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**PROJECT TITLE: COMPARATIVE STUDY OF  
DECOMPOSITION OF DIFFERENT BIODEGRADABLE  
PRODUCTS.**

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## **II. INTRODUCTION**

This research focuses on studying how different biodegradable products decompose under similar environmental conditions. Biodegradable items break down naturally with the help of microorganisms, sunlight, and moisture, turning into simpler compounds such as carbon dioxide, water, and humus. Understanding the decomposition rates of different products helps us manage waste more effectively and encourages sustainable practices like composting.

The increasing awareness of environmental issues has led to a growing interest in biodegradable products as a potential solution to reduce waste and promote sustainability. Biodegradable products are designed to break down naturally in the environment, reducing the amount of waste sent to landfills and minimizing the impact on ecosystems. However, the decomposition rates of these products can vary significantly depending on the materials used and environmental conditions.

Biodegradation is a natural process that involves the breakdown of organic matter by microorganisms, sunlight, and moisture. This process converts complex organic compounds into simpler substances such as carbon dioxide, water, and humus. Understanding the decomposition rates of different biodegradable products is crucial for managing waste effectively and promoting sustainable practices like composting.

The purpose of this research is to study how different biodegradable products decompose under similar environmental conditions. By comparing the decomposition rates of various products, we can gain insights into the factors that influence biodegradation and identify the most sustainable options. This knowledge can inform waste management practices and encourage the development of more eco-friendly products.

Biodegradable products are made from a variety of materials, including plant-based bioplastics, paper, and natural fibers. These materials are designed to be composted at the end of their life cycle, reducing the amount of waste sent to landfills and minimizing the environmental impact. However, the decomposition rates of these products can vary significantly, and it is essential to understand the factors that influence biodegradation.

The decomposition rate of biodegradable products depends on several factors, including the type of material, environmental conditions, and microorganisms present. For example, products made from natural fibers like cotton and hemp tend to decompose faster than those made from synthetic materials.

Understanding these factors can help us design more sustainable products and waste management systems.

The benefits of biodegradable products extend beyond waste management. By reducing the amount of waste sent to landfills, biodegradable products can also help mitigate climate change by reducing greenhouse gas emissions.

Additionally, biodegradable products can promote sustainable consumption patterns and encourage individuals to adopt more eco-friendly practices.

This research aims to contribute to the growing body of knowledge on biodegradable products and their role in promoting sustainability. By studying the decomposition rates of different biodegradable products, we can gain a better understanding of their environmental impact and identify opportunities for improvement.

## HYPOTHESIS

1. Cellulose-based natural materials (banana peel, cotton, paper) will decompose faster than polymer-based biodegradable plastics (PLA, starch-blend) in aerobic compost and vermicompost.
2. Anaerobic conditions will slow visible mass loss for many materials but increase methane production for carbon-rich items.
3. Higher temperature and adequate moisture in composting accelerate decomposition for all materials.

Vermicomposting will outperform plain soil burial in reducing mass of organic, easily accessible substrates (fruit peels) but may show smaller differences for industrially processed biodegradable plastics.

## ABSTRACT

The main purpose of this project is to **compare the decomposition rates of different biodegradable materials** to understand which items break down faster and why. The detailed objectives are:

1. **To study and compare the decomposition process** of different biodegradable products such as fruit peels, paper, cardboard, and natural fabrics when placed under similar soil conditions.
2. **To identify the effect of material composition** (sugars, fibers, lignin, oils, acids) on the speed of decomposition.
3. **To analyze physical and chemical changes** (color, texture, odor, fungal growth, fragmentation, weight loss) that occur during the decomposition process.
4. **To find which biodegradable products are most suitable for composting** because they decompose quickly and enrich the soil.
5. **To highlight the limitations of slow-decomposing materials**, which require longer time periods and special conditions for proper breakdown.
6. **To promote awareness of eco-friendly waste disposal** by showing how common household biodegradable items behave differently when returned to the soil.

