

**NATIONAL SCIENCE FAIR 2025 - OMEIAT**

# **eco-friendly plastics**

**NSF-SCH 2025-458**

**Name : Abubakr Siddiqe K**

**Class: VIII A**

**Category : EVS**

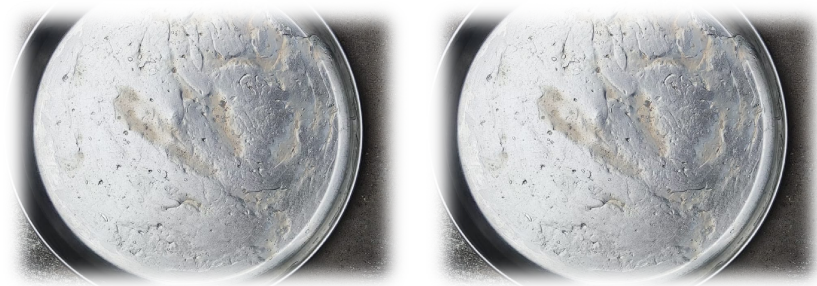
**Level : Middle Level**

**School: K.H Matriculation Boys Hr.Sec.School**

**Thennandiyalam**

**Melvisharam – Ranipet Dist**

**Tamilnadu**



## **INTRODUCTION**

### **RESEARCH QUESTION :**

Can I get alternate to Plastics?

Why people are using much plastics ?

How it can be reduced or reused?

How much it affects our surrounding ?

Plastics are non bio degradable but I can try bio degradable ?

Conventional plastics are durable but **non-biodegradable**, creating huge waste and pollution problems.

### **Purpose of the study :**

The purpose of this research is to develop **Bio plastics** made from natural, renewable materials (like cornstarch or banana peels) decompose faster and are safer for the environment.

### **Hypothesis:**

If natural materials rich in starch/cellulose are processed with heat and plasticizers, they can form biodegradable plastics .

Does it possible to carry load ?

Can the bio plastic made of starch/cellulose are easily decompose ?

What will be the quality of these plastics ?

## Principle

- **Cornstarch** contains **amylose and amylopectin**, which can form polymer-like structures when heated with water, glycerol, and vinegar.
- **Banana peels** contain **starch and cellulose**, which also work as raw material for bioplastic production.
- Adding **plasticizers** (like glycerol) makes the bioplastic flexible instead of brittle.

## Aim

To make an eco-friendly plastic film from cornstarch and banana peels.

## Method

### Procedure:

#### 1. **Mixing the ingredients:**

I measured the required quantities of cornstarch, water, glycerol, and vinegar. All the ingredients were added to a small saucepan. The mixture appeared milky white and slightly thick.

#### 2. **Heating the mixture:**

The saucepan was placed on low heat. I continuously stirred the mixture to avoid lumps. As it heated, the liquid gradually thickened and turned into a **gel-like consistency**. The mixture became transparent and sticky — indicating the cornstarch had gelatinized.

#### 3. **Forming the plastic sheet:**

Once the mixture reached a thick, paste-like texture, I removed it from the heat. I then poured the hot gel onto a flat tray and spread it evenly using a spatula to form a thin layer.

#### 4. Drying process:

The tray was kept in a well-ventilated area at room temperature for about **1–2 days**. During this time, the moisture slowly evaporated, and the film hardened into a **thin, flexible plastic-like sheet**.

