

# DESIGN AND DEVELOPMENT OF BIODEGRADABLE PACKAGING FOR WET WIPES-A REVIEW

MAMTHI K, GAYATHRIDEVI N, GOMINI P, B.TECH SCHOLARS

MS.POOJA P,

ASSISTANT PROFESSOR I,

DEPARTMENT OF FASHION TECHNOLOGY,

KUMARAGURU COLLEGE OF TECHNOLOGY,

COIMBATORE 641049.

Corresponding email: [pooja.p.ft@kct.ac.in](mailto:pooja.p.ft@kct.ac.in)

## Abstract

The increasing use of plastic-based packaging in wet wipes has raised serious environmental concerns due to non-biodegradability and accumulation of plastic waste. This study focuses on the design and development of biodegradable packaging materials as a sustainable alternative for wet wipes. Natural polymers and agro-waste-based materials such as cellulose, starch, and pectin were explored to develop eco-friendly packaging. The developed material was tested for strength, flexibility, moisture resistance, and biodegradability. The results indicate that biodegradable packaging can effectively replace conventional plastic packaging while maintaining required functional properties. This research contributes to sustainable product development and supports environmentally responsible packaging solutions.

## Keywords:

Biodegradable packaging, Wet wipes, Sustainable materials, Cellulose, Eco-friendly packaging, Agro waste, Circular economy

## 1. Introduction

Wet wipes are widely used in personal hygiene, medical, and household applications. However, most wet wipes packaging materials are made from plastic polymers such as polyethylene and polypropylene, which are non-biodegradable and harmful to the environment. With increasing environmental awareness, there is a growing demand for sustainable alternatives. Biodegradable packaging materials derived from natural sources such as plant fibers, starch, and agricultural waste offer a promising solution. This project aims to design and develop biodegradable packaging for wet wipes using eco-friendly materials while maintaining required durability and functionality.

## 2. Objectives

- To develop biodegradable packaging material for wet wipes
- To reduce plastic usage in packaging
- To utilize natural and sustainable raw materials
- To evaluate physical and functional properties of the developed material

### 3. Materials and Methodology

- 1.Existing Product
- 2.Analysis
- 3.Material Selection
- 4.Preparation of
- 5.Packaging Materials
- 6.Packaging Finishes
- 7.Performance Testing
- 8.Prototype
- 9.Development
- 10.User Testing and
- 11.Feedback

#### 3.1 Materials Used

- Natural cellulose fiber-agar agar
- Starch-based biopolymer
- Pectin (binding agent)
- Glycerine (plasticizer)
- Water



#### 3.2 Preparation of Biodegradable Film

- Raw materials were mixed in required proportions
- The mixture was heated to form a uniform solution
- The solution was cast into thin films
- Films were dried under controlled conditions
- Dried sheets were cut and shaped into packaging

### 3.3 Design Development

- Packaging structure designed for wet wipes usability
- Focus on flexibility, sealing ability, and durability
- Prototype packaging developed and tested

### 3.4 Characteristics of Agar-Agar

- Agar-agar is a natural polysaccharide obtained from red algae.
- It has excellent film-forming ability, making it suitable for biodegradable packaging.
- It shows good gel strength and forms a firm structure when cooled.
- Agar-agar is biodegradable and eco-friendly, reducing environmental impact.
- It has good water absorption capacity, but is slightly sensitive to moisture.
- It provides transparency and smooth texture in films.
- It is non-toxic and safe, suitable for food and hygiene applications.
- It has moderate mechanical strength, which can be improved by blending with other materials.

### 3.5 Characteristics of Glycerol

- Glycerol is a natural plasticizer commonly used in biodegradable films.
- It improves the flexibility and softness of the material.
- It reduces brittleness and prevents cracking of films.
- Glycerol enhances stretchability and elasticity of packaging material.
- It is water-soluble and helps in uniform mixing of components.
- It is non-toxic and safe, widely used in food and pharmaceutical products.
- It increases moisture retention, which may slightly reduce water resistance.
- It improves the overall handling and durability of biodegradable films.

## 4. Results and Discussion

The developed biodegradable packaging showed satisfactory performance in terms of flexibility and strength. Moisture resistance was moderate but acceptable for short-term wet wipe storage.

The biodegradability test confirmed that the material decomposed naturally within a specific period, unlike conventional plastic packaging.

The use of natural materials such as cellulose and starch improved environmental sustainability. However, improvements are required in water resistance and shelf-life for commercial applications.

## 5. Advantages

- Eco-friendly and biodegradable
- Reduces plastic pollution
- Made from renewable resources
- Supports sustainable packaging industry

## 6. Limitations

- Lower moisture resistance compared to plastic
- Limited durability for long-term storage
- Requires further improvement for large-scale production

## 7. Applications

- Wet wipes packaging
- Hygiene product packaging
- Medical disposable packaging
- Eco-friendly consumer goods packaging

## 8. Conclusion

This study demonstrates that biodegradable materials can be effectively used for wet wipes packaging. The developed packaging provides an eco-friendly alternative to conventional plastic packaging.

