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Research Article

PRODUCTION OF STARCH BASED BIODEGRADABLE PLASTIC FROM JACK FRUIT SEED FLOUR (*ARTOCARPUS HETEROPHYLLUS*)

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A R T I C L E I N F O

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A B S T R A C T

Indian jackfruit seeds were collected from local market of Virudhunagar. Jackfruit seeds powder, glycerol, gelatin, were used as raw material for starch based bioplastic preparation. Starch was extracted and biofilm was prepared. The prepared biofilm was analysed by Tensile strength test, Acid and Alkalinity test, solubility and Flame test. Starch content of the biofilm was also analysed by FTIR method.

INTRODUCTION

The natural environment encompasses all living and non-living thing occurring naturally on Earth. The natural environment is contrasted with the built environment which comprise the areas and components that are strongly influenced by humans. All life that has survived must have adapted to condition of its environment. (Shreema Pradhan, 2014) .Pollutions may lead to critical problems in the global geochemical cycles as well as the sustainable habitation of humans as well as other organisms. Even through other organisms suffer from the adverse effects of natural changes, however, the main culprit is human. Various types of hazardous substances can enter the natural environment by a number of natural and/or anthropogenic activities, disturbing the living systems along with many adverse changes in the environment (Kampa and Castanas,2008).

Plastic

Plastic are manmade long chain polymeric molecules (Scott, 1999). Plastics exhibit many desirable features like transparence, softness heat seal ability and good strength to weight ratio (Bohlmann, 2006). The most widely used plastics used in packaging are polyethylene (LDPE, MDPE, HDPE and LLDPE), polypropylene (PP), Polystyrene (PS), polyvinylchloride (PVC), Polyurethene (PUR), polybutyleneterephthalate (PET), polybutyleneterephthalate (PBT), and nylons (Said *et al*., 2013). The widespread application of plastics are not only due to favorable mechanical and thermal properties but also mainly due to the stability and durability (Rivard *et al*., 1995). Polymer biodegradability depends on molecular weight crystallinity and physical forms (Gu *et al*., 1998).

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Bioplastic

Bio-plastic development efforts have focused predominantly upon starch, which is a renewable and widely available raw material. Starch is economically competitive with petroleum and has been used in several methods for preparing compostable plastics (Chandra and Rustgi, 1997). Corn is the most common source of starch for bio-plastics, although more recent global research is evaluating the potential use in bio-plastics for starches from other sources like potato, wheat, rice, barley, oat and soy (James *et al*., 2005).

Bio-plastic or organic plastic is a polymer material obtained from renewable biomass sources such as vegetable oil, corn starch, potato starch, and pea starch unlike fossil-fuel plastics derived from petroleum (Kipngetich& Hillary, 2013). This type of plastic is naturally degradable by microorganism to become environmentally substances. Materials that use to make biodegradable plastic are compounds such as cellulose, starch, and lignin that are can be obtain from the plants, and casein, protein and lipid from the animals (Averous, 2004).

Jackfruit

Jackfriut (*Artocarpus Heterophyllus*), a member of the family Moracea is a popular fruit of the tropics. It grows widely and abundantly in India (Rahman M A, Nahar N, Mian A J and Mosihnzzman M. *et al*., 1997). South-East Asia and in the evergreen forest zone of West Africa (Burkill HM, 1997).

Jackfruit seed is used occasionally as a minor supplement in culinary recipes but are mostly wasted. The jackfruit seed flour may also be blendend with wheat flour to explore the potential of low cost flour from jackfruit seed as an alternative raw material for bakery and confectionary products. The jackfruit seed flour is not only a rich source of protein, starch and dietary fibers but can also be regarded as an abundant yet cheap source of the said nutrients (Burkill H M, 1997).

The present work is carried out to investigate the functional characteristics of jackfruit seed flour blends with wheat floor for new bioplastic synthesis.

MATERIALS AND METHODS

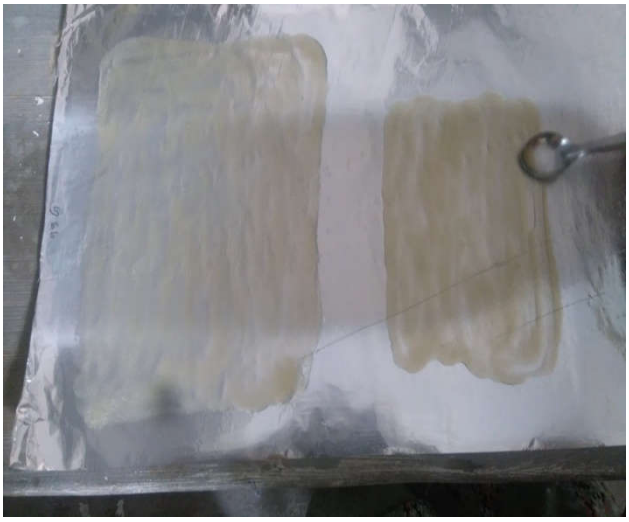
Jackfruit seeds powder, glycerol, gelatin, water, atta, beaker, rod, glassware, shredder, grinder stone, spatula, aluminum foil, oven, measuring cylinder, food additives, Javvarisi.

Collection of Seed

Indian jackfruit seeds were collected from local market of virudhunagar and were used for this study.

Synthesis of Starch-Based Bio Plastic

500g of starch is placed in a beaker. 60ml of (0.5N) HCL is added to this mixture and stirred using glass rod. 1000ml of plasticizer (500ml of glycerol and 500ml of castor oil) was added and stirred. 0.5N NaOH is added according to pH desired.



