A Research Article On Design And Development of Secondary Packaging Material From Bark of Fishtail Palm

Shital Kailash Raut[1], Prof Anand Gawai[2] Dr. Nandu Kayande[3]

1 Student of Bachelor of Pharmacy, Dr. R. N. Lahoti Institute of Pharmaceutical Education and Research Centre, Sultanpur Tq.Lonar, Dist.Buldhan , Pin Code- 443302.

2 Professor, Dr. R. N. Lahoti Institute of Pharmaceutical Education and Research Centre, Sultanpur Tq. Lonar, Dist. Buldhana, Pin Code- 443302.

3 Principal, Dr. R. N. Lahoti Institute of Pharmaceutical Education and Research Centre, Sultanpur Tq. Lonar, Dist. Buldhana, Pin Code- 443302

Abstract : The present study focuses on the design and development of eco-friendly pharmaceutical secondary packaging material using fishtail palm bark. Conventional packaging materials such as plastic and paper contribute significantly to environmental pollution. Hence, there is a need to develop biodegradable and sustainable alternatives. In this study, bark of fishtail palm was processed, powdered, and combined with natural binding agents like starch to prepare sheet-like packaging material. The prepared material was subjected to various evaluation tests including thickness, tensile strength, folding endurance, water absorption, and surface texture. The results indicated that the developed material possesses moderate mechanical strength, acceptable flexibility, and biodegradable nature. However, improvements in smoothness and water resistance are required. This study suggests that fishtail palm bark can be used as a potential raw material for sustainable pharmaceutical secondary packaging.

Keywords: Biodegradable packaging material, eco-friendly, fishtail palm bark.

1. Introduction: Packaging is an important component in the development of various drug formulation in pharmaceutical industry. Pharmaceutical packaging plays an important role in protecting drug products from environmental factors such as moisture, light, and contamination . Secondary packaging is mainly used for transportation, storage, and labelling purposes.

Conventional packaging materials such as plastics and paperboard are widely used but are non-biodegradable and cause environmental pollution.Due to this, there is increasing interest in biodegradable materials derived from natural sources.

2. Plant profile :

- **Synonyms:** caryota urens
- **Common name:** fishtail palm, toddy palm ,jaggery palm.

Image No.1 Fishtail palm

- **Phytochemical constituent:** The plant contains a variety of bioactive compounds:

1. Sap (Toddy / Kithul syrup)

- Sugars (mainly sucrose, glucose, fructose)
- Fermentable carbohydrates
- Minor vitamins and minerals

2. Leaves & Fibers

- Cellulose
- Hemicellulose
- Lignin

3. General Phytochemicals

- Phenolic compounds
- Flavonoids
- Tannins (in small amounts) 4.fruit

The fruit pulp contain calcium oxalate crystals, which can cause irritation and itching.

3. Aim And Objectives:

Aim: To design and development of secondary packaging material from the fishtail palm bark.

Objective-

- To develop eco-friendly secondary packaging material from plant bark as an alternative to synthetic packaging materials.
- To utilize natural and renewable resources such as bark fibers for sustainable packaging applications.
- To prepare sheet-form packaging material using plant bark powder and natural binders like starch.
- To evaluate physical properties such as thickness, weight and surface texture of the prepared material.
- To study water absorption behavior of the developed packaging material.
- To promote biodegradable and environmentally safe packaging solution to reduce plastic waste.

4 Material And Method:

4.1Materials

- Fishtail palm bark powder.
- Starch
- Distilled water
- Sodium hydroxide

4.1.1 Role of starch used as a binding agent-

Starch is commonly used as a binding agent in the preparation of packaging materials from plant fibers such as fishtail palm bark due to following reasons-

1. Natural and Biodegradable ;- Starch is a plant-based material that is completely biodegradable and environmentally friendly. It decomposes naturally without causing pollution.

2. Good Binding Property;- Starch has excellent adhesive characteristics. When mixed with water and heated, it forms a paste that effectively binds fibers together, improving the structural integrity of the material.

3. Improves Strength;- It increases the mechanical strength of the packaging material by holding fibers tightly, resulting in better durability and load-bearing capacity.

4. Easily Available and Low Cost ;- Starch is widely available from sources like corn, potato, and rice, making it an economical choice for large-scale applications.

5. Non-toxic and Safe;- Starch is non-toxic and safe to handle, making it suitable even for food- related packaging applications.

6. Compatible with Natural Fibers;- Since both starch and plant fibers are natural materials, they have good compatibility, leading to uniform mixing and better bonding.

7. Improves Moulding Process;- Starch helps in shaping the material easily during moulding by providing proper consistency to the pulp mixture.

8. Renewable Resource;- It is obtained from renewable plant sources, supporting sustainable development.

9. Enhances Surface Finish;- Starch improves the smoothness and finish of the final product, making it more suitable for packaging.

10. Alternative to Synthetic Binders

11. It replaces harmful synthetic adhesives, reducing environmental impact.

4.1.2 Why fishtail palm bark is used for preparing secondary packaging material

The bark of Fishtail Palm is used for developing secondary packaging materials due to its unique natural properties and sustainability advantages.

1. High Fiber Content

Fishtail palm bark contains a high amount of natural fibers (cellulose and lignin), which provide strength, flexibility, and structural support to the material.

2. Biodegradable Nature

The bark is completely natural and biodegradable, making it an environmentally friendly alternative to plastic and thermocol packaging.

3. Good Mechanical Strength

Fibers from the bark have good tensile strength and durability, which helps in making strong and protective packaging materials.

4. Lightweight Material

The bark-based material is light in weight, which is important for reducing transportation costs and improving handling.

