IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 7 ISSUE : 01 Print / Issue Publication Date: 07-Jul-2022

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2022.v07i01.039

Indexed In

Google SCHOLAR OPEN ACCESS doi Crossref

WWW.IJEAST.COM

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International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 1, ISSN No. 2455-2143, Pages 268-272
Published Online May 2022 in IJEAST (http://www.ijeast.com)

DEVELOPMENT OF STARCH BASED BIODEGRADABLE BIOPLASTIC FROM SEEDS OF AMARANTHUS CRUENTUS

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***Abstract*— In the recent years, bioplastic have attracted increasing interest due to their wide application in food packaging and in the biomedical science. These eco-friendly bioplastics reduce rapidly and replace the usage of the petroleum based plastic due to their safety and biodegradability. This research focuses on starch based bio plastic making from Amaranthus cruentus . It aims to characterize the resulted bioplastic (acid test, alkali test, solubility test, biodegradability test by flame test and FTIR analysis). The bioplastic preparation takes place by mixing of starch from Amaranths cruentus and glycerol (used as plasticizer). The research result concluded that the synthesis of starch based bioplastic from Amaranthus cruentus seed starch was feasible solution. The analysis of functional group by FTIR shows the presence of functional group of C=C H, Aromatic hydrocarbon, α, β, NH, C=C, C=N, C-S stretching.**

***Keywords*— Amaranthus cruentus, bioplastics, FTIR Analysis, Glycerol**

I. INTRODUCTION

In early 20th century, the first synthetic plastic was invented by John Wesley, who repared plastic materials as an alternate source for natural material like ivory, tortoise shell and horn. Plastic material could be crafted into many shapes in olden days, so people use the plastic to full fill the scarcity of natural resources like ivory etc., but it was very expensive, and it is made up of plant polymer from cotton plant.

Plastic is one of the major toxic pollutants of present time. Being composed of toxic chemicals and most importantly a non-biodegradable substance, plastic pollutes earth and leads to air pollution and water pollution. The production of plastic around the world represents over 90 million tonnes and the growth is assessed to be around 3% per year. The worldwide reduction of plastic has grown by more than five hundred percent during the last 40 years.

In recent years, many scientists are trying to produce degradable plastic. The starch is made up of two natural polymer that is amylose and amylopectin. Amylose is unbranched chain it gives mechanichal support to the plastic film. Many researchers have used starch from different sources to make film and coating. It has indicated that, starch is a promissing material for biodegradable film.

In the Amaranthaceae family, the seeds have unique starch itself. Amaranth starch is isolated from Amaranthus spp. Amaranthaceae include 60 species where in Amaranthus cruentus, Amaranthus tricolor, Amaranthus blitum are the species those are easily available and also have starch content. These seeds have high amylopectin chain content, Seeds of Amaranthaceae is very minute, it is smaller than other starch sources like, wheat, rice, etc, while Amaranths cruentus seeds have high amount of starch.

II. MATERIALS AND METHODS

A. Materials

Materials used were Starch from Amaranths cruentus seed collected from local market of Coimbatore, distilled water, Glycerol as plasticizer, Hydrochloric acid used for breakdown of branched amylopectin molecule into amylase, Sodium hydroxide used for break the inter and intra molecular H- bond between water and starch. Equipment used were blender, oven, hot plate, centrifuger, digital balance.

B. Extraction of starch

Amaranth seeds were manually cleaned, starch was isolated from Amaranth grain by following the alkaline steeping method (Choi et. al., 2000). Grains are steeped in 0.25% NaOH solution for 16 hours at room temperature and stirred 3-4 times during this period. After steeping, the grains were washed 2-3 times with distilled water and ground in a blender at full speed for 2 min. Slurry was filtered through sieve, then

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the slury passed through 100, 200, 300 and 400 mesh size sieve. The starch was isolated from the filterate by centrifugation at 25,000g for 20 min. The supernatant was discarded, this step was repeated to obtain a white starch layer. The starch layer was resuspended in distilled water, shaken and centrifuged a described above. Thereafter, the isolated starch was dried in hot air oven at below 40◦c for 8-10 hours and stored at room temperature in sealed container.

C. Producing of bioplastic

Take require amount of starch in a beaker, soak it in distilled water for few minutes. (0.5N) HCL is added to this mixture and stirred using glass rod. Plasticizer (glycerol) was added to this mixture and stirred. Now the pH was checked (pH7). 0.5N NaOH is added according to PH desired. Then added gelatine for more adhesiveness for film. The mixture was heated (Figure 1)in low temperature for 10 minutes until the mixture become gelly in nature. The gel was spread on aluminium foil (Figure 2). Then it was allow to dry in a hot air oven (Figure 3)for 3 days in 40°C.