## GUIDING PRINCIPLE

Decomposition is a **natural biological process** in which organic matter is broken down into simpler substances by the action of microorganisms such as bacteria and fungi. These microorganisms consume the biodegradable material as food, using enzymes to break down complex compounds like carbohydrates, proteins, fats, cellulose, and lignin into simpler molecules such as carbon dioxide, water, and humus (organic matter that enriches the soil).

The rate of decomposition depends on several key factors:

### 1. **Moisture Content**

- Water is essential for microbial activity. Materials with high moisture content (like banana peels) decompose quickly because they provide an ideal environment for microbes.
- Dry materials (like cardboard or jute) require extra moisture before microbes can act on them.

### 2. **Temperature**

- Warm temperatures accelerate microbial growth, speeding up decomposition.
- In colder climates, decomposition is slower because microbial activity is reduced.

### **Composition of Material**

- **Sugars and starches** in fruit peels are easy for microbes to digest, leading to rapid decomposition.
- **Cellulose and lignin**, found in paper, cardboard, and jute, are tougher compounds that require specialized microbes and more time.
- **Natural oils and acids**, like those in orange peels, act as preservatives and slow down microbial action.

### **Surface Area**

- Smaller or shredded pieces decompose faster because they expose more surface area for microbes.
- Larger, thick pieces (like whole cardboard or fabric) take longer.

### **Oxygen Availability**

- In well-aerated soil, aerobic decomposition dominates, which is faster and less foul-smelling.
- Lack of oxygen may cause anaerobic decomposition, which is slower and produces bad odors.

## II.METHODOLOGY

### MATERIALS

- Banana peel
- Orange peel
- Newspaper
- Cardboard
- Cotton cloth (small piece)
- Jute (small piece)
- 6 soil-filled containers/pots
- Weighing scale
- Spray bottle for water
- Gloves



piece)

containers/pots

### PROCEDURE

1. Prepare six containers with equal amounts of garden soil.
2. Place 50 g of each biodegradable material (banana peel, orange peel, newspaper, cardboard, cotton cloth, jute) into separate containers.
3. Cover lightly with soil.
4. Sprinkle water to keep moisture consistent.
5. Keep all containers in the same environment (temperature, sunlight exposure).
6. Record observations weekly (weight loss, physical appearance, fungal growth, odor changes).
7. Continue for 8–12 weeks until significant decomposition occurs.





## INDEPENDENT VARIABLES

- Type of biodegradable material.
  1. Paper Products: Newspaper.
  2. Natural Fibers: Cotton cloth, Jute.
  3. Food Waste: Banana peel, orange peel.
  4. Other Biodegradable Materials: Cardboard.

## DEPENDENT VARIABLES

- Rate of Decomposition:
  1. Time taken for initial breakdown – Banana Peel starts to show visible signs of degradation (e.g., tears, holes, or discoloration) after 7 days in a composting environment, the time taken for initial breakdown would be 7 days.
  2. Time taken for complete decomposition- Banana peel took 7 days to decompose. Orange peel took 10 days to decompose.
  3. Natural Fiber and other material- Cotton cloth and cardboard show visible sign of fungal growth after 15 days in a composting environment.
  4. Paper Products- Newspaper shows visible sign of non-absorption of water and the texture is sticky.
- Extent of Decomposition:
  1. Weight loss (measured periodically) – Banana peel 30%, orange peel 30%, other materials absence of weight loss.
  2. Appearance changes (visual observations) – Fungal growth in cotton cloth and cardboard.
  3. Color change- Banana peel [5 days] and orange peel [7 days] changed into brown.
  4. Shape change – Orange peel changed to triangle shape.

## RISK FACTORS

- 1. Handling Soil and Compost**
  - Soil and compost may contain bacteria, fungi, or insects that can cause infection or skin irritation.
- 2. Bad Odors and Gases**
  - Decomposition releases gases like carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). If containers are airtight, pressure may build up.
- 3. Use of Sharp Tools**
  - Scissors, cutters, or knives used to cut materials may cause cuts or injuries.
- 4. Moisture and Mold Growth**
  - Too much moisture can lead to mold growth, which may cause allergies or breathing problems.
- 5. Heat in Compost Piles**
  - Active compost can become hot (up to 50–60 °C), which may cause burns if touched directly.
- 6. Improper Disposal**
  - If decomposed materials are not disposed of properly, they may attract flies, insects, or create foul smells.

