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Bioplastic from Cassava Starch

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ABSTRACT

India generates nearly 26,000 a lot of plastics on a daily basis. These plastics pollute the water and soil. The solid plastic wastes incinerated by the municipal agency pollute the air. Consistent with Central Pollution panel 94% of the plastics are thermoplastics or recyclable materials like PET (polyethylene terephthalate) and PVC (Polyvinyl Chloride)The purpose of bioplastic production is an alternate for synthetic plastic. The starch may is a natural biopolymer. Cassava is employed to provide the bioplastic by using glycerol plasticizer. Perform Fourier-transform infrared spectroscopy (FTIR) for functional groups present within the bioplastic And analysis of degradation potential of developed bioplastic.
KEYWORDS: *Bioplastic, Cassava, Glycerol, Starch*

INTRODUCTION

Plastics are mostly produced by the packaging industries. Plastics are polluted the environment. Replacement is critical for the plastic packaging industries because it's estimated to grow to 22 million tons by 2020 from 13.5million tons in 2015. 1/2 the plastics are thrown off after single use, in line with a study by the Federation of Indian Chambers of Commerce and industry. These plastics are commonly made up of petroleum sources; they're non-biodegradable so require another source.Starch is a cheap and abundant product available in nature. It's fully biodegradable and that we need can to develop completely degradable bioplastic.

Manihotesculenta (Cassava) could be a shrub (native to South America) of the family Euphorbiaceae, Cassava is cultivated as an annual crop in tropical and subtropical regions. It's an edible starchy root that's used as food, animal feed and industrial purpose. They're accustomed extract manioc from the edible flour obtained by grating cassava roots and drying it. The natural polymer starch is generated from the mix of carbonic acid gas and water by photosynthesis in plants (Teramoto. N et al. 2003).

The development of Starch-Based Polymers (SCBP) will be accustomed conserve the petrochemical resources and reduce its environmental impact as they need various applications (Schwach E., Averous L., et al. 2004)

Bioplastics produced from starch possesses higher amylopectin level so it's higher enduringness and fast degradation when properties composted (OgbuUdensiet al. 2009).

Cassava starch is created of two polymers amylose and amylopectin. Therein amylase contributes 20- 30% andamylopectin contributes about 70 — 80% (Nigel et al. 2004). Cassava starch films were characterized by scanning microscopy. These films promise an honest appearance without stickiness while exhibiting shininess and transparency (Cereda et al. 1992, 1995).

Glycerol is employed as a plasticizer to take care of an adequate moisture level for an eternal film casting. Keeping the film hydrated assures adequate flexibility and resiliency. When starch-based edible films are subjected to ratio environments below 20–25%, they will experience cracking. Use of glycerol can lower tolerances to 10–15% ratio. So during this research glycerol is employed with amylum for the assembly of biofilm.

The development of most bioplastic is assumed to scale back petroleum source usage, and plastic waste, additionally as green house gas emissions.The biodegradability characteristics of those plastics create a positive impact in society, and awareness of biodegradable packaging also attracts researchers and industries.

Advantage of Using cassava after taking starch from cassava waste are removed and used for biofuel production. The purpose of bioplastic production is another for synthetic plastic.

Cassava could be a major food crop within the world after rice and maize. The starch may be a natural biopolymer. Manioc is employed to supply the bioplastic by using glycerol plasticizer. Perform Fourier-transform infrared spectroscopy (FTIR) for functional groups present within the bioplastic And analysis of degradation potential of developed bioplastic.

Methodology

- Preparation of cassava starch
- Bioplastic production by Film casting and Film blowing method

Preparation of cassava starch:

The used starch was extracted from cassava. The tubers were peeled, washed and gratedinto paste. The paste was strained into a sterile beaker using a muslin cloth and the extract obtained topped with three liters of sterile distilled water. The starch extract was left in the laboratory under room temperature for 24h, after that the supernatant was removed and then starch paste was sun dried.

Fig-1 obtain starch

Bioplastic production:

Cassava starch (6g) was added in100ml of distilled water into the 250ml beaker and mixed thoroughly for few minutes to obtain a homogeneous mixture. Glycerol (2ml) plasticizer was added and mixed then it was heated in magnetic stirrer at 120°C the mixture was continuously stirred for the gelatinization of starch,After heating, the thick opaque mixture was formed and it casted on an aluminum tray and allowed to dry for 4 days at room temperature. After that bioplastics were cooled to ambient temperature before peeled off.

RESULTS AND DISCUSSION

All bioplastics obtained in this research were odorless, transparent, and smooth. The glycerol may increases the flexibility of bioplastic.

