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Preparation Of Bioplastic From Banana Peel Using Chemical Method: A Research

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Abstract: The global plastic pollution crisis necessitates a shift towards sustainable alternatives, and bioplastics emerge as a promising solution. This study explores the development of next-generation bioplastics derived from renewable, biodegradable sources such as agricultural waste, algae, and microbial polymers. Unlike conventional bioplastics, which often compromise on durability or cost-effectiveness, our approach integrates nanotechnology and bioengineering to enhance mechanical strength, flexibility, and decomposition rate. We propose a novel bioplastic formulation that balances sustainability with high-performance properties, making it suitable for diverse applications—from packaging to medical devices. Our research also investigates enzymatic degradation pathways to accelerate biodegradability without harming ecosystems.

Keywords **- Bioplastic, Banana peel, Chemical based, biodegradation period, water absorption, self life.**

I. INTRODUCTION

The mature ovary or ovaries of one or more flowers are called fruits. A famous tropical fruit, bananas are prized for their soft texture and sweet flavor. When mature, they are usually yellow, but depending on how ripe they are, they can also be green or even brown. Potassium, vitamin C, fiber, and other nutrients are abundant in bananas. Bioplastics are a class of plastic that is not derived from petroleum but rather from renewable biological sources, such as plant-based components like cellulose, algae, and starch. The outer layer of a banana fruit is called the peel. When ripe, they are usually yellow, although depending on the state of ripeness, they can also be green or brown. Banana peels are frequently thrown away, but they can be used in a number of ways. Then, due to its higher starch content, these advantageous banana peels are utilized in biodegradable plastic.

Environmental pollution, particularly plastic waste, is a global issue affecting both developed and developing nations. Plastics have become an essential part of modern life due to their numerous uses. The widespread issue of plastic pollution is linked to the fact that plastics are inexpensive, durable, and widely used (Hester et al., 2011). The term "plastic" originally referred to materials that are flexible and easily shaped (Azieyanti et al., 2020). Their low cost, ease of production, versatility, and water resistance have led to their extensive use across various industries (Beev et al., 2020). In recent years, global plastic production reached 380 million tons in 2022.

Plastic pollution has detrimental effects on land, water, and marine environments. It diminishes the soil's ability to absorb water, contributing to natural disasters like flooding. Plastics are primarily made from synthetic polymers such as polyethylene (PE), polypropylene (PP), polystyrene (PS), and polyvinyl chloride (PVC), all of which are thermoplastic. When burned, these materials do not degrade but instead melt, solidifying again when cooled (Rusdi et al., 2019). These petrochemicals are resistant to microbial degradation, making them difficult to break down in the environment (Wang et al., 2013). The degradation process for these materials takes an estimated 1,000 years, and during this time, they can become toxic once decomposed (Triawan et al., 2020). Conventional plastics not only take decades or longer to decompose, but they also release harmful toxins during the degradation process. Plastic pollution also poses significant risks to human health. For instance, it can interfere with the thyroid hormone system and affect hormone levels. When plastics break down, they can release toxic chemicals into groundwater and nearby water sources, which can harm the species that rely on these water supplies.

Furthermore, the buildup of plastic waste disrupts the natural flow of air, as plastics have high resistance to the permeability of oxygen and carbon dioxide. The burning of plastic waste releases harmful substances such as dioxins, furans, and benzopyrene, which are toxic and can lead to cancer and damage the immune system. This highlights the urgent need for the development of plastics made from materials that can be safely and easily removed from the environment in an eco-friendly way.

II. AIM

To produce biodegradable plastic from banana peels as a substitute for conventional plastic and to prove that the starch in the banana peel could be used in the production of the biodegradable plastic.

III. METHADALOGY

Materials required

Banana, Plate, Knife, 500 ml beaker – 2, Hot plate (for boil), Funnel (for decant the water), Hand blender (to make paste), Baking sheet , Timer, Electronic balance(weight machine), 150 ml beaker , 10ml measuring cylinder , Glass rod, 1000 ml micro pipette , Petri plate.

Chemicals

3 ml of NaOH at 0.5 M

3 ml of HCL at 0.5 M

2ml of Glycerol

Sodium Meta-bi-sulphate

Glycerol as a Plasticizer

Plasticizers or dispersants were additives that increase the plasticity or fluidity of a material. These plasticizers make it possible to achieve improved compound processing characteristics, while also providing flexibility in the end-use product. Glycerol (also called glycerin) was a simple polyol (sugar alcohol) compound. It was a colorless, odorless, viscous liquid that was sweet-tasting and non-toxic.

Sodium metabisulfite as an Antioxidant

The sodium meta bisulfite (Na2S2O5) was used as an antioxidant. It prevents the microbial growth in the peels. It was used as a disinfectant, antioxidant and preserving agent. It was very soluble in ethanol and water.

