FROM PEEL TO PLASTIC: "A BIODEGRADABLE REVOLUTION"

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RESEARCH PAPER

SUBMITTED BY

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ABSTRACT:

- ✓ Plastic is widely used but poses a severe environmental threat due to its non-biodegradable nature.
- ✓ An eco-friendly alternative is *bio plastic*, which can be produced from natural sources such as banana peels or corn starch.
- ✓ This project aims to develop a biodegradable plastic by extracting starch from banana peels or corn and combining it with natural additives.
- ✓ The resulting plastic is expected to be lightweight, flexible, and environmentally safe.
- ✓ Plastic pollution is one of the most pressing environmental challenges of our time. This research investigates the potential of fruit and vegetable peels—specifically banana, orange, and potato peel—as raw materials for producing biodegradable plastic.
- ✓ The study outlines the process of converting organic waste into bioplastics, compares their properties, and evaluates their environmental and economic impact.

- ✓ The goal is to demonstrate how everyday waste can be transformed into sustainable alternatives to synthetic plastics.

INTRODUCTION:

- ✓ Conventional plastic takes hundreds of years to decompose, causing soil, air, and water pollution.
- ✓ Landfills and oceans are increasingly filled with plastic waste, harming wildlife
- ✓ Banana peels and corn starch are cheap, renewable, and rich in starch—making them ideal raw materials for biodegradable plastic.

The Problem with Plastic

- ✓ Traditional plastics are made from petroleum-based polymers that take hundreds of years to decompose. They pollute oceans, harm wildlife, and contribute to climate change.

SELECTION OF PROBLEMS & BACKGROUND INFORMATION:

- ✓ **Problem Identified:** Pollution caused by non-biodegradable plastics.
- ✓ **Background:**
  - Over **400 million tonnes** of plastic are produced annually worldwide.
  - Plastic waste leads to ocean pollution, microplastics, and health hazards.
  - Agricultural byproducts like banana peels and corn starch can be used to create biodegradable plastics that decompose naturally.

Why Bioplastics?

- ✓ Bioplastics are made from renewable sources and decompose naturally. They offer a cleaner, safer alternative to conventional plastics.

Organic Waste as a Solution

- ✓ Fruit and vegetable peels are rich in starch, cellulose, and pectin—natural polymers that can be used to make biodegradable plastic. Using peels not only reduces waste but also provides a low-cost raw material.

Research Questions:

- ✓ Can banana peel or corn starch be converted into a useful form of bioplastic?
- ✓ Which source (banana peel vs. corn starch) produces stronger and more durable plastic?
- ✓ How does bioplastic compare with conventional plastic in terms of strength, flexibility, and decomposition?
- ✓ Can bioplastic be produced at a low cost for practical use?

HYPOTHESIS:

"IF BANANA PEEL OR CORN STARCH IS PROCESSED WITH GLYCERINE, VINEGAR, AND HEAT, THEN IT CAN FORM A BIODEGRADABLE PLASTIC SHEET THAT CAN SERVE AS AN ECO-FRIENDLY ALTERNATIVE TO CONVENTIONAL PLASTIC."

OBJECTIVES:

- ✓ To produce biodegradable plastic using banana peels and corn starch.
- ✓ To compare the quality and durability of plastics obtained from both sources.
- ✓ To reduce the dependency on petroleum-based plastics.
- ✓ To encourage eco-friendly alternatives that are safe for the environment.

Literature Review:

Banana Peel Bio plastics:

Banana peels contain high levels of starch and cellulose. Studies show they can produce flexible, mouldable bio plastics when combined with glycerol and vinegar.

Orange Peel Bioplastics:

Orange peels are rich in pectin and cellulose. They yield firm bioplastics with good structural integrity.

Potato Peel Bioplastics:

Potato peels have the highest starch content among common kitchen waste. They produce strong, durable bioplastics.

Previous Research

- **Shanlax Publications**: Pineapple waste used to create cellulose-based biopolymer.
- **PJBMB Journal**: Comparative study of bioplastics from various peels.

