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Bio-degradable pads using materials such as banana fiber: An overview

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Abstract:

The increasing environmental apprehensions linked to disposable sanitary pads have prompted the investigation of sustainable alternatives. Derived from the stems of banana plants, banana fiber is a natural and biodegradable material that shows great potential for manufacturing environmentally friendly sanitary pads. This article explores the application of banana fiber in the production of biodegradable pads, emphasizing its benefits and discussing possible obstacles.

Benefits of utilizing sanitary pads made from banana fiber:

1. Environmental Sustainability: Banana fiber is a replenishable and decomposable material, providing a notable ecological benefit compared to traditional plastic-based pads.
2. Comfort and breathability are guaranteed during menstruation due to the soft and absorbent characteristics of banana fiber.
3. Antibacterial qualities: Research indicates that banana fiber exhibits antibacterial qualities, which may help decrease the likelihood of illnesses.
4. Economic Feasibility: Banana fiber is abundantly accessible and comparatively affordable, rendering it a financially efficient substitute for the production of sanitary pads.

Obstacles and possible resolutions:

1. Water Absorption Potential: The water retention capacity of banana fiber may require improvement in order to equal the absorbency level of traditional pads.
2. Production Optimization: Additional investigation and advancement are necessary to enhance the production procedure of banana fiber sanitary pads to guarantee consistent quality and performance.

3. Enhancing consumer awareness on the advantages of sanitary pads made from banana fiber is imperative to promote their broader acceptance and usage.

To summarize, the utilization of banana fiber presents a viable remedy for manufacturing eco-friendly sanitary pads, effectively tackling the environmental issues linked to traditional disposable pads. Through ongoing research and development aimed at enhancing performance and increasing consumer awareness, banana fiber sanitary pads possess the capacity to transform menstrual hygiene practices.

Keywords:

Biodegradable Pads, Banana Fiber, Sustainable Alternative, Menstrual Hygiene, Eco-Friendly, Renewable Material, Antibacterial Properties, Economic Viability, Water Retention Capacity, Production Optimization, Consumer Awareness, Adoption.

1. Introduction:

Disposable sanitary pads have become an essential component of a woman's lives in the field of feminine hygiene. However, the ecological consequences of these traditional pads have led to noteworthy conclusions. Conventional sanitary pads, which are mainly made of non-biodegradable plastic materials, exacerbate the problems of overflowing landfills and endangered marine habitats.

In the pursuit of environmentally sustainable options, scientists and inventors have shifted their focus towards utilizing natural, decomposable substances. Among these options, banana fiber has emerged as a potential choice for manufacturing environmentally friendly sanitary pads. Banana fiber, extracted from the stems of banana plants, presents numerous benefits, making it a practical option for tackling the environmental issues associated with disposable pads.

Banana fiber, obtained from the stems of banana plants, has emerged as a highly promising substance for the production of biodegradable sanitary pads. It possesses numerous benefits that render it suitable for this particular application.

a. Biodegradability: Banana fiber is an inherently biodegradable substance that decomposes gradually without causing any harm to the environment.

b. Absorbency: Banana fibers exhibit exceptional absorbent characteristics and efficiently soak menstrual fluid.

c. Comfort: Banana fiber possesses a supple texture, sleek surface, and excellent breathability, guaranteeing a comfortable experience and averting any potential irritation during usage.

d. Antibacterial qualities: Research indicates that banana fibers exhibit antibacterial qualities, which could potentially mitigate the likelihood of illnesses.

e. Economic Viability: Banana fiber is abundant and affordable, making it a cost-efficient substitute for producing sanitary pads. As shown in the Table1.

Singh, An et.al in his report examines the current status of research on biodegradable sanitary napkins. The authors explored various categories of biodegradable materials suitable for manufacturing sanitary napkins while also addressing the accompanying obstacles and prospects linked to this technology [1].

Kumar, An et.al this study examines the positive impacts of the utilization of environmentally friendly sanitary pads on the environment and human health. The authors also analyze the

various categories of environmentally sustainable sanitary pads that are now accessible, along with the difficulties and prospects linked to this market [2].

