© 2019 IJSRST | Volume 5 | Issue 4 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section : Science and Technology

Bio-plastic Synthesis from Plant Substances

Deshmukh Sulakshana, Dr. Oza Rajeshwari1, Shelke Vishal, Shingote Mayur
Department of Chemistry, S.N Arts, D.J.M. Commerce, B.N.S Science College, Sangamner, Tal-Sangamner, Dist.- Ahmednagar, Maharashtra, India

ABSTRACT

Bio-plastic from acetylated starch of phaseolus vulgaris beans, Hylocereous undatus fruit peels and Euphorbia tirucalli latex offers a new combination of starting material, easy and inexpensive method, effective results for crucial tests. The starch, latex and fruit peel paste were mixed in certain proportion and heated at 1200C. The mixture was spread onto petri dish and dried in oven at 600C. The solvent uptake capability of bioplastic was checked with solvents like NaOH, dilute HCl, Ethanol, Acetone and water. The solvent uptake test was carried out to determine the absorption capability of bioplastic for selected solvents. The results shows that the plastic dipped in dilute HCl and NaOH (2N) get swollen. Less absorption is observed in ethanol, distilled water and acetone. Polyhydroxybutyrate (PHB) is a bio-degradable polymer belonging to the polyhydroxyalkanoates (PHA). The high plasticity generating sources when combined under appropriate conditions help in the synthesis of biodegradable polymer i.e. PHB.[1]

Keywords : Phaseolus vulgaris, Hylocereous undatus and Euphorbia tirucalli Polyhydroxyalkanoate, NaOH, dilute HCl, Ethanol, Acetone

I. INTRODUCTION

The overabundant use of plastic generate enormous environmental as well as health issues. Usually plastic is made up of heterochain polymers obtained from polymerization of raw material such as oil, natural gas, and coal. This raw material is limited and synthetic plastic are resistant to degradation. Consequently, their disposal problem is the driving force for the piercing of ecological alternatives. Since plastic is inseparable in our daily lives numerous substitutes are being launched. Replacement of fossil fuel with biomass for production of new polymers can have both economic and environmental benefits. Starch is the most preferred key ingredient for the synthesis of bio-plastic. The other composites with starch are agricultural byproducts and plasticizers like glycerine, plant seed oil, cellulose molding compounds etc.[2]

Selection of starting material

1. Starch

Starch is a easily available, affordable and bio-degradable polymer. Synthesis of bioplastic from starch of plants like yam, corn, potato, cassava, pumpkin, various beans is already reported. Starch in its native form has limited applications; hence, to process it with desired properties, acetylation of starch was carried out. In the acetylation process, the hydroxyl group of the glucose monomer are converted to the CH_3COO- group[3] The substitution of bulky acetyl groups increases the hydrophobicity and thermo plasticity and decreases the gelatinization temperature of the starch. In this work acetylated starch of *phaseolus vulgaris* is used.

2. Latex

To improve the flexibility, tensile strength and expediency the plasticizers are used the plastic synthesis. Preferring the natural plasticizers the latex

of plants can be used. The *Euphorbia tirucalli* is well known and easily available plant in regions of India. The latex of *Euphorbia tirucalli* was used as plasticizer.

3. *Hylocereous undatus* fruit peels

The peels *Hylocereous undatus* i.e dragon fruit is highly fibrous and antioxidant.[4] The peels are the agricultural waste of fruit processing industries. It is cultivated in regions of tropical climate.

II. MATERIAL AND METHODS

Extraction of starch

For the extraction of starch from *phaseolus vulgaris* beans, 500 gm beans were soaked in water for 15 hours. The beans are peeled off and pestle in grinder. The fine paste was mixed with 2 litre distilled water and strained.The filtrate was allowed to set for 8 hours. The starch settled at bottom was collected. The wet starch deposition was dried in oven at 80^{0}C for one hour. The dried starch weighed 55gm.