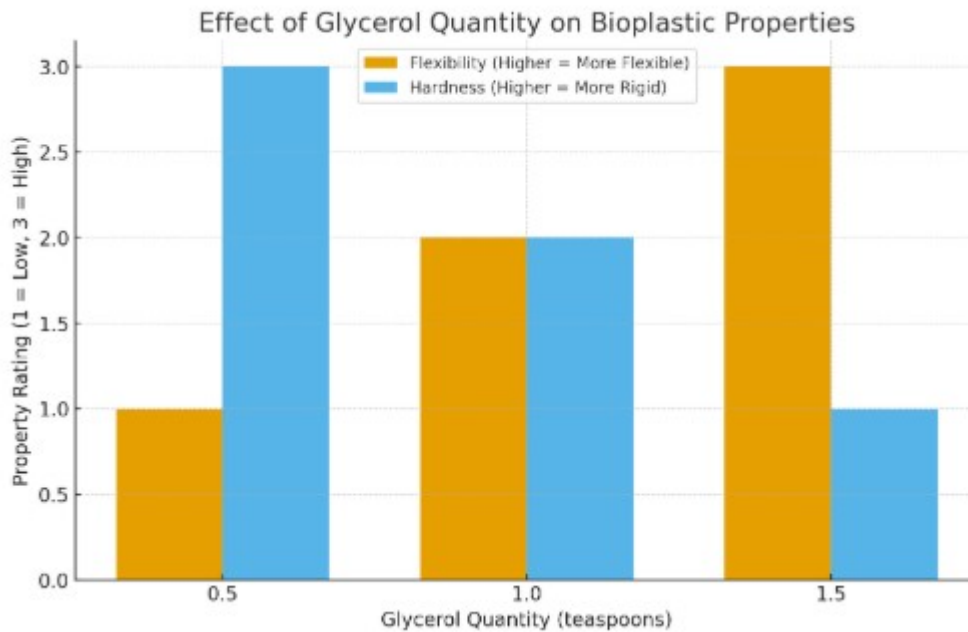
#### Observation:

- The final sheet was **translucent**, smooth, and **slightly flexible**.
- The presence of glycerol helped prevent brittleness.
- If less glycerol was used, the plastic became hard and cracked easily.

#### Data Analysis

To study the effect of each ingredient on the quality of the bioplastic, I prepared **three samples** by varying the amount of glycerol. Glycerol acts as a *plasticizer* — it increases flexibility but reduces hardness.

Sample No.	Amount of Glycerol	Drying Time (hrs)	Flexibility	Hardness	Transparency	Observation
1	0.5 teaspoon	30	Low	High (brittle)	Opaque	Sheet cracked on bending
2	1 teaspoon	36	Medium	Medium	Slightly transparent	Balanced properties
3	1.5 teaspoons	40	High	Low (soft)	Transparent	Very flexible but sticky



- As the amount of **glycerol increases**, **flexibility** rises.
- At the same time, **hardness** decreases.

This visually supports your analysis that glycerol makes the bioplastic softer and more elastic.

Type of Variable	Description	Examples in my Experiment
<b>Independent Variable</b>	Factor you change	Amount of glycerol
<b>Dependent Variables</b>	Factors you measure/observe	Flexibility, hardness, drying time
<b>Controlled Variables</b>	Kept constant	Amount of starch, vinegar, water, heat, drying conditions
<b>Uncontrolled Variables</b>	May vary unintentionally	Room temperature, spreading thickness, heating uniformity

## **Result:**

A biodegradable plastic sheet was successfully prepared using cornstarch, water, glycerol, and vinegar. The experiment demonstrated that natural materials can be used to create environmentally friendly alternatives to synthetic plastics.

## **Conclusion:**

This project showed that **cornstarch bioplastic** is a simple, low-cost, and sustainable material. It decomposes faster than petroleum-based plastics and can be an excellent step toward reducing plastic pollution

## **Banana peel bioplastic**

### **1. Procedure:**

#### **1. Preparation of banana peel slurry:**

I washed the banana peels thoroughly to remove dirt and sticky residues. The outer fibrous layer was removed to make the texture smoother. The peels were then cut into small pieces and blended with a small amount of water until a **thick slurry** was formed.

#### **2. Mixing ingredients:**

The banana peel slurry was poured into a saucepan. I added **1 teaspoon of glycerol** and **1 teaspoon of vinegar** to the mixture and stirred it well to ensure even blending.

#### **3. Heating the mixture:**

The saucepan was placed on low heat. While gently heating, I kept stirring the mixture continuously. After a few minutes, the mixture started

**thickening and turning gel-like**, indicating that the starch and natural cellulose in the banana peel were gelatinizing.