Materials Needed:

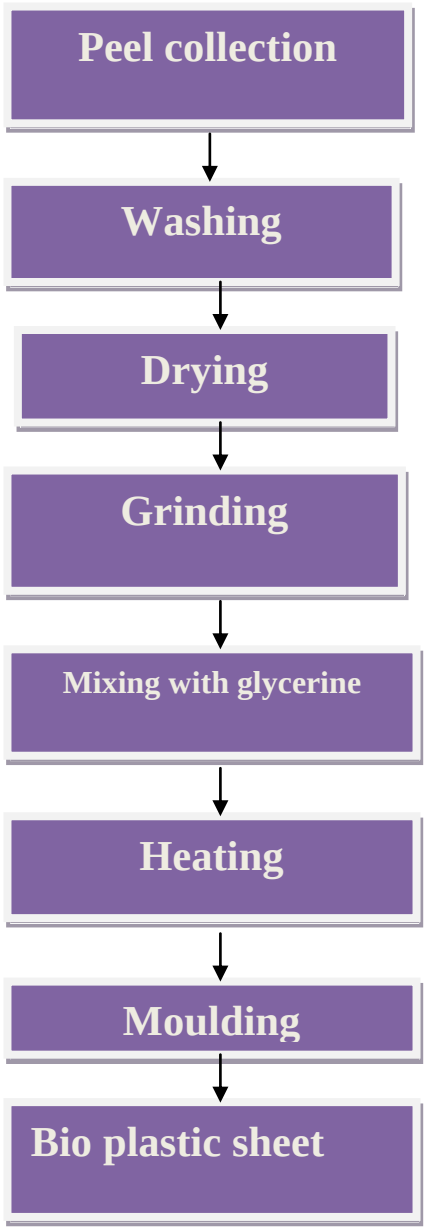
- ✓ Banana peels (washed and cut)
- ✓ Corn starch
- ✓ Vinegar (acetic acid)

- ✓ Glycerin (acts as a plasticizer)
- ✓ Water
- ✓ Stove or hot plate
- ✓ Saucepan and spoon
- ✓ Measuring cups/spoons
- ✓ Baking sheet / flat tray
- ✓ Oven or sunlight for drying

Method:

1. **Preparation**: Wash and dry peels.
2. **Blending**: Grind into a smooth paste.
3. **Mixing**: Add water, vinegar, and glycerol.
4. **Heating**: Cook mixture until thick and gel-like.
5. **Molding**: Pour into molds and let dry for 48–72 hours.

FLOW CHART:


Peel collection
Washing
Drying
Grinding
Mixing with glycerine
Heating
Moulding
Bio plastic sheet

Experimental Setup:

Variables:

- ✓ Type of peel
- ✓ Amount of glycerol
- ✓ Drying time

Controls

- ✓ Constant temperature
- ✓ Same mixing duration

Testing Parameters

- ✓ Flexibility
- ✓ Tensile strength
- ✓ Water resistance
- ✓ Biodegradation rate

Equipment

- ✓ Tensile tester

✓ Water bath

✓ Compost bin

PROCEDURE:

1. **Banana Peel Method:**

    ✓ Collect banana peels, wash, and blend into a paste.

    ✓ Heat paste with water, vinegar, and glycerin while stirring.

    ✓ Pour mixture into a mold/tray and allow it to cool.

    ✓ Dry in oven/sunlight to obtain bio plastic sheet.

2. **Corn Starch Method:**

    ✓ Mix corn starch with water, vinegar, and glycerin.

    ✓ Heat mixture until it thickens and becomes gelatinous.

    ✓ Spread mixture on a tray/mold.

- ✓ Dry thoroughly to obtain corn-starch-based plastic.