Table. 1: Shows various types of Fibers

Sl. No.	Types of Fibers Used for Pads	Advantages	Disadvantages	Methods of Production	References	Scope for Future Work
1	Bamboo Fiber	Soft, absorbent, breathable, hypoallergenic, Odor-resistant, renewable	Relatively expensive, may require additional processing	Mechanical and chemical processing to extract and refine bamboo fibers	Singh, A., & Sharma, S. (2022). Biodegradable sanitary napkins—A review. International Journal of Research and Review, 9(1), 1-12.	Improve cost-effectiveness and optimize processing methods to enhance absorbency and durability
2	Cotton Fiber	Soft, comfortable, breathable, absorbent, relatively inexpensive	Conventional cotton cultivation has environmental concerns	Mechanical processing to extract and refine cotton fibers	Kumar, A., & Katiyar, V. (2022). Eco-friendly sanitary pads: A boon for women's health and environmental sustainability. Journal of	Promote organic cotton cultivation and explore sustainable processing techniques to minimize environmental impact

					Environmental Research and Development, 16(4), 183-192.	
3	Corn Starch	Biodegradable, renewable, absorbent, inexpensive	May not provide sufficient absorbency on its own, requires additional components for pad structure	Starch extraction from corn kernels, incorporation into pad design	Jain, N., & Jain, N. (2021). Biodegradable sanitary napkins: A sustainable alternative to conventional pads. Journal of Cleaner Production, 281, 147069.	Enhance absorbency properties and develop innovative pad designs using corn starch as a primary component
4	Banana Fiber	Biodegradable, absorbent, comfortable, potentially antibacterial, economically viable	May require additional processing to improve absorbency and durability	Mechanical processing to extract and refine banana fibers	Singh, A., & Sharma, S. (2022). Biodegradable sanitary napkins—A review. International Journal of Research and Review, 9(1), 1-12.	Enhance processing techniques to optimize absorbency and durability, explore antibacterial properties and potential health benefits

Jain, N This study examined the advantages of utilizing biodegradable sanitary napkins in terms of sustainability. The authors also examine the many categories of biodegradable sanitary napkins that are already accessible, along with the difficulties and prospects linked to this sector [3].

This article explores the application of banana fiber in the production of biodegradable pads, emphasizing its benefits and discussing possible obstacles. We will examine the distinctive characteristics of banana fiber, its appropriateness for manufacturing sanitary pads, and its potential influence on menstrual hygiene practices [1-7].

2. Materials and methods:

The production of biodegradable sanitary pads utilizing banana fiber entails a series of procedures, including the extraction of fibers, their subsequent processing, and pad construction. As shown in Fig. 1.

2.1. Required materials:

1. Stems of bananas
2. Aqueous solution of sodium hydroxide (NaOH)
3. H_2O Oxidizing agent (if desired)
4. Biodegradable adhesives
5. Materials that can break down naturally over time without causing harm to the environment are used to create barriers.
6. Sanitary pad molds or templates

2.2. Fiber extraction:

a. Slice bananas stem into small segments.

b. Segments of banana stem were submerged in a solution of NaOH (approximately 5% concentration) for 24 h.

c. Fragments of banana stems were eliminated and thoroughly rinsed with water to eliminate NaOH.

d. Banana fibers are extracted from residual stem material by mechanical procedures, such as pounding or manipulation.

e. The fibers were then rinsed with water to eliminate contaminants. Shown in Table. 2.

Table. 2: Shows the types of extraction of Fibers

Feature	**Mechanical Extraction**	**Chemical Extraction**
Efficiency	Less efficient	More efficient
Environmental impact	More environmentally friendly	Less environmentally friendly

2.3. Fiber processing:

f. If required, bleaching techniques are employed on the extracted banana fibers to attain the desired level of whiteness.

g. Ensure that the banana fibers are completely dried.

1. Card the dehydrated banana fibers to arrange and untangle them.

2. Pad Fabrication: a. Gathering the necessary biodegradable barrier materials such as bioplastics or compostable films.

h. Construct pad construction using molds or templates.

i. Arrange banana fibers on the pristine surface.

j. Use adhesives to attach banana fibers and biodegradable barrier materials.

k. The layers of the pad were arranged in the desired order, ensuring correct positioning of the absorbent core made of banana fiber and protective barrier layers.

l. Pressure was applied to the combined layers of the pad to create a unified solid structure.

m. The edges of the pads were trimmed to achieve the desired shape and size.

n. Allow the adhesive to completely cure and securely attach the layers of the pad.

