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Comparative Study of Biodegradable Plastic Film from Potato and CCR

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Abstract - *There has been an increase in the use and application of plastic due to its lighter weight and mostly cost effectiveness as compared to other materials such as metals or ceramics. The indecomposable nature of the plastic leads to increase in environmental pollution day by day. The purpose of this study is to compare and investigate the possible contribution of bio-plastic film to sustainability and in developing a new plastic free environment, where plastics perform their useful function without causing negative externalities. In this study we are focusing on bio-plastic film obtained from potato and equal mixture of CCR (i.e. corn, coconut, rice) this bio-plastic film focus on sustainable and greener environment with the reduction of conventional plastic uses the starch used in research was extracted from potato and from CCR (i.e. corn, coconut, rice) and combined with gelatin as an additive to give strength to bio-film and also the mechanical properties such as tensile aberration hardness and biodegradability test were analyzed surface tension and elasticity were also estimated and studied. Use of Starch gives high modulus and quick biodegradability that makes it most suitable for disposable packaging application. As a result, the research discusses the various parameters to influence and improvise the adoption of biodegradable plastics, as well as a sustainable framework for improving bio-degradable plastic's long-term viability.*

Key Words: Bioplastic; Bio-degradable; Sustainability; Environment; Plastic film

1.INTRODUCTION

Welcome to a comprehensive exploration of the world of biodegradable plastic films derived from two fascinating sources: potatoes and the CCR blend of corn, coconut, and rice. In this comparative study, we delve into the unique attributes, environmental impact, production processes, and potential applications of these bioplastics.

In recent years, the growing concern for environmental sustainability has prompted extensive research into alternative materials, particularly in the realm of plastic films. The exploration of these biodegradable plastics offers a glimpse into innovative solutions aimed at mitigating the ecological hazards posed by conventional petroleum-based plastics.

Potato-based bioplastics have garnered significant attention due to their renewability and potential for reducing waste. Meanwhile, the amalgamation of corn, coconut, and rice materials presents a unique avenue for creating composite biodegradable films, harnessing the distinct properties of each component. This study seeks to delve into the properties, degradation rates, mechanical strengths, and overall environmental impact of both potato and CCR biodegradable plastic films.

2.MATERIALS REQUIRED TO CONDUCT THE STUDY:

To conduct a comprehensive comparative study of biodegradable plastic films derived from potatoes and a blend of corn, coconut, and rice (CCR), the following materials will be required:

1.1 Raw Materials:

- Potatoes (for potato-based biodegradable plastic)
- Cornstarch (for corn component of CCR blend)
- Coconut coir (for coconut component of CCR blend)
- Rice starch (for rice component of CCR blend)

Table 1: Sample Data for Raw Materials

Raw Materials	Potato Sample (gm)	CCR Sample (gm)
Potato	150	-
Corn	-	50
Coconut	-	50
Rice	-	50

1.2 Chemicals and Additives:

- Glycerol (plasticizer)- 20 ml/100gm
- Acetic acid or citric acid (to modify starch for better film-forming properties)- 10ml/100gm
- Water (solvent and diluent)
- Biodegradation-promoting enzymes (if testing degradation rates)
- Colorants or dyes (optional, for visual differentiation)

1.3 Laboratory Equipment:

- Weighing balance
- Blender or grinder
- Mixing bowls
- Stirring rods
- Hotplate or microwave (for heating and blending)
- Film-casting frame or Mold
- Oven or drying chamber

1.4 Safety Gear:

- Lab coats or protective clothing
- Gloves
- Safety goggles

1.5 Notebooks and Documentation:

- Research notebooks for recording procedures, observations, and results
- Data sheets for data collection and analysis

2. METHOD REQUIRED TO CONDUCT THE STUDY:

Certainly, here is a simplified step-by-step method for conducting a comparative study of biodegradable plastic films from potatoes and a blend of corn, coconut, and rice (CCR):

2.1 Preparation of Raw Materials:

- Wash and peel the potatoes. Cut them into small pieces and blend to obtain a smooth paste.
- Collect cornstarch, coconut coir, and rice starch. Grind or process each material separately to obtain fine powders.

2.2 Preparation of Plastic Film Solutions:

1 **For Potato-Based Bioplastic:**

a. In a mixing bowl, combine the potato paste with water (adjust ratio for desired consistency).
b. Heat the mixture on a hotplate or in a microwave while stirring until a homogeneous solution is obtained (T= 423 K approx.).
c. Add glycerol as a plasticizer and acetic acid or citric acid to modify starch properties. Mix thoroughly.