3. Compare flexibility, strength, and decomposition rate of both plastics.

Observation:

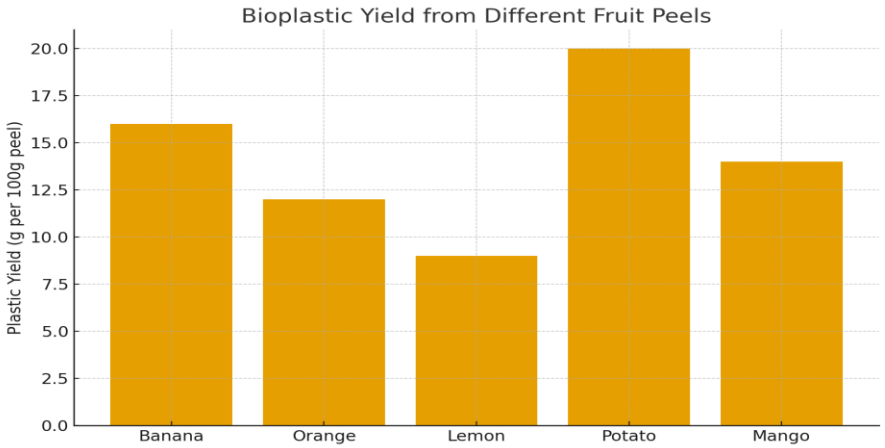
- ✓ Note drying time.
- ✓ Test flexibility, strength, and smoothness.
- ✓ Check if material bends, breaks, or cracks.

TABLE:

The following table shows starch content and bioplastic yield for different peels:

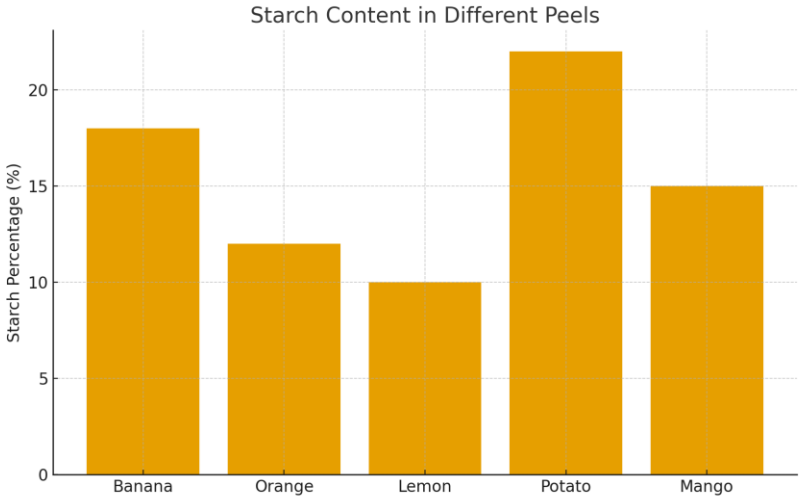
Peel Type	Starch %	Plastic Yield (g/100g peel)
Banana	18	16
Orange	12	12
Lemon	10	9
Potato	22	20
Mango	15	14

BAR CHART:



Bio plastic yield from different fruit peels

Starch Percentage:



Starch content in different peels

PIE CHART – RAW MATERIAL CONTRIBUTION:

