will reach over 1,100 million tonnes (Thompson et al., 2009)

The success and dominance of plastics starting in the early 20th century has caused widespread environmental problems, due to their slow decomposition rate in natural ecosystems. The main companies producing plastics doubted the economic viability of recycling at the time, and the economic viability has never improved. Plastic collection and recycling is largely ineffective because of failures of contemporary complexity required in cleaning and sorting post-consumer plastics for effective reuse. Plastic pollution can be seen everywhere, creating garbage in all of the world's oceans and contaminating terrestrial ecosystems.

Some researchers suggest that by 2050 there could be more plastic than fish in the oceans by weight. Living organisms, particularly marine animals, can be harmed either by mechanical effects such as entanglement in plastic objects, problems related to ingestion of plastic waste, or through exposure to chemicals within plastics that interfere with their physiology. Degraded plastic waste can directly affect humans through both direct

consumption (i.e. in tap water), indirect consumption (by eating animals), and disruption of various hormonal mechanisms. Micro plastic particles have been ubiquitously detected in a broad range of shapes, polymers, sizes and concentrations in the environments of marine water, freshwater, agro ecosystems, atmosphere, food and drinking-water, biota, and other remote locations .They can be as thin as small veils and be carried away by the wind from miles away, or they can be hard and compact like rocks. Micro plastics can latch on to the outer membranes of red blood cells and may limit their ability to transport oxygen. The particles have also been found in the placentas of pregnant women.

Bioplastics are plastic materials produced from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, sawdust, recycled food waste, etc. Some bioplastics are obtained by processing directly from natural biopolymers including polysaccharides (e.g. starch, cellulose, chitosan and alginate) and proteins (e.g. soy protein, gluten and gelatin) Andrey et al., 2009, while others are chemically synthesized from sugar derivatives (e.g. lactic acid) and lipids (oils and fats) from either plants or animals, or biologically generated by fermentation of sugars or lipids.

Starch-based plastics

Thermoplastic starch represents the most widely used bioplastics, constituting about 50 percent of the bioplastics market. Simple starch bioplastics film can be made at home by gelatinizing starch and solution casting. Pure starch is able to absorb humidity, and is thus a suitable material for the production of drug capsules by the pharmaceutical sector. However, pure starch-based bioplastics is brittle. Plasticizer such as glycerol, glycol, and sorbitol can also be added so that the starch can also be processed thermo-plastically. In food packaging, these films are seen as bakery or fruit and vegetable bags. Composting bags with the films are used in selective collecting of organic waste.

Many of the properties and characteristics of starch are required for the use as coating or packaging material (e.g., biodegradability, biocompatibility, edible material (nutritional value), availability, relatively simple extraction process, and low cost). Other properties such as odorless, tasteless, and generally nontoxic, characterize starch as a molecule with the potential to be applied for packaging applications.

This research focuses on utilizing renewable waste from agricultural sources, such as fruit peels, along with a blend of peel starch to create bioplastics. This approach can play a significant role in mitigating the problems associated with traditional plastics, while also improving their mechanical properties by incorporating easily accessible, plentiful, biodegradable, and renewable natural waste as reinforcement materials.

2. Materials and Methods

In the present study different types of starch were used, from papaya peels, rice and corn. Reinforcement was done using waste products as fillers, like wood shavings and sawdust.

Bioplastics Production

Bioplastics from Papaya peel starch (BPP) was produced using slightly modified methods of (Yaradoddi et al., 2016). Peels of raw papaya were dried in the sun while covering with a muslin cloth for 6-8 days at a stretch. There peels were then ground very finely using a blender. The powder was passed through a metal sieve to obtain a fine consistency. This powder was sieved using a cotton cloth to obtain a finer powder. Aqueous acetic acid (5%) solution; plasticizers and water were the main ingredients (Campanale et al., 2020)

Wood shavings were dried using a hot air oven set at 90 degree Celsius for 6-7 hours. These shavings were then finely powdered using a blender and sieved.

3. Results

Preparation of composite starch solution

Varying combinations of the plasticizers (glycerol and sorbitol) and filler (saw dust powder) were added as per the table below :

Sample number	Weight of powder used (gms)	Rice starch	Corn starch	Glycerol	Sorbitol
1	3	1gm/50ml water	-----	------	3g
2	3	-----	1gm/50 ml water	------	3g
3	3	1gm/50ml water	------	3 ml	-----
4	3	-----	1gm/50ml water	3ml	-----
5	3	1gm/50ml water	------	3ml	3g
6	3	------	1gm//50ml water	3ml	3g

- 1gm starch sample was mixed with 50 ml distilled water and heated using a magnetic hot plate with constant stirring at 60 degrees.
- 3 gm of powder along with plasticizers were added after 20 min. along with 1 ml acetic acid solution.
- The composite solution was stirred using the stirrer at 60 degrees Celsius for 30-35 min. until the volume of the beaker was reduced by 50%.
- This solution was then poured on a petri plate lined with aluminum foil and spread into a thin layer.
- This was left to dry at room temperature for 24 hours.

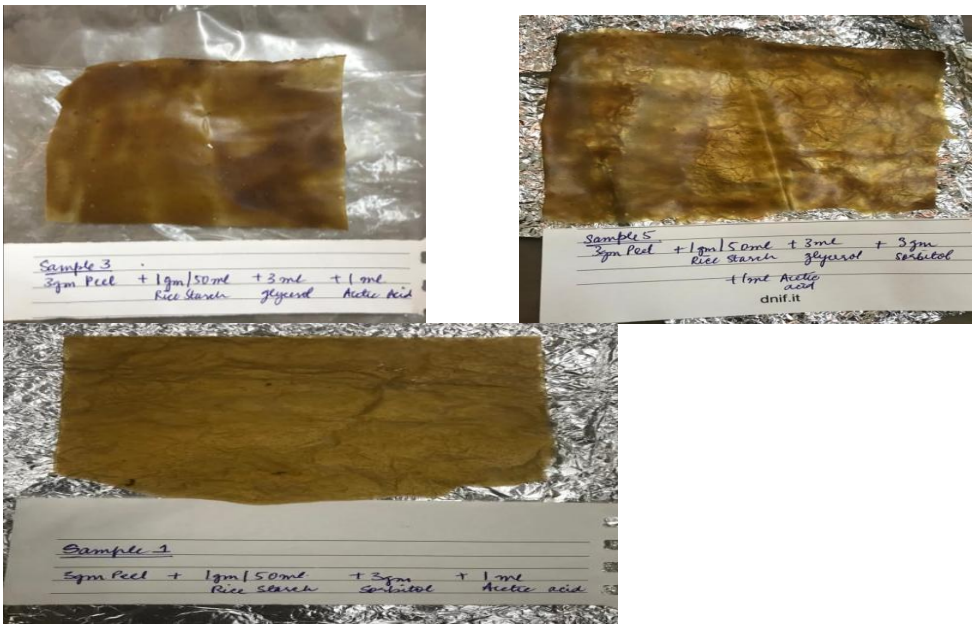

Figure 1. Image of different samples of bioplastics produced.

This study demonstrates that starches from several natural sources can be utilized individually or in combination, with or without the addition of plasticizers and natural fillers. That helps in creation of diverse bioplastics with unique physical and chemical properties. The bioplastics produced in present study needs further characterization to check solubility, elasticity and other parameters so that it can be commercialized. Bioplastics have unique features that make them appropriate for a variety of applications. The bioplastics created are biodegradable and environmentally friendly, making them a viable alternative to petroleum-based plastics and an effective solution to reduce plastic pollution.

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