NATIONAL SCIENCE FAIR RESEARCH PLAN

LEVEL : PRIMARY LEVEL

CATEGORY : ENVIRONMENTAL SCIENCE

SUBMITTED BY

MODEEN MUHAMMED MAFAAZ

(GRADE : 5)

1. (Community Building & Academic Excellence)

Abstract

1. Project Details

Project ID: NSF-SCH-2025-203
Project Title: Earth-Friendly Plastics: Harnessing Nature for Sustainability
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This project investigates how natural materials like starch, gelatin, egg shells, casein, and fruit peels can be used to make biodegradable plastics. Bioplastics were prepared, tested for strength, flexibility, water solubility, and decomposition, and compared with each other. Starch, gelatin, and eggshell successfully formed plastic sheets, while casein and fruit peels did not. The results show that natural materials can create eco-friendly plastics that break down faster than synthetic plastics, offering a safe and sustainable alternative to reduce pollution.

Introduction

Can plastics made from natural materials such as starch, casein, gelatin, egg shells, and fruit peels serve as biodegradable alternatives to conventional plastics?

Plastic pollution has become a global concern due to the non-biodegradable nature of conventional plastics. These materials persist in the environment for hundreds of years, harming ecosystems, wildlife, and even human health.

Researchers have explored natural polymers such as starch, casein, and gelatin as eco-friendly substitutes for petroleum-based plastics. These natural substances are biodegradable, renewable, and can be sourced from everyday organic materials.

Hypothesis

If plastics are made from natural polymers, they will degrade naturally and display different levels of strength and flexibility compared to synthetic plastics.

Methodology

Bioplastics were prepared using five natural sources: starch, casein, gelatin, egg shells, and fruit peels. Each material was processed using water, vinegar, and glycerol (as a plasticizer). The resulting mixtures were poured into trays and allowed to dry into thin sheets.

After drying, samples were tested for:

- Flexibility by bending test
- Strength by measuring breaking weight
- Water solubility by immersing in water
- Decomposition rate by observing breakdown over days

Variables

Independent Variable: Type of natural ma

Dependent Variables:

- Flexibility
- Strength
- Solubility
- biodegradation rate

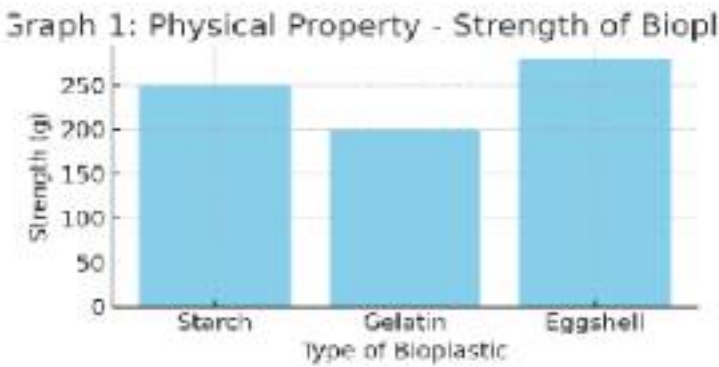
Controlled Variables:

- Drying time
- temperature
- glycerol amount
- sample thickness

Table 1 – Raw Materials and Source

Sample	Bioplastic Type	Source Material	Key Components	Availability	Cost
1	Starch Plastic	Potato starch	Amylose, amylopectin	High	Low
2	Casein Plastic	Milk	Casein protein	Moderate	Low
3	Fruit Peel Plastic	Banana & orange peels	Cellulose, pectin	High	Very Low
4	Gelatin Plastic	Animal protein	Collagen	Moderate	Low
5	Eggshell Plastic	Eggshell powder	Calcium carbonate	High	Very Low

GRAPH : 1 Physical Properties



Sample	Type	Thickness (mm)	Flexibility (1–5)	Strength (g)	Water Solubility	Transparency
1	Starch	0.8	4	250	Medium	Semi-clear
2	Gelatin	0.6	5	200	High	Transparent
3	Eggshell	1.1	3	280	Low	Opaque

GRAPH : 2 Breaking force of Bioplastic

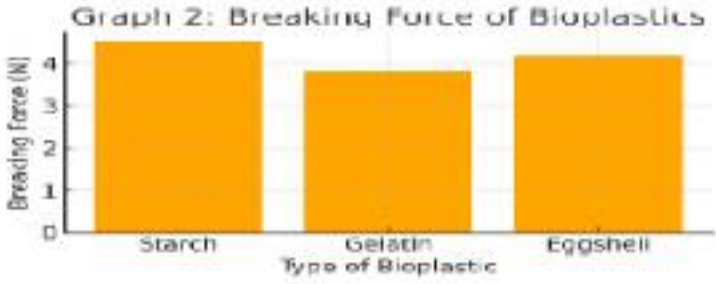


Table 3 – Durability and Environmental Impact

Type	Decomposition (days)	Eco-friendliness	Water Resistance	Applications
Starch	20	Excellent	Medium	Food packaging
Gelatin	18	Very Good	Low	Biodegradable films
Eggshell	30	Excellent	High	Rigid packaging

