Multidisciplinary Applied Research and Innovation Vol. 3 No. 5 (2022) 118-121


**MARI**

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/mari
e-ISSN:2773-4773

# Characterization of Bioplastic from Cassava Peel Using Fourier Transform Infrared (FTIR) Spectroscopy

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DOI: https://doi.org/10.30880/mari.2022.03.05.017
Received 15 July 2022; Accepted 30 November 2022; Available online 31 December 2022

**Abstract** : The importance of this research project is to gain knowledge in every process including preparation and characterization of irradiated bioplastic by making good use of the agriculture waste product. Since the Earth has this concerning issue of solid waste pollution caused by an abundance of thrown plastics, biodegradable plastics will become the main substitution for the usage of plastics. Since the bioplastic is produced from the agricultural waste product which can be decomposed, it is a more environmentally friendly material to replace plastics in our daily lives. Besides, bioplastics will make a significant contribution in making our planet earth a better place. Since they are generated from natural renewable resources and biodegradable, they can assist in diminishing dependency on fossil fuels, boosting sustainability programs, and allowing manufacturing to diversify feedstocks. Fourier Transform Infrared (FTIR) was used to determine the type of chemical bonding present inside the molecules. Bioplastic made from cassava peel were proved that it is possible with the addition of sorbitol and chitosan and specific dose rate of radiation treatment on bioplastic can enhance cassava starch-based bioplastic.

**Keywords**: Bioplastic, Cassava, plastic

## 1. Introduction

Plastic is a reliable product where it has lightweight, highly durable and chemically resistant. Nowadays, plastic is always used every day and is very useful in our daily life especially in the food packaging industry, textiles, consumer products, automobiles, and electronic equipment. However, the high usage and demand for plastics made from non-renewable fossil fuels will result in waste accumulating and pollution problems that impact the environment and the whole world. Over the last few decades, the world's understanding of natural resource scarcity and pollution problems has grown. In truth, the demand for plastic is said to be continued to rise, with the latest figure indicating that 368 million tons of plastic were manufactured globally in 2019 [1]. Thus, the attempt to solve the unrenewable and non-corroding properties of fossil-based plastics by producing bioplastics. Bioplastics

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are bio-based plastics which are a type of biodegradable plastics. Bioplastics are produced entirely or sometimes partially from green biomass sources and agricultural waste product sources like sugarcane, corn, coconut husks, cassava peel or from microbes like yeast [2]. The term “biomass” refers to non-fossilized and biodegradable organic material yield from plants, animals, and microorganisms. Additionally, biodegradable plastics are clarified as substances with biodegradable characteristics that will decay and degrade when exposed to water and with the presence of carbon dioxide and oxygen [3]. Bioplastics are known to contribute to reduce the reliance on the usage of fossils fuels, petroleum supply and the worrying carbon dioxide emissions. This is because bioplastics are produced from renewable materials that can be recycled naturally through decaying and biological processes, reducing the use of fossil fuels and improve the quality of the atmosphere. Until today, bioplastics have become essential in almost all industrial applications covering cultivation activities, garbage bags for waste composting, food packaging and electrical products. As global plastic use is on the rise, more effort and research are being devoted to the exploration of renewable materials and improved approaches to process them in producing bioplastic. There is the necessity to produce bioplastic with comparable characteristics and properties to petroleum-based plastic.

Petroleum-based plastics have been causing a rapid increase in environmental issues and pollution of solid waste pollution. In addition to that, pollution in the environment by the use of plastic is known to difficult to decay. Thus, an abundance of agricultural residue causes the world to be full of waste. Even though plastics are useful in our daily lives, the increase in the usage of plastic bags is damaging our environment. It is known that plastics bags use up a lot of natural resources of the Earth, consume a numerous of energy to manufacture but also on the other hand create a lot of litter and trash on the landfill waste. The plastic degradability issues relating to littering and resource use is also the main obstacle. Chitosan has a number of remarkable features which are biodegradability, biocompatibility, chemically inert, mechanically strong, strong film-forming capabilities, and cheap.

In this research, the agro-waste product is used in the preparation and production of bioplastic. The agro-waste product used in producing bioplastics is cassava peel while sorbitol is used as the plasticizers. The key purpose of this study is to obtain and produce bioplastic using an agro-waste byproduct which is cassava peel. Besides, this research is aimed to investigate the bioplastic when exposed to radiation exposure at a specific dose in KiloGray (kGy).

Chitosan was as filler in production of bioplastic in this project is because according to [4], it was proven that chitosan bioplastic increase the value of tensile strength. Chitosan acts as thickener in bioplastic which affects the bioplastic chemical bond and increases its tensile strength. The advantage of choosing cassava peel as based for production of biofilms is that the starch derived from cassava peel odorless, non-toxic and tasteless [5]. By that, the biofilms produced can be widely used in many fields especially in food packaging.

## 2. Materials and Methods

### 2.1 Starch extraction from cassava peel

Small parts of clean cassava skin with excessive starch are crushed into a pulp in a grinder. The formulation consisted of 100 g cassava peel and 120 ml of water. The resulting slurry was combined with water in a 1:1 ratio to extract starch from cassava peel. Following the mixing procedure, the starch slurry was filtered and placed in a tank to settle which required at least 30 minutes. The starch sediment was removed from the slurry and rinsed with distilled water once more. The extract was mixed with water in the same proportion and filtered to produce a second filtrate. Following the second settling, the starch sediment was dried in an oven at 70$^{o}$C for 30 minutes to remove unwanted moisture. The dried precipitate is then grinded to obtain a more refined sample. The gauze was used to filter the precipitate and cassava starch precipitate is ready to use.