Figure-1 Heat of the mixture Figure -2 Spread over the Sheet

Figure -3 Drying the film in hot air oven

Figure -4 Bioplastic film

D. Characterization of bioplastic

The synthesized bioplastic were introduced various following test that is acid, alkali, solubility and biodegradability and Functional groups of bioplastic were analysed by using FTIR. This analysis was conducted in chemistry department of Krishnammal College for women, Coimbatore. Sample of film was placed into set holder, and then appropriate spectrum was searched. The result was in the form of diffract gram of relation between wave number and intensity, spectrum of FTIR was recorded by using spectrometer at room temperature

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III. RESULT AND DISCUSSION

Amaranthus cruentus seed starch could be an effective substrate for the production of starch based bioplastics. The properties of the films are influenced by the composition of flour mixture and the glycerol concentration. Amaranthus cruents seed starch contributes to the strength and elongation of the film as a result of its higher content in amylose. It is also found that higher concentration of glycerol will result in lower values of tensile strength and higher value of elongation at break. The synthesized starch based bioplastic films exhibit good mechanical properties and are excellent oxygen barriers.

Characterization of bioplastic (Figure 4) is carried out comparition of the acid test and alkali test was done. The bioplastic material was time taken to dissolve in Sulphutic acid 265 ± min and Acetic acid 125± min (acetic solution) and < 90 in sodium hydroxide (alkali solution). Result shows that bioplastic material have poor alkali resistance and good acid resitance. The solubility test was conducted with distilled water. The duration for dissolving bioplastic material in water was 250 minutes.

The flame test was conducted in front of the water. bioplastic was taken and kept on wire gauze and burnt with Bunsen burner. The time taken for the bioplastic to form ash is 2 min. This test was conducted to check the biodegradability of bioplastic. It was easiest and quickest test to find biodegradability of bioplastic.

Bioplastic functional group is analyzed to identify its structure (organic and in organic compound) Figure 5 shows the result of functional group analysis. The absorption band were seen at 3348.42, 3332.99, 2125.56, 164.21, 1543.05 and 698.23. it indicate the presence of functional group like, C=C H, Aromatic hydrocarbon, α,β, NH,C=C,C=N,C-S stretching.

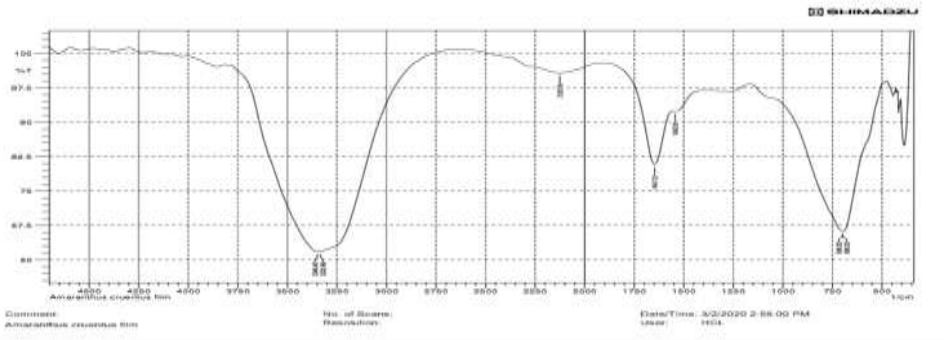

Figure-5 FTIR Analysis

Table -1 FTIR Analysis

S.No	Standared (nm)	Bond	Wave number	Functional group
1	3500-4000	O-H Bond of α-cellulose	–	–
2	3700-3500	N-H stretching (amine)	–	–
3	**3500-3300**	**C=C H stretching**	**3348.42 3332.99**	+
4	3500	N-H stretching	–	–
5	3100-3300	C=C-H stretching	–	–
6	2960-2850	C-H stretching (alkanes)	–	–
7	2830-2695	H-C=O: C-H stretch	–	–
8	2590-2540	S-H stretching	–	–

9	**2000-2250**	**Aromatic hydrocarbon**	**2125.56**	**+**
10	1740-1735	C=O stretching of hemicellulose	–	–
11	**1685-1655**	**α, β-unsaturated stretching**	**1647.21**	**+**
12	1680-1650	N=O stretching	–	–
13	1650-1630	OH (absorbed water)	–	–
14	1600	C=O stretching (amide)	–	–

IV.CONCLUSION

Advantages of the bioplastic compared to the conventional plastic are biodegradability in the natural environment. The present study was concluded that the synthesis of starch based bioplastic from Amaranths cruentus seed starch was a feasible solution as a substitute for petroleum based plastic. Future work is necessary to characterize Amaranths cruentus bioplastic structure, physical and functional properties.

V. ACKNOWLEDGEMENT

The study was financially supported by GRG trust of PSGR. Krishnammal College for Women in Coimbatore, Tamilnadu. The authors would like to thank Dr. Krishnaveni Head of the Department, Botany in PSGR. Krishnammal College for women for her support.

DECLARATION

The author declare that they have no conflicts of interest.

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