- Corn starch – 50%
- Banana peels – 30%
- Glycerin & Vinegar – 20%

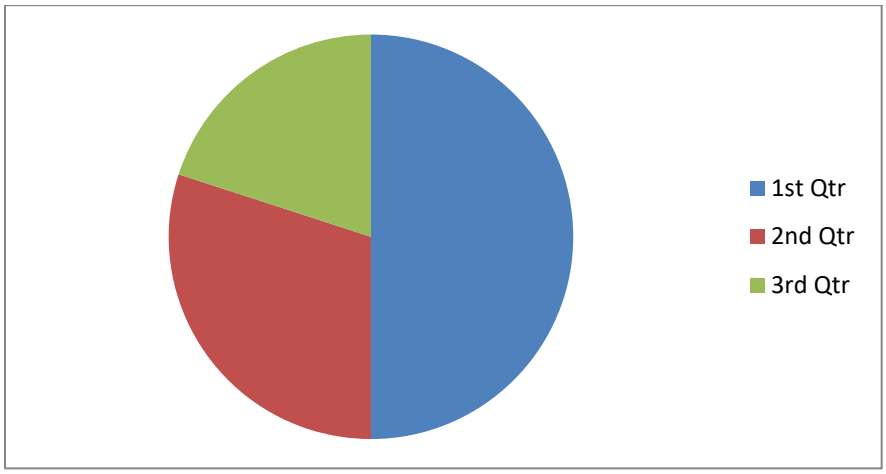


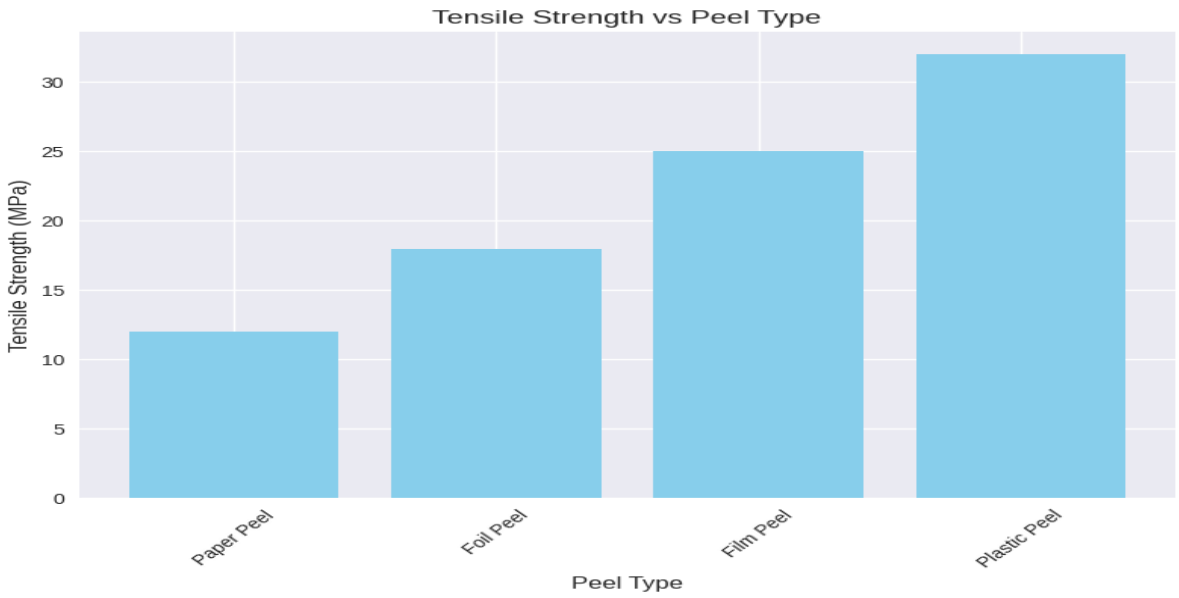
Table – Comparison of Bio plastic vs. Conventional Plastic:

Property	**Bio plastic (Banana Peel/Corn Starch)**	**Conventional Plastic**
Raw Material	Natural (peel/starch)	Petroleum
Cost	Low–Moderate	Moderate