Fig-2 bioplastic sample-1

Fig-3 bioplastic sample-2

Structural characterization of the bioplastic:

S.No	Wave number(cm-1)	Assignment
1	3234 cm-1	OH stretch vibration
2	1,635 cm-1	Stretching carbonylgroup (C=O)
3	1112 cm-1	Aromatic skeletal C–O stretch
4	1041 cm-1	C-O stretch vibration
5	976 cm -1	CH3 rocking C-C chain stretch

Table: characteristic bands of typical cassava starch based bioplastic

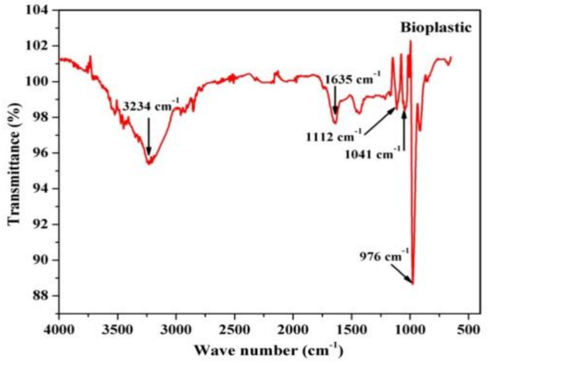

Fig-4 FTIR spectrum graph

FTIR showed (Fig-4) the chemical compatibility between the starch, glycerol the Chemical characterization of the cassava starch, and glycerol based bioplastic was evaluated by FTIR. It shows the spectra of the initial cassava starch and glycerol used for production of the bioplastic.

PhysicalCharacteristic tests

1. Film thickness:

The thickness of the bioplastics is measured by using a Scew gauge, and the average value is calculated. The average thickness of thebioplastics sample-1 (Fig-2) is found to be 0.5 mm (500 microns) and bioplastics sample-2 (Fig-3) is found to be 0.7 mm (700 microns). Indian government, banned the less than 50 micronsthickness carry bags and tamilnadu also banned plastic bags.

The results show that the prepared bioplastics have a thickness of 500 and 700 micronsso it can be used for preparing carry bags and packing materials.. However, several works have been reported on the thickness of starch films are less microns. In this work, the thickness is higher, which may be due to the presence of cassava starch.

2. Colour:

The obtain bioplastics (fig-2,3) were looks transparent and lite white and yellowish white color.

2. Solubility test:

- Normal water
- Hot water
- Normal water:

The bioplastic is not soluble in normal tab water but it affected the film strength

Hot water:

The bioplastic is dissolved in 80°c of hot water. And also this is the meeting point of the cassava starch based bioplastic.

4. Thermal analysis:

The bioplastic were degraded in three stages, the first weight loss stage (30–185 °C) was associated with the release of excess water in the bioplastic. The second weight loss stage (185–260 °C) was because of glycerol evaporation. The third weight loss stage (260–800 °C) was depolymerization and decomposition of starch molecule. The obtained results point to one predominating broad endothermal peak characteristic for all bioplastic samples in the temperature range between 65°C and 190°C, which is a consequence of incomplete gelatinization of starch film production (Mali et al., 2002).

5. Degradation test:

- Hot water
- Fire
- Soil

In hot water:

The bioplastic is fully degradable in hot water

In fire:

When these bioplastic burn it fully degradable and it doesn't release harmful gases to the environment so that these bioplastics are eco friendly And also it burn like normal paper

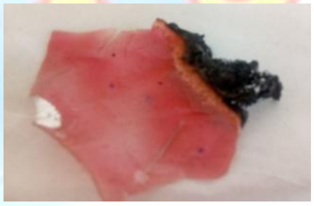

Fig-5 plastic burning

In soli:

The bioplastics made by natural source cassava starch and water, small amount of glycerol. Starch and glycerol naturally biodegradable.

6) Colour absorption test:

The obtain bioplastics were looks lite white and yellowish white colour. When adding some of the colored substance or stain it adsorption capacity is good. So that we can add some colour and produce different types of coloured packing materials. In this saffron stain (Fig-6) was added and the bioplastics colour absorption were noted.

Fig-6 saffron stain was adsorbed

The bioplastics were produced in this research was odorless, transparent, and smooth. The glycerol was increases the flexibility of the bioplastic. Structural characterization of the bioplastic was done by using FTIR analysis that shows that peaks values are represent the strong bond between the functional groups present in the bioplastic. And also different physical properties of the bioplastics were cheeked. India and tamilnadu is the major producer of cassava and India need in bioplastic production. Using cassava we also produce bioethanol so that it reduces the usage of petroleum source.

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