3.1 EXPERIMENTAL PROCEDURES

PREPARATION OF BANANA PEELS

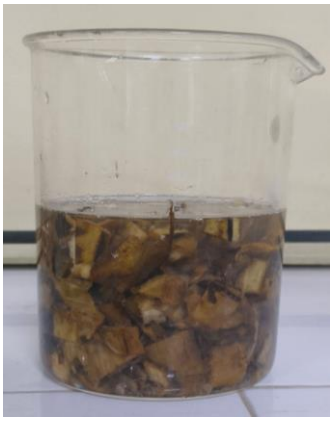
- The banana peels were dip in Sodium meta bisulphite solution for 45 minutes.
- It is used as an antioxidant and preservative, this would increase the biodegradation period of the plastic.
- Then these banana peels were boiled in distilled water for about 30 minutes.
- The water was decanted from the beaker and the peels were left to dry on the filter paper for about 30 minutes.
- After the peels were dried they were made into a uniform paste with the help of the blender.

PREPARATION OF BIOPLASTICS

- The first experimental procedures were performed by mixing up the banana peels paste with chemical-based materials and glycerol as plasticizer.
- For the second experimental by mixing up the banana peels paste with natural-based materials and glycerol as plasticizer.

PREPARATION OF BANANA PEEL BIOPLASTIC WITH CHEMICAL BASED

- 100 gram of banana paste was placed in a beaker and weighted
- 12 ml of HCl were mixed with the paste and stirred using glass rod.
- 8 ml of glycerol were added which act as a plasticizer and stirred using glass rod.
- 12 ml of NaOH were added to balance the pH value of the mixture and also stirred using glass rod. The mixture was stirred for 5 minutes.
- The mixture was stretched and pressed on oven paper and was dried in the oven with a temperature of 120°C.Then the mixture was allowed to cool.


3.2 SWELLING TEST

Swelling test of synthesized bioplastic from banana peels Swelling test is generally conducted to check whether the developed materials retains its original position. The results of the swelling test of bioplastic (banana peel) were shown in (Table 1). The results of the study showed that there was not much change in sample when it was soaked in chloroform and methanol, but slight increase in weight was observed when it was kept in water medium.

TABLE 1 : SWELLING TEST OF SYNTHESIZED BIOPLASTIC FROM BANANA PEELS USING CHEMICAL BASED

SOLVENT MEDIUM	QUANTITY	INITIAL WEIGHT	FINAL WEIGHT	DIFFERENCE IN WEIGHT
DISTILLED WATER	5ML	1.0 GM	1.40 GM	0.40 GM
CHLOROFORM	5 ML	1.0 GM	1,20 GM	0.20 GM
METHANOL	5 ML	1.0 GM	1.06 GM	0.06 GM

3.3 SOLUBILITY TEST

Solubility test of synthesized bioplastic from banana peel, The results of solubility test of bioplastic from banana peel were shown in (Table 2). It was also insoluble ethyl alcohol (nonpolar solvent) and partially soluble in ammonia (polar solvent) and completely soluble in sulfuric acid (strongly acidic solvent). The results of this test revealed that the material was insoluble in water which makes it more eligible to be a bioplastic material. It was also insoluble in ethyl alcohol (non polar solvent) and partially soluble in ammonia (polar solvent) and completely soluble in sulphuric acid (strongly acidic solvent).

TABLE 2: SOLUBILITY TEST OF SYNTHESIZED BIOPLASTIC FROM BANANA PEELS USING CHEMICAL BASED

Solvents Used	Insoluble	Partially Soluble	Completely Soluble
Ammonia	-	+	-
Water	+	-	-
Sulfuric acid	-	-	+
Ethyl alcohol	+	-	-

3.4 WATER ABSORPTION TEST

Banana peel-based bioplastic of natural based and chemical based were showed a water absorption capacity .

3.5 SHELF LIFE OF THE PREPARED BIOPLASTIC

On the 14th day of observation, fungal action was observed on bioplastic prepared based on the chemical based. But in sample incorporated with natural based, fungal action was observed only on the 10th day. The presence of chemicals could enhance the shelf-life of the bioplastics.

3.6 SOIL BURIAL METHOD

Bioplastics showed the following characteristics when undergone the burning test Low odor, Yellow - orange flame, Speed of burning – Slow, of both chemical based and natural based methods.

3.7 SOIL DEGRADATION METHOD

Biodegradability test or the level of biodegradability of bioplastic that was produced was very important in the bioplastic production. This test was done by bioplastic samples in the soil and left for 15 days. Bioplastic samples were weighed with initial and final weight. The more weight lost during testing in the soil, the higher the level of biodegradability of the bioplastic. the results of bioplastic produced based on natural methods showed biodegradability on the day of 6th whereas the chemical based bioplastic shown the biodegradability on the day of 10th (Table 5). Hence the results of the study showed that the natural based bioplastic were better when comparing with chemical based bioplastic production.