Acetylation of starch

The acetylation of starch in aqueous medium was carried out by the process mentioned by[3] Rosana Colussi, Shanise Lisie Mello El Halal, Vania Zanella Pinto, Josiane Bartz, Louz Carlos Gutkoski, elessandra da Rosa Zavareze, Alvaro Renato Guerra Dias / LWT-Food science and Technology 62 (2015) 1076-108. 25 gm of starch was dissolved in 56 ml distilled water with stirring on magnetic stirrer 900 rpm at room temperature. The P^H was adjusted to 8 by addition of 3% NaOH solution. The acetic unhydride was added portion wise 2.5 ml, 5ml and 10 ml. After the complete addition of acetic unhydride the reaction was continued for 15 min. The P^H was adjusted to 4.5 with 0.5M HCl solution. The suspension was centrifuged for 5 min and washed with 95% ethanol. The acetylated starch was dried in oven at 60^{0}C.

Collection of latex

The latex was collected from *Euphorbia tirucalli plant* near Rajapur village, Sangamner taluka of Ahmednagar district, Maharashtra, India. The branches of plant were given slight cut to get latex.

Preparation of bio-plastic

The *Hylocereous undatus* fruit peel was sterilized and cut into small pieces. The pieces were grinded in grinder to fine paste. The fruit peel paste and acetic acid in 2:1 proportion was mixed on placing it on magnetic stirrer for 10 minutes. Then drop by drop addition of the 2ml latex followed by 1gm of acetylated starch was carried out. The blend was stirred for 10-15 minutes, then heated to 120^{0}C and immediately spread on Petri dish. The set layer was dried in oven at 60^{0}C for 10 minutes. After complete removal of moisture from bio-plastic, the product was used to analyze by FTIR spectrum and the solvent uptake test.

Solvent uptake test

This test is based on method performed by M Hasan, et al. 2018 IOP Conf. Ser.Mater.Sci.Eng.333 012087) The bio-plastic was cut into 1x1 cm pieces and weighed. The 5ml of each solvents like H2O, ethanol, acetone, dilute HCl, sodium hydroxide are taken into a beaker. The weighed pieces are dipped into the solvents for 5 minutes. After 5minutes the pieces are removed and wiped with tissue paper. The pieces are again weighed and the % absorption is determined by using the formula

$$\text{Solvent uptake} = \frac{W - W_0}{W_0} \times 100\%$$

Where W_0 = weight of dry sample, W = weight of sample after immersion in the solvent.

III. RESULT AND DISCUSSION

The bio-plastic obtained by this method is flexible at room temperature. The color of the product is off white to yellow. The well dried film is uneasy to powdered for FTIR-spectrum.

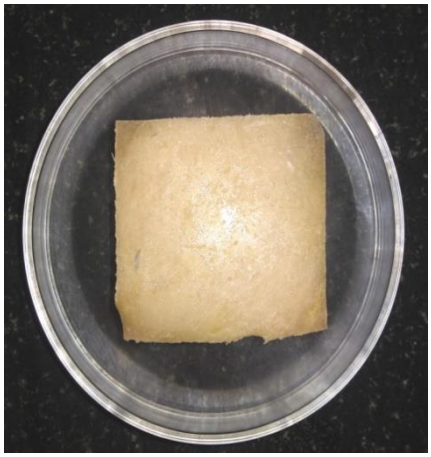

Fig.1. Bio-plastic film

Solvent uptake test

The solvent absorption test is carried out to check the lyophobicity of the synthesized plastic. The results are tabulated below. The plastic can be said hydrophobic as % absorption of water is less. The negative percent is due to the slight solubility of plastic in acetone and ethanol. The lyophobicity is less in case of HCl and NaOH.