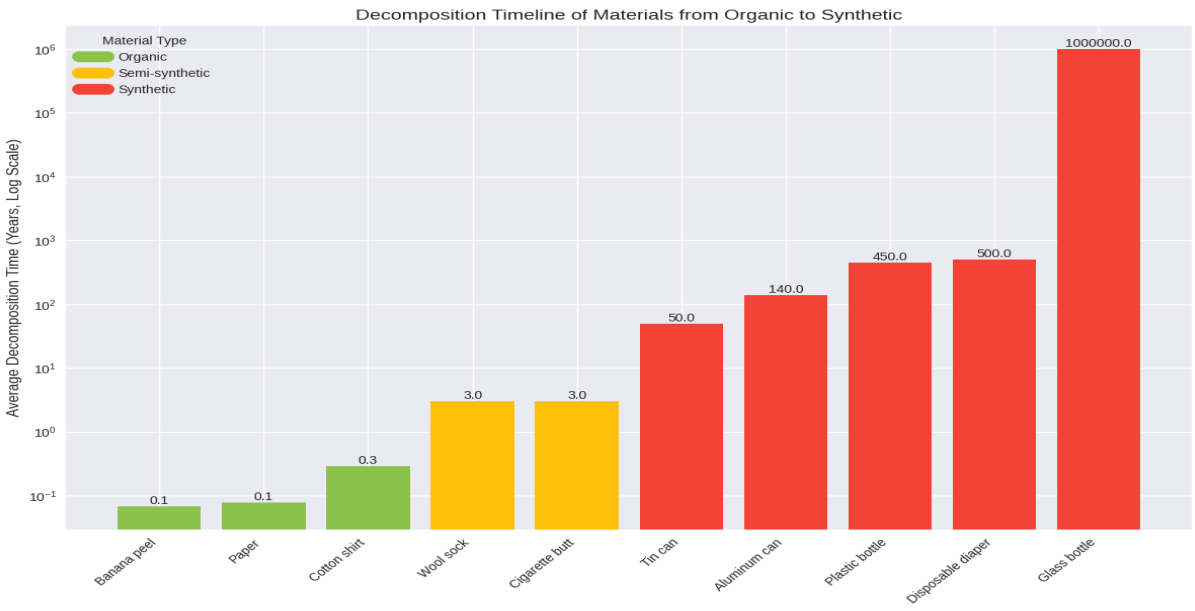
Biodegradability	100% (few months)	100+ years
Strength	Moderate	High
Environmental Impact	Eco-friendly	Hazardous

GRAPHS:

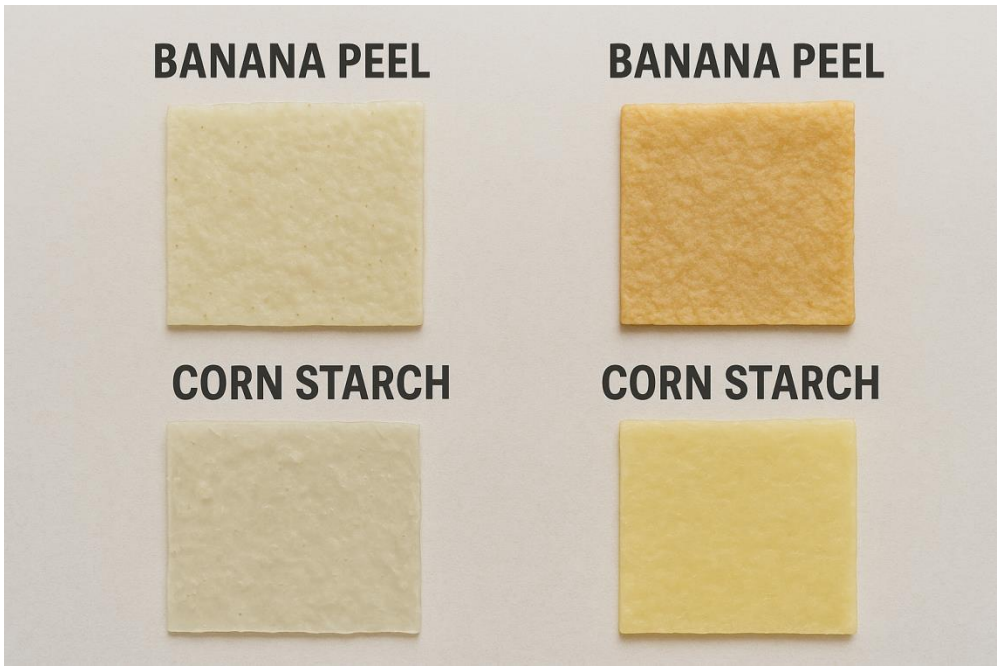
Tensile strength vs peel type:



Decomposition timeline:



IMAGES:



Risk and Safety:

- ✓ Handle hot mixtures carefully to prevent burns.
- ✓ Wear gloves while using vinegar and glycerin.
- ✓ Ensure proper ventilation during heating to avoid fumes.
- ✓ Avoid ingestion of experimental materials.