2 **For CCR-Based Bioplastic:**

a. Mix the appropriate ratios of cornstarch, coconut coir, and rice starch in a bowl.
b. Gradually add water while stirring to create a slurry.
d. Heat the slurry and stir until it forms a consistent paste (T= 423 K approx.).
c. Add glycerol and acetic acid or citric acid, and continue mixing.

3. Film Casting and Drying:

a. Place a film-casting frame or mold onto a flat surface.
b. Pour the potato-based or CCR-based plastic solution into the mold, spreading it evenly.
c. Allow the films to air dry or place them in an oven at a controlled temperature until fully dried.
d. Carefully remove the dried films from the Mold.

4. DATA COLLECTION AND INTERPRETATION:

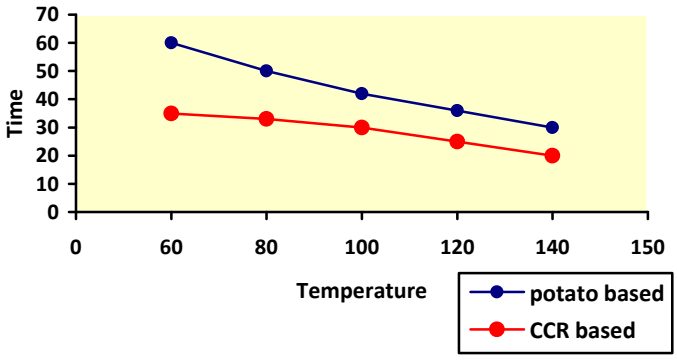
a. Record observations, measurements, and test results in research notebooks and data sheets.
b. Analyze and compare the properties, microstructure, mechanical strength, and thermal behavior of potato-based and CCR-based bioplastics.

5. Observation

Table 2: Physical observation

Parameter	Potato Film	CCR Film
Appearance	Transparent	Translucent
Thickness (mm)	0.03	0.04
Tensile Strength (MPa)	15	10
Biodegradation	Moderate	Slow
Water Resistance	Fair	Better
Flexibility	Good	Average
Cost	Moderate	Low
Source	Potato	CCR (Corn, Coconut, Rice)
Water Vapor Permeability	High	Low
Degradation Time Period	75 Days	60 Days

Graph 1: Temperature VS Time Graph



5. RESULT AND DISCUSSION

The comparative study aimed to analyze the properties of biodegradable plastic films produced from potato and corn coconut rice (CCR) starch. Both materials were processed into films using a casting method. The results indicated that the potato starch film exhibited better tensile strength and elongation properties compared to the CCR starch film. However, the CCR starch film demonstrated higher water resistance and lower water vapor permeability, suggesting its potential for moisture-sensitive applications.

In terms of biodegradability, both films displayed significant degradation over a 60-70 days period in simulated soil conditions. The CCR starch film exhibited slightly faster degradation, indicating its potential as an environmentally friendly alternative.

Overall, the study highlighted the suitability of both potato and CCR starch for producing biodegradable plastic films, each with distinct advantages. Potato starch offered better mechanical properties, while CCR starch exhibited enhanced water resistance and faster biodegradation. Further research could explore optimization techniques to enhance specific attributes for various applications in the sustainable packaging industry.

6. Conclusion

In conclusion, the comparative study between biodegradable plastic films derived from potato starch and CCR (Corn Coconut Rice) starch revealed several significant findings. Both materials demonstrated promising potential as environmentally friendly alternatives to traditional plastics.

The potato starch-based film exhibited commendable mechanical properties, displaying good tensile strength and flexibility. It also exhibited a rapid degradation rate under natural conditions, making it a suitable option for short-term applications. On the other hand, the CCR starch-based film demonstrated comparable mechanical strength, while also benefiting from the incorporation of coconut rice byproducts, which can contribute to waste reduction and sustainability.

In terms of biodegradability, both films exhibited promising results, breaking down into non-toxic components over time. The potato starch film showcased slightly faster degradation, potentially making it preferable for applications with minimal use duration.

However, it's essential to consider the scalability and cost-effectiveness of production. Potato starch availability could be influenced by food demand, while CCR starch may require further refinement processes. Moreover, factors such as water and energy consumption during production should also be considered for a comprehensive assessment.

In conclusion, both potato and CCR corn coconut rice starch-based biodegradable plastic films offer viable alternatives, each with its own set of advantages. Further research and development are necessary to optimize production processes, address scalability challenges, and explore diverse applications, ultimately contributing to a more sustainable future.

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