Table 1. % Absorption of solvent

Solvent used	% Absorption
Distilled water	10.20%
Ethanol	-7.69%
Dil.HCl	22.55%
NaOH	31.09%
Acetone	-0.72%

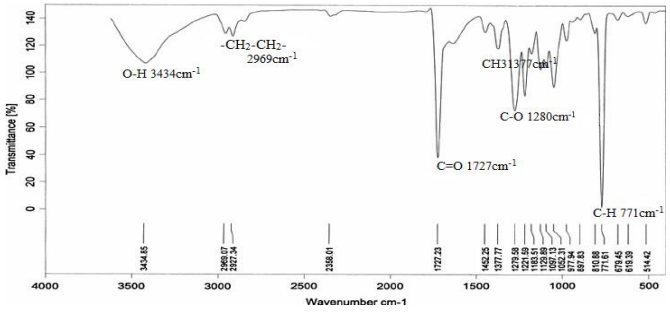

Fig 2. FTIR-spectrum of polyhydroxybutyrate – PHB

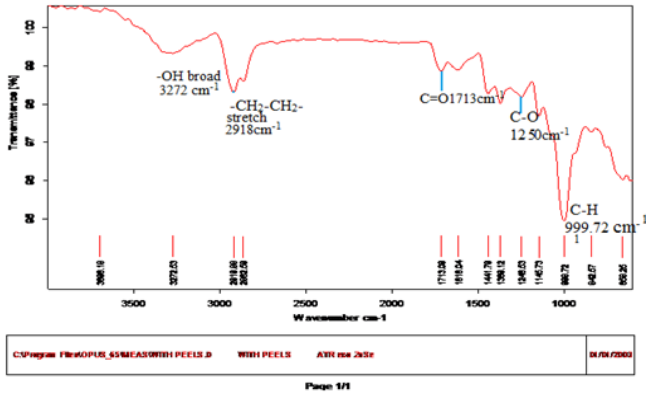

Fig 3. FTIR-spectrum of bioplastic

Table 2. Comparision of IR frequencies of bio-plastic and standard PHB FTIR spectra

No.	C=O cm-1	C-O cm-1	O-H cm-1	CH2-CH2 cm-1	C-H cm-1
Standard PHB	1727.23	1280.58	3434.15	2969.07	771.63
Bio-plastic	1713.09	1250.53	3272.63	2918.88	999.72

The IR frequencies of bio-plastic nearly matches with the standard PHB frequencies, denoting the presence of polyhydroxybutyrate.

IV. CONCLUSION

The combination of phaseolus vulgaris beans, Hylocereous undatus fruit peels and Euphorbia tirucalli latex indicates effective results when compared with standard PHB IR frequencies. The solvent absorption test will help for further modification of process.

V. REFERENCES

[1]. KArvind et. al, Preparation of Bio-plaastic from Starch Blends, IJAIR,Vol.04,Issue 2(Online)2319-1473

[2]. Oleveira dos Santos, Marisa Masumi Beppu; European Polymer Journal, Vol. 47, Issue 3, March 2011, 254-263

[3]. Rosana Colussi, Shanise Lisie Mello El Halal, Vania Zanella Pinto, Josiane Bartz, Louz Carlos Gutkoski, elessandra da Rosa Zavareze, Alvaro Renato Guerra

Dias / LWT-Food science and Technology 62 (2015) 1076-108

[4]. Int. J. Food Eng. 2015 S.L. Chia and G. H. Ehong.

[5]. FM . Manihuruk, T. Suryati, I.I. Arief/ Media Peternakan, April2017, 40(1);47-54

[6]. R Laxmana Reddy et. al/ IJETAEVol.3, Issue 5, May 2013

[7]. MG.A.Vieira et al / European Polymer Journal 47 (2011) 254-263

[8]. NA. Mostafa et. al / Arabian Journal of Chemistry (2018) 11, 546-553

[9]. M Hasan et. al / IOP conf. Series, Material Science and Engineering 333 (2018) 012087

Cite this article as :

Deshmukh Sulakshana, Dr. Oza Rajeshwari, Shelke Vishal, Shingote Mayur, " Bio-plastic Synthesis from Plant Substances", International Journal of Scientific Research in Science and Technology(IJSRST), Print ISSN : 2395-6011, Online ISSN : 2395-602X, Volume 5, Issue 4, pp.05-08, January-2019.
Journal URL : http://ijsrst.com/IJSRST195402