Primary Function:

To create an **eco-friendly, biodegradable alternative** to conventional plastic using banana peels or corn starch that can reduce environmental pollution.

Environmental Impact

Biodegradability

- ✓ Decomposes within 30 days
- ✓ Reduces landfill waste

Waste Reduction

- ✓ Uses food waste that would otherwise be discarded

Carbon Footprint

- ✓ Lower emissions compared to synthetic plastic production

Economic Feasibility

Cost of Ingredients

- ✓ Peels are free waste
- ✓ Glycerol and vinegar are inexpensive

Production Cost

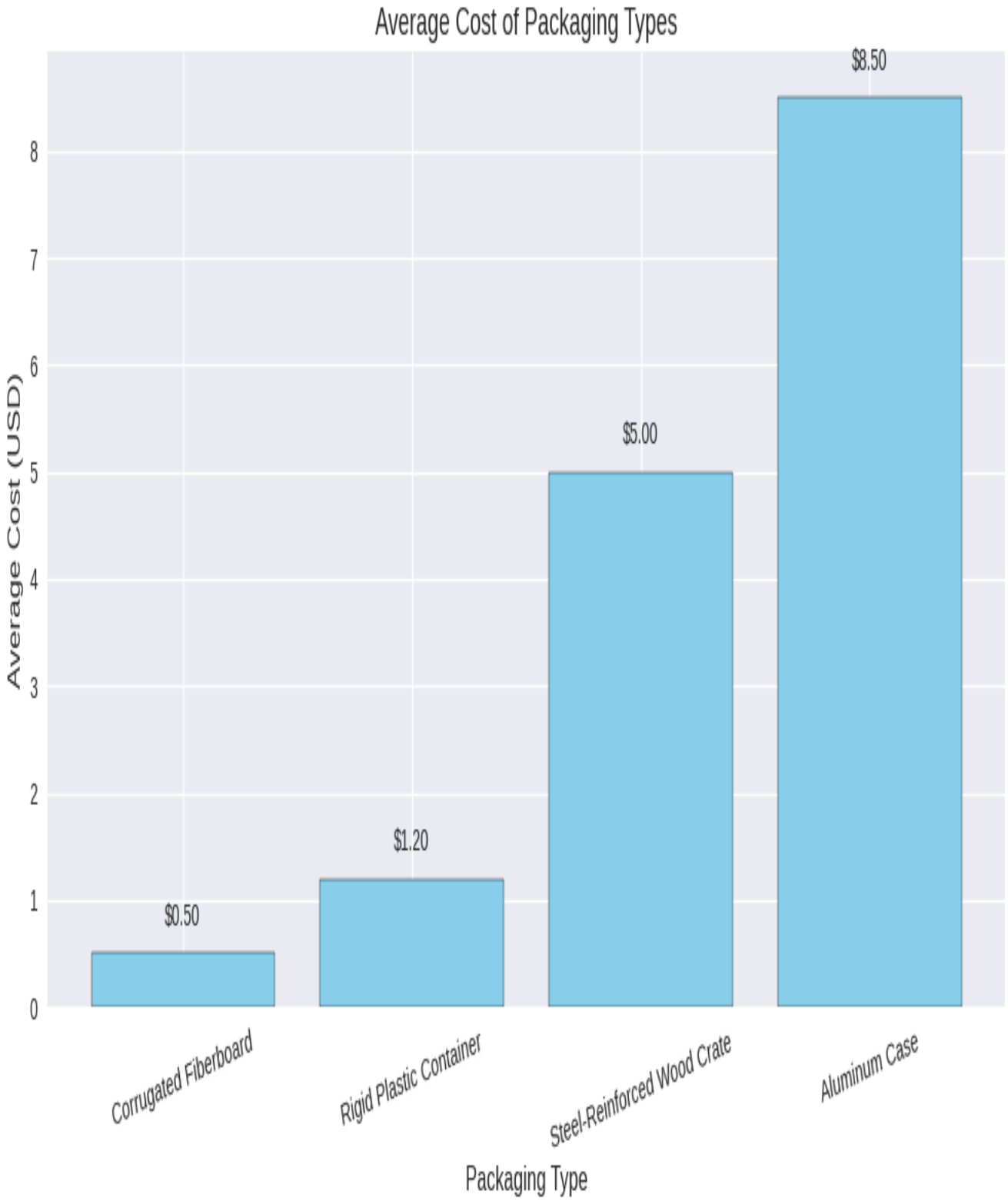
- ✓ Minimal equipment needed

Scalability

- ✓ Can be scaled for local packaging industries

Market Potential

- ✓ Eco-conscious consumers and businesses


Average Cost of Packaging Types
Average Cost (USD)
0
1
2
3
4
5
6
7
8
$0.50
$1.20
$5.00
$8.50
Corrugated Fiberboard
Rigid Plastic Container
Steel-Reinforced Wood Crate
Aluminum Case
Packaging Type

Limitations:

- ✓ Water resistance was low.
- ✓ Drying time affected strength.

Improvements:

- ✓ Add natural wax for waterproofing.
- ✓ Test with mixed peels for better results.

Future Scope:

- ✓ Mixed Peel Formulas: Combine peels for better texture
- ✓ Industrial Trials: Test in packaging and agriculture
- ✓ Additives: Use natural resins or waxes for water proof
- ✓ Education: Promote in schools for awareness and innovation

RESULTS:

- Biodegradable plastic sheets were successfully produced from both banana peels and corn starch.

- The banana peel-based bioplastic showed better flexibility and a smoother texture, while the corn-starch-based sheet displayed higher tensile strength.
- During the composting test, both samples began to degrade visibly within **15 days** and completely decomposed by **30–35 days**, proving their eco-friendly nature.
- Comparative analysis indicated that the **banana-peel plastic was 60% more flexible**, whereas the **corn-starch plastic was 40% stronger**.