TABLE 3: BIODEGRADABILITY TEST OF SYNTHESIZED BIOPLASTIC USING CHEMICAL METHOD

BIOPLASTICS	INITIAL WEIGHT	FINAL WEIGHT	TOTAL NO DAYS
CHEMICAL BASED	10 GM	7 GM	14 DAYS

3.8 CONCLUSION

The exploration of banana peels as a raw material for bioplastic production presents a promising and sustainable alternative to conventional plastic. Through the use of an abundant and biodegradable resource, we can mitigate the environmental impact of plastic waste while promoting a circular economy. The inherent properties of banana peel, such as its cellulose content, offer the potential for producing a material that is both eco-friendly and efficient. As research continues to evolve, the development of bioplastics from agricultural waste like banana peels could play a pivotal role in addressing the global plastic pollution crisis, offering a greener, more sustainable future for material production. Ultimately, this innovative approach not only emphasizes the importance of waste valorization but also highlights the untapped potential of natural resources in creating sustainable solutions for modern-day challenges.

REFERENCES

[1] Jiménez-Rosado, M.; Zarate-Ramírez, L. S.; Romero, A.; Bengoechea, C.; Partal, P.; Guerrero, A. Bioplastics Based on Wheat Gluten Processed by Extrusion. J. Clean. Prod. 2019, 239, 117994

[2] Lu, D. R.; Xiao, C. M.; Xu, S. J. Starch-Based Completely Biodegradable Polymer Materials. Express Polym. Lett. 2009, 3 (6), 366–375.

[3] Tokiwa, Y.; Calabia, B. P.; Ugwu, C. U.; Aiba, S. Biodegradability of Plastics. Int. J. Mol. Sci.2009, 10 (9), 3722–3742

[4] Razzaq, H. A. A.; Pezzuto, M.; Santagata, G.; Silvestre, C.; Cimmino, S.; Larsen, N.; Duraccio, D. Barley β-Glucan-Protein Based Bioplastic Film with Enhanced Physicochemical Properties for Packaging. Food Hydrocoll. 2016, 58, 276–283

[5] Sayeed, M. M. A.; Sayem, A. S. M.; Haider, J. Opportunities With Renewable Jute Fiber Composites to Reduce Eco-Impact of Nonrenewable Polymers. Encycl. Renew. Sustain. Mater. 2020, 810–821

[6] Sayeed, M. M. A.; Sayem, A. S. M.; Haider, J. Opportunities With Renewable Jute Fiber Composites to Reduce Eco-Impact of Nonrenewable Polymers. Encycl. Renew. Sustain. Mater. 2020, 810–821.

[7] Khorami, M.; Arti, H.; Ghasemi, M.; Fakoor, M.; Moosavi, S.; Heidari, S.; Meshki, M.; Khorami, Y.; Mashayekhi, M. Biodegradable Plastic Production from Fruit Waste Material and Its Sustainable Use for Green Applications. Int. J. Pharm. Res. Allied Sci. 2016, 5 (2).

[8] Amobonye, A.; Bhagwat, P.; Singh, S.; Pillai, S. Plastic Biodegradation: Frontline Microbes and Their Enzymes. Sci. Total Environ. 2021, 759, 143536.

[9] Price, S.; Kuzhiumparambil, U.; Pernice, M.; Ralph, P. J. Cyanobacterial Polyhydroxybutyrate for Sustainable Bioplastic Production: Critical Review and Perspectives. J. Environ. Chem. Eng.2020, 8 (4), 104007.

[10] Marichelvam, M. K.; Jawaid, M.; Asim, M. Corn and Rice Starch-Based Bio-Plastics as Alternative Packaging Materials.Abdou, S.; Rouf, S. Bioplastics Production & Characterization. Int. Res. J. Adv. Eng.Techonology 2019, 5 (6).

[11] Ruggero, F.; Porter, A. E.; Voulvoulis, N.; Carretti, E.; Lotti, T.; Lubello, C.; Gori, R. A Highly Efficient Multi-Step Methodology for the Quantification of Micro-(Bio)Plastics in Sludge. Waste Manag. Res. 2020 Rani, G. U.; Sharma, S. Biopolymers, Bioplastics and Biodegradability: An Introduction. Ref. Modul. Mater. Sci. Mater. Eng. 2021

[12] Unmar, G. and Mohee, R. R "Assessing the effect of biodegradable and degradable plastics on the composting of green wastes and compost quality". Bioresour. Technol. 99 (15),6738–6744, 2008

[13] Mukti Gill. (2014) Bioplastic: a better alternative to plastics International Journal of Research in Applied Natural Sciences Vol. 2, issue 8,115-120

[14] Ying J. C. (2014), bioplastics and their role in achieving global sustainability, Journal of Chemical and Pharmaceutical Research, 6 (1): 226-231

[15] Javed A and K. J. (2002) "Biopolymers" (ed. Doi Y and Steinbuchel A), Willy-VCH, Weinheim 4, 53-68