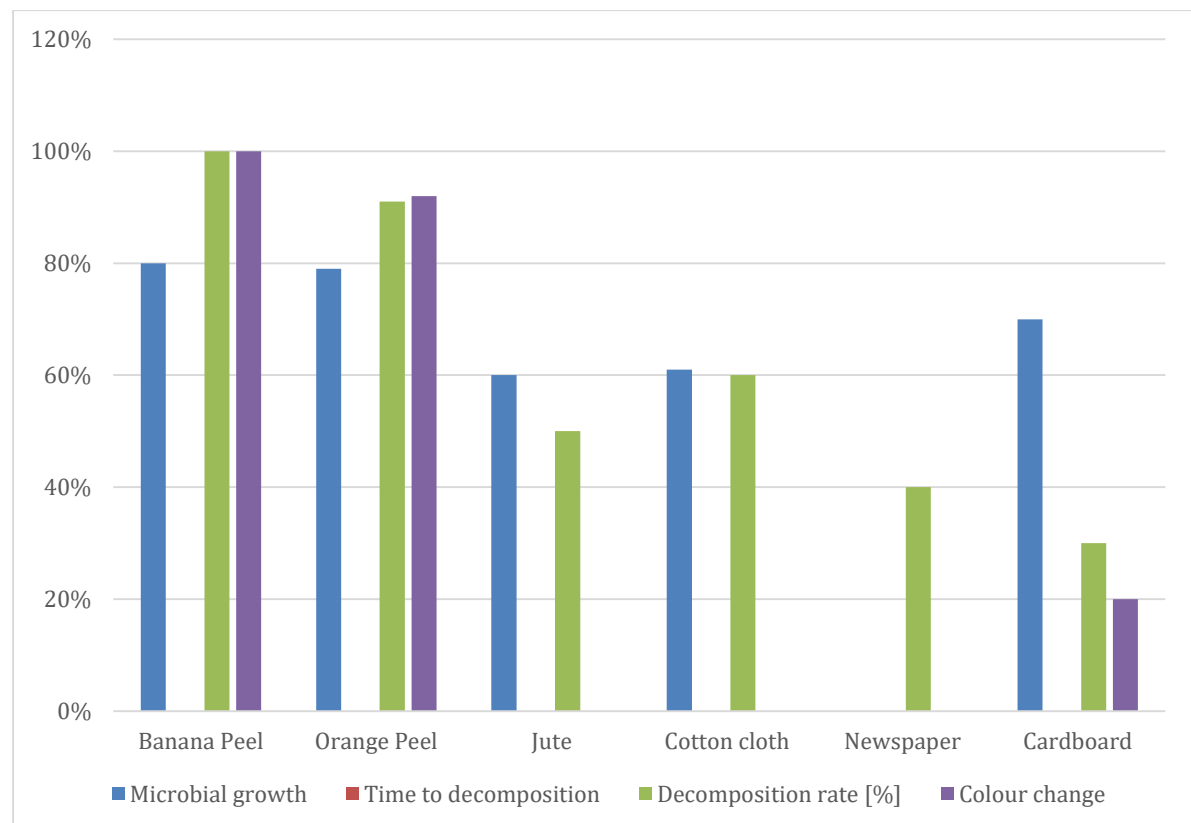
## SAFETY MEASURES

- 1. Personal Protection**
  - Wear gloves while handling soil or compost.
  - Wash hands thoroughly after the experiment.
  - Wear a mask if mold is visible.
- 2. Working Environment**
  - Keep containers in a well-ventilated area.
  - Do not keep jars completely airtight; allow gases to escape safely.
- 3. Tool Handling**
  - Use scissors carefully under adult supervision.
  - Cut materials on a flat surface to avoid injuries.
- 4. Compost Handling**
  - Measure compost temperature with a thermometer instead of touching it directly.
  - Do not dig hands deep into compost piles.
- 5. Hygiene and Disposal**
  - Dispose of decomposed materials in a proper compost pit or waste bin.
  - Clean all containers, tools, and work surfaces after the project.