Although certain limitations exist, further research and material modifications can improve performance and enable large-scale adoption. This work supports the development of sustainable packaging solutions and contributes to environmental protection.

## 9. Future Scope

- Improvement in water resistance
- Use of advanced bio-coatings
- Large-scale production techniques
- Development of fully compostable packaging systems

## 10. References

1. Davis, G., & Song, J. (n.d.). Biodegradable packaging based on raw materials from crops and their impact on waste management. *Industrial Crops and Products*, 23(2), 147–161. <https://doi.org/10.1016/j.indcrop.2005.05.004>
2. Selvalakshmi, S., Vijaya, N., Selvasekarapandian, S., & Premalatha, M. (2017). Biopolymer agar-agar doped with NH<sub>4</sub>SCN as solid polymer electrolyte for electrochemical cell application. *Journal of Applied Polymer Science*, 134(15).  
<https://doi.org/10.1002/app.44702>
3. Liu, J., Wang, H., Wang, P., Guo, M., Jiang, S., Li, X., & Jiang, S. (2018). Films based on  $\kappa$ -carrageenan incorporated with curcumin for freshness monitoring. *Food Hydrocolloids*, 83, 134–142. <https://doi.org/10.1016/j.foodhyd.2018.05.012>
4. Gontard, N., Guilbert, S., & Cuq, J. (1993). Water and glycerol as plasticizers affect mechanical and water vapor barrier properties of an edible wheat gluten film. *Journal of Food Science*, 58(1), 206–211. <https://doi.org/10.1111/j.1365-2621.1993.tb03246.x>
5. Kale, G., Auras, R., & Singh, S. P. (2006). Degradation of Commercial Biodegradable Packages under Real Composting and Ambient Exposure Conditions. *Journal of Environmental Polymer Degradation*, 14(3), 317–334. <https://doi.org/10.1007/s10924-006-0015-6>
6. Hitchens, A. P., & Leikind, M. C. (1939). The Introduction of Agar-agar into Bacteriology. *Journal of Bacteriology*, 37(5), 485–493. <https://doi.org/10.1128/jb.37.5.485-493.1939>
7. Jost, V., Kobsik, K., Schmid, M., & Noller, K. (2014). Influence of plasticiser on the barrier, mechanical and grease resistance properties of alginate cast films. *Carbohydrate Polymers*, 110, 309–319. <https://doi.org/10.1016/j.carbpol.2014.03.096>
8. Chouhan, N. (2018). Silver nanoparticles: synthesis, characterization and applications. In *InTech eBooks*. <https://doi.org/10.5772/intechopen.75611>

9. Araki, C. (1956). Structure of the agarose constituent of agar-agar. *Bulletin of the Chemical Society of Japan*, 29(4), 543–544. <https://doi.org/10.1246/bcsj.29.543>
10. Jost, V., Kobsik, K., Schmid, M., & Noller, K. (2014). Influence of plasticiser on the barrier, mechanical and grease resistance properties of alginate cast films. *Carbohydrate Polymers*, 110, 309–319. <https://doi.org/10.1016/j.carbpol.2014.03.096>
11. De Ruiter, G. A., & Rudolph, B. (1997). Carrageenan biotechnology. *Trends in Food Science & Technology*, 8(12), 389–395. [https://doi.org/10.1016/s0924-2244\(97\)01091-1](https://doi.org/10.1016/s0924-2244(97)01091-1)
12. Kale, G., Auras, R., & Singh, S. P. (2006b). Degradation of Commercial Biodegradable Packages under Real Composting and Ambient Exposure Conditions. *Journal of Environmental Polymer Degradation*, 14(3), 317–334. <https://doi.org/10.1007/s10924-006-0015-6>
13. Liu, J., Wang, H., Wang, P., Guo, M., Jiang, S., Li, X., & Jiang, S. (2018b). Films based on  $\kappa$ -carrageenan incorporated with curcumin for freshness monitoring. *Food Hydrocolloids*, 83, 134–142. <https://doi.org/10.1016/j.foodhyd.2018.05.012>
14. Oksanen, J., Simpson, G. L., Blanchet, F. G., Kindt, R., Legendre, P., Minchin, P. R., O'Hara, R., Solymos, P., Stevens, M. H. H., Szoecs, E., Wagner, H., Barbour, M., Bedward, M., Bolker, B., Borcard, D., Carvalho, G., Chirico, M., De Caceres, M., Durand, S., . . . Weedon, J. (2001). *vegan: Community Ecology Package* [Dataset]. <https://doi.org/10.32614/cran.package.vegan>
15. Labuda, J., Barek, J., Gajdosechova, Z., Jacob, S., Johnston, L., Krystek, P., Mester, Z., Moreira, J., Svitkova, V., & Wilkinson, K. J. (2023). Analytical chemistry of engineered nanomaterials: Part 2. analysis in complex samples (IUPAC Technical Report). *Pure and Applied Chemistry*, 95(11), 1159–1196. <https://doi.org/10.1515/pac-2022-0401>