Experemental Procedure

And adding filler as per 0%, 5% and 10% respectively. Then add gelatin for more adhesiveness for filler. The mixture is Place the saucepan on the stove and start heating the mixture on medium high heat. The mixture was heated for15minutes until an opaque gel was formed. The gel was poured into aluminum foil and was spread it out. The mixture was allowed to try at overnight. Now the specimen is eligible for testing.

Test of bioplastics

Mechnical and chemical tests

Tensile strength Test
Acid and Alkaline Test
Solubility Test
Flame Test
Fourier transforms infra ray spectroscopy (FTIR)

RESULTS

Starch Based Bioplastic Film

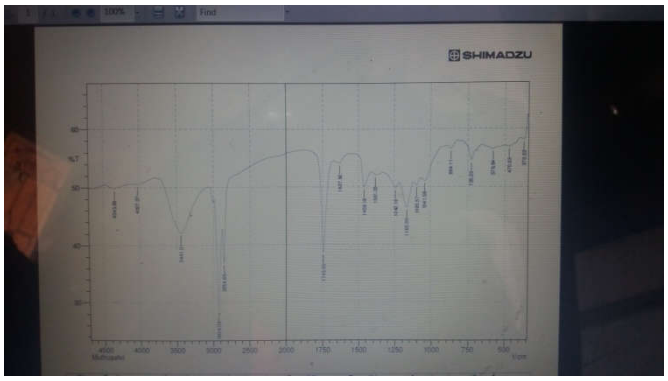
Bioplastic flim

Bioplastic products

Starch based bioplastics characterization test result:

Sample	Property	Solvent	Duration
Starch	Strong Acid test	Sulphuric acid	90 minutes
Starch	Weak Acid Test	Acetic Acid	120 minutes
Starch	Alkaline Test	Sodium hydroxide	95 minutes
Starch	Solubility Test	Water	50 minutes
Starch	Flame Test	----	10 minutes

Fourier Transform Infrared Spectroscopy (FTIR) Analysis



FTIR measurements were performed. The spectra of the samples were obtained by averaging 15 scans, with a wavenumber range of 4500 to 500 cm−1 and a resolution of 1 cm−1.

The major constituent of the Jack fruit flour is starch. Starch content was also analysed by FTIR. The peaks was observed in the regions below 800 cm^{-1}, 800 to 1,500 cm^{-1} (the fingerprint region), the region between 2,854 and 2924cm^{-1} (C-H stretch region), and finally the region between 3,441 cm^{-1}(O-H stretch region). The infrared spectra of Polysaccharides was shown to be important in the structural elucidation of small molecules and also in polymer analysis where they represent structural units. The most frequently used IR spectral range in carbohydrate analysis was the anomeric region at 1041 to 725 cm^{-1}. Determination of the esterification degree of carbonyl groups of pectin by means of infrared spectroscopy was carried out at 1,743 and 1,627 cm^{-1} for ester vs. carboxylate regions respectively.

DISCUSSION

Stevens., 2002, reported the results of biodegradable plastics synthesized from cassava starch. In the present study the obtained results showed that jackfruit seed powder served as a good raw material for the production of starch based bio degradable plastic.

The glass transition temperature of amorphous starch can be controlled by adding plasticizer (Lourdin *et al*., 1997). Traditional plasticizer are polyols, such as glycerol, glycol, sorbitol and sugars. The glass transition temperature of amorphous starch can be controlled by adding plasticizer (Lourdin *et al*., 1997). Traditional plasticizer are polyols, such as glycerol, gcycol, sorbitol and sugars. In this work also glycerol act as a plasticizer.

The tensile strength of biodegradable plastics decreases as the starch content in the formulation increases. Thus from the data presented here on tensile strength, it could be observed that a bioplastic with 90%starch composition had the highest tensile strength. This has not in any way contradicted the observations of Wool (1993), as the deviation could be as a result of the material thickness (Stevens, 2002). It is this discrepancy that might have caused the increase in tensile strength of the 90% bioplastics produced from the two starches. As the thickness of the bioplastics increases, it becomes more difficult to be stretched and the force required for breaking them individually increases (Shah, 1984; Stevens, 2002). In my present study also similar results were observed.

Bioplastic with high tensile strength assumed to have better characteristics than the other bioplastic was found at the content of 30% gycerol. In the present study Bioplastic with optimum tensile strength assumed to have better characteristics than the other bioplastic was found at the content of 20% gycerol.

FTIR analysis showed that glycerol could form a stable hydrogen bond while the addition of castor oil could disrupt inter and intramolecular hydrogen bond effectively.FTIR spectra provided information about hydrogen bond through its characteristic peak. In the present study FTIR test result showed that numerous relavant functional groups were present in the test sample.

Summary

Jack fruit seed powder could be an effective substrate for the production of starch based bioplastics. The synthesised starch based bioplastic flims exhibit good mechanical properties and are excellent oxygen barriers. Tensile strength test, Acid and Alkalinity test showed the strength and solubility of the test sample.The tensile properties of the starch-based polymers were observed to be higher when the thickness of the polymer was increased. Flame test result confirms the biodegradability of test sample. FTIR analysis also performed for characterization of some peaks showing the presence of functional groups like, C-OH, C-O, C-O-C, C-H, H-H, Which are also present in starch and glycerol.The present study was concluded that the synthesis of starch based bioplastic from jackfruit seed powder was a feasible solution as a substitute for petroleum based plastics.

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