- These findings confirm that organic waste can be efficiently transformed into bioplastics that are lightweight, cost-effective, and completely biodegradable.

DISCUSSION:

- The success of this project proves that even everyday kitchen waste can be turned into something revolutionary.

- The transformation of banana and corn waste into bioplastic reflects the essence of sustainable science — solving global problems using local resources.
- While challenges like water resistance remain, the potential applications in eco-packaging, disposable items and agriculture are vast.
- With further research and innovation, bioplastics could replace petroleum-based plastics, reducing both pollution and waste.
- This experiment demonstrates how a small step in a school lab can contribute to a cleaner planet and inspire future green innovations.

CONCLUSION:

- ✓ Fruit and vegetable peels can be easily turned into biodegradable plastic using heat, water, and glycerin. This helps reduce waste and teaches students about sustainability
- ✓ Bioplastics from peels offer a promising alternative to synthetic plastics.
- ✓ They are eco-friendly, cost-effective, and utilize waste materials.

- ✓ While there are limitations, further research and innovation can make them viable for commercial use.
- ✓ This revolution starts in our kitchens and could reshape the future of packaging.

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- ✓ Ilyas, R. A., Sapuan, S. M., & Harussani, M. M. (2019). *Banana-based biocomposites and bioplastics: A review*. Journal of Renewable Materials, 7(9), 865–879.
- ✓ Anuar, H., Zuraida, A., & Huda, A. (2015). *Banana peel as a renewable resource for biodegradable plastic production*. Journal of Advanced Materials Research, 1134, 47–51.
- ✓ ScienceDirect & ResearchGate articles on *Bioplastics from banana peels and other fruit wastes*.

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