4. **Forming the plastic sheet:**

Once the mixture reached a thick, sticky texture, it was removed from heat and spread evenly on a flat tray using a spatula to form a thin layer.

5. **Drying process:**

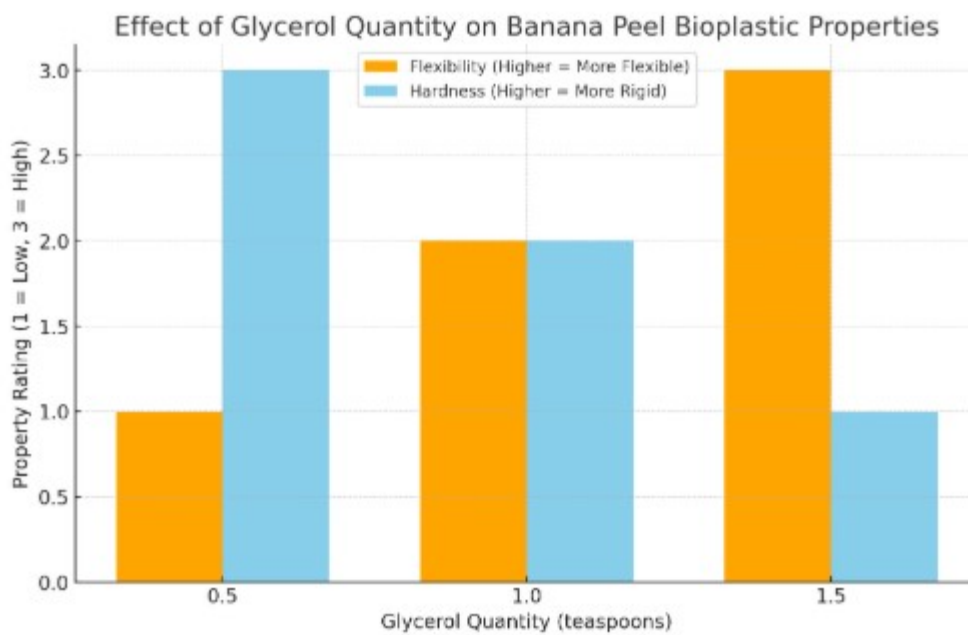
The spread mixture was left to dry at room temperature for **2–3 days**. After drying, a **thin, flexible, and brownish sheet** of bioplastic was formed.

**Observation:**

- The resulting sheet was **smooth, flexible, and slightly glossy**.
- The **color** depended on how ripe the banana was — darker peels produced a darker sheet.
- When placed in water for a few hours, the sheet softened, showing its **biodegradable nature**.

## Data analysis :

Sample	Glycerol (teaspoon)	Drying Time (days)	Flexibility	Hardness	Color	Observation
1	0.5	2	Low	High (brittle)	Light brown	Cracked easily
2	1.0	3	Medium	Medium	Brown	Good balance
3	1.5	3	High	Low (soft)	Dark brown	Too soft and sticky



## Graphical Representation:

- **X-axis:** Glycerol quantity (teaspoons)
- **Y-axis:** Flexibility rating (1 = Low, 2 = Medium, 3 = High)

As glycerol increases, flexibility increases but hardness decreases.

## Result:

A **bioplastic sheet was successfully produced** using banana peels, glycerol, and vinegar. The sheet showed good flexibility and could decompose naturally, making it an environmentally friendly plastic alternative

## Conclusion:

This project proved that **banana peels**, which are agricultural waste, can be turned into a **biodegradable plastic** using simple ingredients. Increasing glycerol made the plastic softer and more flexible. This method helps reduce **plastic pollution** and promotes **sustainable waste recycling**.