2.2 Preparation of bioplastic

4g of sorbitol and chitosan were dissolved at proportions 4:0 in 200mL of distilled water. Then, 10g of cassava starch were mixed into solution while heating all of the mixture at temperature of 90ºC. The mixture were stirred for about 40 minutes until the solution become gelatinize. Then, the mixtures is poured into the cast and keep dried in an oven at a temperature of 60ºC for 24 hours. Once a thin film sheet of bioplastic is set, the sample is kept at room temperature for the cooling process. Remove the bioplastic film sheet from the mold.

## 3. Results and Discussion

The structure of a bioplastic functional group is determined whether it is organic or inorganic compounds. FTIR test was done using Perkin Elmer Spectrum. Figure 1 shows the findings of the characteristic peaks of wavenumber and spectra for cassava peel starch and bioplastic after irradiation treatment. In Figure 1, the cassava peel starch extraction showed characteristic peaks at 3326 $cm^{-1}$ indicating there is interaction within O-H groups starch-water and between starch molecules (O-H stretching). According to [6], a lower wavenumber leads to a stronger hydrogen bond. Figure 2 depicting the spectra for irradiated cassava bioplastic. There is spectra band on the graph near 1415 $cm^{-1}$ define to the bending of $CH_2$. The characteristic peaks at 462.91 $cm^{-1}$ and 439.43 $cm^{-1}$ were unable to be defined but can be suggested that there is unpredicted existence of alkyl halides groups that may be obtained from contamination inside the cassava bioplastic sample.

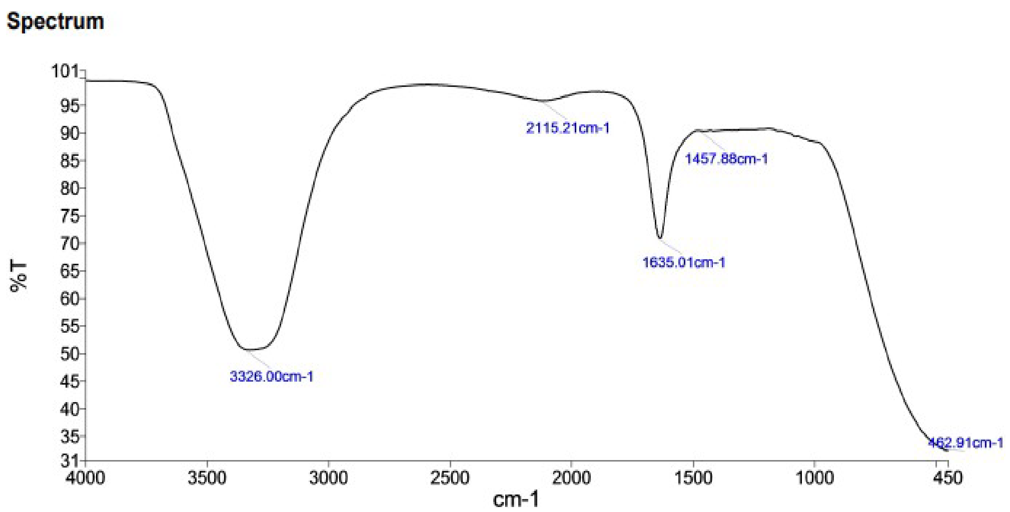


**Figure 1: FTIR spectrum with characteristic peaks from the cassava peel starch bioplastic**

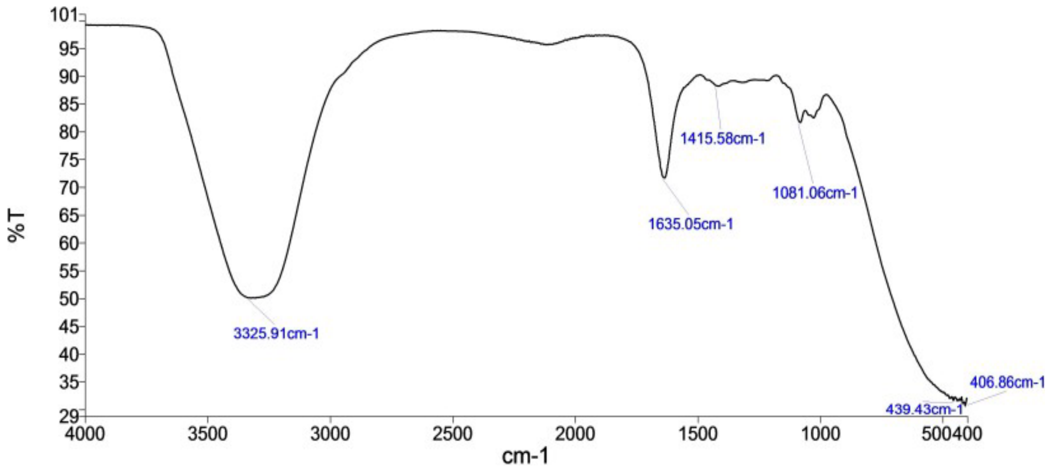


**Figure 2: FTIR spectrum with characteristic peaks from irradiated cassava bioplastic plasticized with sorbitol and chitosan**

## 4. Conclusion

In this project, irradiated bioplastic made from agro-waste product have been successfully prepared by using cassava peel with addition of sorbitol and chitosan. Based on FTIR results spectra, when compared to the original bioplastic sample that was not irradiated, the irradiated bioplastic sample showed somewhat decreased absorption for the absorption spectra in general and exceptional decreased absorption of peaks.

## Acknowledgement

The authors would like to thank the Universiti Tun Hussein Onn Malaysia for facilities provided that make the research possible.

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