GRAPH :3 Weight of Bioplastics

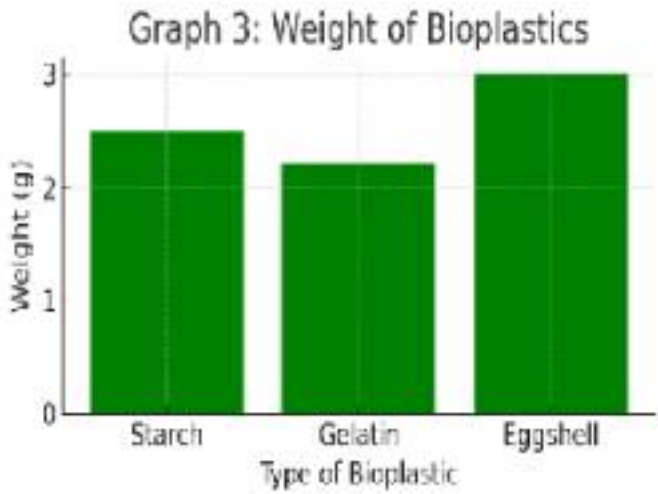
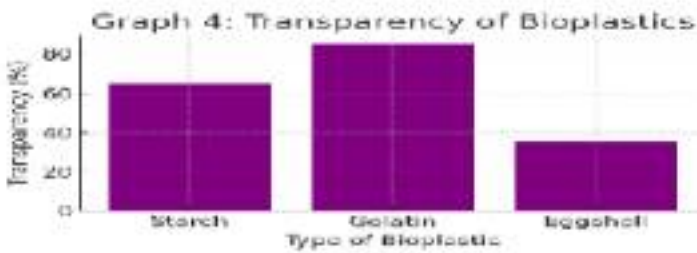
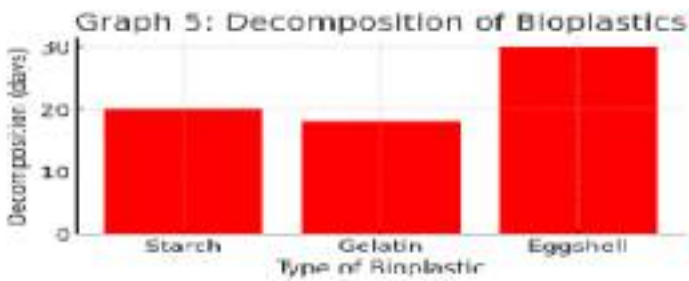


Table 4 – Experimental Comparison Data

Type	Thickness (mm)	Weight (g)	Breaking Force (N)	Transparency (%)	Decomposition (days)
Starch	0.8	2.5	4.5	65	20
Gelatin	0.6	2.2	3.8	85	18
Eggshell	1.1	3.0	4.2	35	30

GRAPH :4 Transparency of Bioplastics





Collection of data- photographs


11:12 am


11:12 am


EGG SHELL PLASTIC
GELATIN PLASTIC
RICE STARCH PLASTIC
CASEIN PLASTIC
FRUITS PEEL PLASTIC
EGG SHELL PLASTIC


GELATIN
PLASTIC


EGG
SHELL
PLASTIC


RICE
STARCH
PLASTIC


FRUITS
PEEL
PLASTIC
CASEIN
PLASTIC

Results

Bioplastics were successfully prepared from starch, gelatin, and eggshell, but attempts to prepare plastics from casein and fruit peels were unsuccessful.

The casein sample did not solidify into a usable plastic sheet. It remained soft and sticky even after drying, possibly due to improper protein coagulation.

The fruit peel mixture failed to form a consistent film and showed cracking and uneven texture after drying, likely because of excess moisture and low binding strength in the organic material.

Discussion

- The failure of casein and fruit peel plastics indicates that not all natural materials are equally suitable for bioplastic formation under the same preparation conditions. Casein, being protein-based, may require controlled heating or different acidic treatment for proper polymer formation. Fruit peels, on the other hand, contain pectin and cellulose, which might need blending with starch or gelatin to improve bonding
- The successful results from starch, gelatin, and eggshell samples confirm that natural biopolymers can produce viable eco-friendly plastics with varied textures, strength, and decomposition rates.Starch offers a good balance ,flexibility and strength.
- Gelatin provides elasticity and clarity but lower water resistance.Eggshell gives rigidity and water resistance but slower degradation.

Conclusion

Overall, the experiment demonstrates that natural materials have potential for sustainable plastic alternatives, though further optimization is needed for materials like casein and fruit peels to achieve better consistency and durability.

References

1. Thompson, R. C., Moore, C. J., & vom Saal, F. S. (2009). Plastics, the environment, and human health. Science Journal.

2. Marsh, K., & Bugusu , B. (2007). Food packaging—roles, materials, and environmental issues. Journal of Food Science.

3. Emadian, S. M., Onay, T. T., & Demirel, B. (2017). Biodegradation of bioplastics in natural environments. Waste Management.

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