## Final Observations

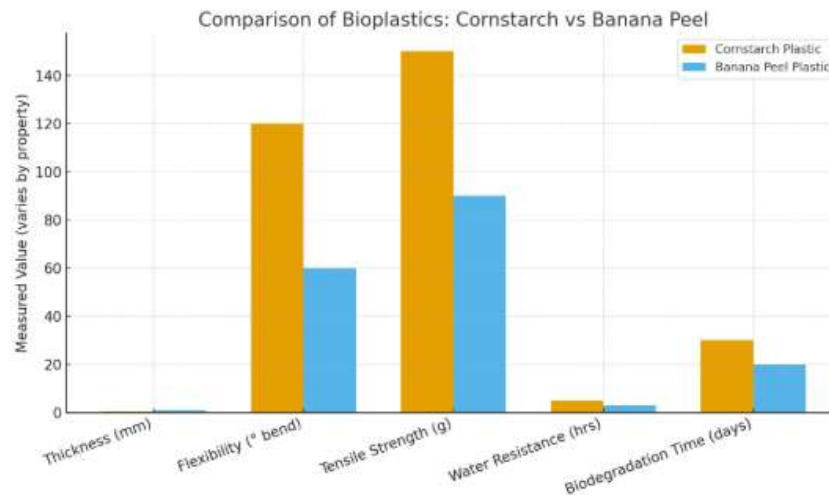
- Cornstarch plastic → transparent, smooth, flexible if glycerol used.
- Banana peel plastic → thicker, slightly darker, less flexible.
- Both are biodegradable (start breaking down in soil within weeks).

## Results / Data :

Property	Cornstarch Plastic	Banana Peel Plastic
Appearance	Transparent	Brownish / opaque
Flexibility	Flexible (with glycerol)	Less flexible
Biodegradability	~4–6 weeks	~3–5 weeks
Strength	Moderate	Brittle when dry

## Analysis

- ❖ Both **cornstarch** and **banana peels** can produce biodegradable plastics.
- ❖ **Cornstarch plastic** is more transparent and flexible.
- ❖ **Banana peel plastic** is less flexible but uses waste material, making it sustainable.
- ❖ These eco-friendly plastics are promising alternatives to petroleum-based plastics but need scaling and improvements for real-world use.



## Conclusion

This project shows that natural materials such as **cornstarch** and **banana peels** can be used to produce simple **biodegradable plastics**. Both types of plastics are eco-friendly alternatives to conventional petroleum-based plastics, but they differ in properties:

- **Cornstarch-based plastic** is smoother, more flexible, semi-transparent, and lasts longer in water.
- **Banana peel-based plastic** is thicker, less flexible, and breaks down faster in soil, making it more biodegradable.

## References :

1. **Agarwal, M., & Chauhan, G. S. (2018).**  
*Preparation and characterization of bioplastics from banana peel waste.*  
*International Journal of Scientific Research in Science and Technology (IJSRST)*, 4(8), 135–142.
2. **Gadhve, R. V., Das, A., Mahanwar, P. A., & Gadekar, P. T. (2018).**  
*Starch-based biodegradable plastics: Preparation, properties and applications.*  
*Polymers from Renewable Resources*, 9(1), 1–11.
3. **Thakur, V. K., & Thakur, M. K. (2014).**  
*Processing and characterization of natural cellulose fibers/thermoset polymer composites.*  
*Carbohydrate Polymers*, 109, 102–117.  
Describes biodegradable plastics and polymer structures derived from starch.
4. **Gadhve, R. V., Das, A., Mahanwar, P. A., & Gadekar, P. T. (2018).**  
*Starch-based biodegradable plastics: Preparation, properties and applications.*  
*Polymers from Renewable Resources*, 9(1), 1–11.  
Explains cornstarch-based plastic making methods and the effect of glycerol.
5. **Gómez, E. F., & Michel, F. C. Jr. (2013).**  
*Biodegradability of conventional and bio-based plastics and natural fiber composites during composting, anaerobic digestion and long-term soil incubation.*  
*Polymer Degradation and Stability*, 98(12), 2583–2591.  
Evaluates how starch plastics decompose naturally.



## PREPARATION OF BIO PLASTICS