5. Easily Available

Fishtail palm trees are widely available in tropical regions, especially in India, making the raw material easy to source.

6. Utilization of Agricultural Waste

The bark is often considered waste material. Using it for packaging helps in waste management and adds economic value.

7. Eco-friendly and Sustainable

It is a renewable resource and supports sustainable development by reducing dependency on non-renewable materials.

8. Easy Processing

The bark can be easily processed into fibers and pulp, which can then be moulded into different packaging shapes.

9. Cost-effective

Since it is a natural and locally available material, the overall production cost is low compared to synthetic materials.

10. Compatibility with Natural Binders

It works well with binders like starch, improving bonding and final product quality

4.2Method Preparation of bark powder : 1] collection and preparation of raw material ;- Fishtail palm bark was collected and washed thoroughly with water to remove dust and impurities. The cleaned bark was sun-dried for 2-3 days to remove moisture and then cut small piece for further processing.

Image No.2 Bark of fishtail palm

2] Size Reducing [powder preparation];- The dried bark pieces were ground using a grinder to obtain fine powder. The powder was sieved to ensure uniform particle size Uniform particle size improves fiber distribution and sheet formation.

Image No.3 bark powder

Procedure:-

1] Take a 10g of bark powder measure it accurately. 2]chemical treatment procedure;

Prepare a 5% NaOH (sodium hydroxide) solution.Soak the bark powder in the solution for 2–3 hours .Wash the material with distilled water until neutral pH is obtained .Dry the treated material.

Purpose: To remove lignin and improve fiber bonding. 3] preparation of starch binder solution ;

Starch (10 g) was dissolved in 100 ml water and heated with continuous stirring until a gel- like solution was formed. Starch acts as a natural binder and improves mechanical strength.

4] preparation of pulp formation ;

The treated bark powder was mixed with the starch solution to form a uniform paste. The mixture was stirred continuously to ensure proper mixing Homogeneous mixing ensures uniform sheet structure.

5] Sheet Formation (Casting Method)

The prepared paste was spread uniformly on a flat surface or mould lined with plastic sheet or butter paper. The thickness of the layer was controlled manually.Uniform spreading ensures consistent thickness.

6] The cast sheet was dried at room temperature for 24–48 hours or in a hot air oven at 50– 60°C until complete drying. Proper drying prevents cracks and improves strength [4]

7] pressing; The semi-dried sheet was pressed using a flat plate to improve surface smoothness and compactness. Pressing enhances surface finish and density [7]

8] Cutting and Finishing

The dried sheet was carefully removed and cut into required dimensions. Edges were trimmed for uniformity.

5.Evaluation test:- 1]Visual appaeance:-

The material show dark colour .surface appears slightly uneven with some spot. .material has a non-uniform appearance with visible patches.

2] surface texture test:-

Cheaked by touch and visual infection. The material has a rough surface texture.

3] Water absorption test :- Few drop of water were placed on the surface. The material show moderate water absorption capacity. water absorption test is pass.

Image No.4 water absorption test

4] folding endurance:-

The material can be folded without breaking.it does not break on normal folding. It break only when extra pressure is applied. folding endurance test is pass.

Image No.5 folding test

5] Tensile test:-

The material was held from both end.it was pulled slowly in opposite direction .The force required to break it was observed.

The given sample shows moderate tensile strength.it does not break under the normal force is applied . The strength ability is limited.

Results and Discussion:

The developed material showed dark brown colour due to the presence of natural components such as lignin in bark.The surface was slightly rough due to uneven fiber distribution.

The thickness of the material was found to be nearly uniform with minor variations. The tensile strength was moderate, indicating the ability of the material to withstand normal handling conditions. Folding endurance was satisfactory as the material did not break under normal folding conditions.

Water absorption was moderate to high due to hydrophilic nature of plant fibers. The material exhibited moderate weight and density, making it suitable for handling and packaging purposes.

Conclusion:-

The developed material from fishtail palm bark shows potential as a biodegradable pharmaceutical secondary packaging material. It possesses moderate strength and flexibility, but requires improvement in water resistance and surface smoothness for better performance.

References

1] Aulton, M.E., Taylor, K. (2018). Aulton's Pharmaceutics: The Design and Manufacture of Medicines. Elsevier.

2] Marsh, K., Bugusu, B. (2007). Food packaging—roles, materials, and environmental issues. Journal of Food Science, 72(3), R39–R55.

3] Siracusa, V., Rocculi, P., Romani, S., Rosa, M.D. (2008). Biodegradable polymers for food packaging. Trends in Food Science & Technology, 19(12), 634–643.

4] Khalil, H.P.S.A., Bhat, A.H., Yusra, A.F.I. (2012). Green composites from sustainable cellulose fibers. Carbohydrate Polymers, 87(2), 963–979.

5] Rhim, J.W., Park, H.M., Ha, C.S. (2013). Bio-nanocomposites for packaging applications. Progress in Polymer Science, 38(10–11), 1629–1652.

6] Tharanathan, R.N. (2003). Biodegradable films and composite coatings. Trends in Food Science & Technology, 14(3), 71–78.

7] ASTM D570 – Standard Test Method for Water Absorption.

8] Robertson, G.L. (2012). Pharmaceutical Packaging. CRC Press. 9] Study on oil palm fiber packaging paper – ScienceDirect

10] Green delignification of palm fibers – Bioresource Technology □ 11] Sustainable paper production from palm fibers – Nature/Elsevier □ 12] Fishtail palm fiber characterization – PMC □

13] Natural fiber packaging materials review – ScienceDirect