## IV. RESULTS

*Observations Table*

Material Type	Microbial growth	Time to decomposition	Decomposition rate [%]	Colour change
Banana Peel	80%	7 days	100%	100%
Orange Peel	79%	10 days	91%	92%
Jute	60%	Degrading slowly	50%	No changes
Cotton cloth	61%	Degrading slowly	60%	No changes
Newspaper	0	Degrading slowly	40%	No changes
Cardboard	70%	Degrading slowly	30%	20%



## V. DISCUSSION

The decomposition rates of various materials were studied, and the results are presented in the table. The materials tested included banana peels, orange peels, jute, cotton cloth, newspaper, and cardboard. The parameters measured included microbial growth, time to decomposition, decomposition rate, and color change.

The results show that banana peels decomposed the fastest, with a decomposition rate of 100% in just 7 days. This is likely due to the high moisture content and nutrient-rich composition of banana peels, which provided an ideal environment for microbial growth. Indeed, the microbial growth rate for banana peels was 80%, indicating a high level of microbial activity.

Orange peels also decomposed relatively quickly, with a decomposition rate of 91% in 10 days. The microbial growth rate for orange peels was 79%, which is slightly lower than that of banana peels. This may be due to the slightly lower moisture content and higher acidity of orange peels compared to banana peels.

In contrast, jute, cotton cloth, newspaper, and cardboard decomposed much more slowly. Jute and cotton cloth had microbial growth rates of 60% and 61%, respectively, and decomposition rates of 50% and 60%, respectively. Newspaper had no microbial growth and a decomposition rate of 40%, while cardboard had a microbial growth rate of 70% but a decomposition rate of only 30%. These results suggest that these materials are more resistant to decomposition, possibly due to their higher lignin content or lower moisture levels.

The color change data also provides interesting insights. Banana peels and orange peels showed significant color changes, with 100% and 92% changes, respectively. In contrast, jute, cotton cloth, and newspaper showed no color

changes, while cardboard showed a 20% change. This suggests that the color change is related to the decomposition rate, with faster-decomposing materials showing more pronounced color changes.

The slow decomposition rates of jute, cotton cloth, newspaper, and cardboard have implications for waste management. These materials may require longer composting times or specialized treatment to break them down efficiently. On the other hand, banana peels and orange peels can be easily composted and may provide valuable nutrients for plants.

The microbial growth data also provides insights into the decomposition process. Materials with higher microbial growth rates tended to have faster decomposition rates, indicating that microorganisms play a key role in breaking down organic matter. The absence of microbial growth on newspaper may be due to the presence of chemicals or other inhibitory substances.

Overall, this study highlights the importance of understanding the decomposition rates of different materials. By understanding how different materials decompose, we can develop more effective waste management strategies and reduce the environmental impacts of waste disposal.

## VI. CONCLUSION

In conclusion, this study provides valuable insights into the decomposition rates of various materials, including banana peels, orange peels, jute, cotton cloth, newspaper, and cardboard. The results show that organic materials like banana peels and orange peels decompose quickly, while natural fibers like jute and cotton cloth take longer to break down.

The study highlights the importance of understanding the decomposition rates of different materials, which can inform waste management strategies and reduce environmental impacts. By identifying materials that decompose quickly, we can prioritize their composting and reduce the amount of waste sent to landfills.

The findings also underscore the role of microorganisms in decomposition, with materials that support higher microbial growth rates tend to decompose more quickly. This knowledge can be used to develop more effective composting strategies that promote microbial activity.

The slow decomposition rates of materials like jute, cotton cloth, newspaper, and cardboard suggest that these materials may require specialized treatment or longer composting times. This has implications for waste management practices and highlights the need for more sustainable approaches to managing these materials.

Overall, this study contributes to our understanding of the decomposition process and highlights the importance of considering the unique characteristics of different materials. By applying these findings, we can develop more effective waste management strategies and reduce the environmental impacts of waste disposal.

Ultimately, the results of this study can inform the development of more sustainable waste management practices, reducing the environmental impacts of waste disposal and promoting a more circular economy.

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