2.4. Quality control:

a. Examine the pads for any flaws or variations in material composition or adhesion.

b. Evaluate the absorbency of the pads using defined methodologies.

a. Assess the level of comfort and breathability provided by the pads.

2.5. Packaging:

c. Encase biodegradable sanitary pads with environmentally friendly materials, such as biodegradable packaging or recycled materials.

a. Attach product information to the packaging and clearly indicate the composition, absorbency, and instructions for disposal.

Figure. 1: Shows the banana pads from banana fibers

3. Characteristics of banana fibres:

Banana fibers provide sustainable and adaptable properties that render them appropriate for a variety of applications such as the manufacture of biodegradable sanitary pads. Below is a summary of the primary attributes of banana fibers.

1. Biodegradability: Banana fibers possess inherent biodegradability and undergo natural decomposition over a period of time without causing any harm to the environment. This environmentally conscious establishment caters to the increasing need for sustainable materials, and mitigates the ecological consequences of waste management.

2. Absorbency: Banana fibers possess exceptional absorbent characteristics and efficiently soak fluids and liquids. For sanitary pad applications, absorbency is a vital attribute that significantly affects both comfort and performance.

3. Comfort and Breathability: Banana fibers are renowned for their plushness, sleekness, and ability to allow air circulation. These characteristics enhance the comfort of sanitary pads, thereby minimizing irritation and discomfort when using them.

4. Tensile Strength: Although banana fibers may not be as robust as certain synthetic fibers, they do contain sufficient tensile strength for use in sanitary pads. The pads could endure the required forces and deformations without compromising their structural integrity.

5. Antibacterial qualities: Research indicates that banana fibers possess antibacterial qualities that could potentially mitigate the likelihood of illnesses linked to the utilization of sanitary pads.

6. Economic Viability: Banana fibers are a cost-efficient option compared to standard synthetic fibers commonly utilized in sanitary pads, therefore providing a financially advantageous choice.

7. Banana fibers are obtained from the stems of banana plants, which are renewable resources. The cultivation of banana plants for fiber production does not require large amounts of land or water resources. This is consistent with the principles of sustainability and minimizes the environmental consequences of acquiring materials.

8. Banana fibers are lightweight and flexible, which enhances the overall comfort and flexibility of sanitary pads. They facilitate effortless mobility and conform to natural curves of the body.

9. Odor Resistance: Banana fibers have inherent odor-resistant properties, thereby reducing the occurrence of unpleasant odors commonly linked with the utilization of sanitary pads.

In summary, banana fibers possess a range of advantageous attributes such as biodegradability, absorbency, comfort, breathability, tensile strength, potential antibacterial qualities, economic viability, renewability, lightweight nature, flexibility, and odor resistance. These characteristics render them viable for the manufacture of environmentally friendly sanitary pads and for other sustainable uses [1-7]. The table. 3 and 4 shows the characteristics of natural fibers and mechanical properties.

Table. 3 Characteristics of natural fibers at the molecular level

Fibre	**Cellulose (%)**	**Hemicellulose (%)**	**Lignin (%)**	**Pectin (%)**	**Ash (%)**	**Reference**
Banana pseudo-stem	60-85	6-8	5-10	2.5-4	7-21	(Jayaprabha et al. 2011)
Coir	36-43	0.15-0.25	41-45	4	2.7-10.2	(Yan et al. 2016)
Cotton	83-95	4	0.75	6	0.6	(Yan et al. 2016)
Bamboo	34.5	20.5	26	-	-	(Yan et al. 2016)

Sisal	66-78	10-13	8-10	12	1	(Simbana et al. 2020)
Pineapple leaf fibre	81	18	12.7	-	3.6-7.0	(Faruk et al. 2012)

Table. 4 Characteristics of natural fibers in terms of their mechanical properties.

Fibre	**Tensile strength (MPa)**	**Flexural strength (GPa)**	**Elongation (%)**	**Reference**
Banana pseudo-stem	529-914	27-32	3	(Ramesh et al. 2017)
Coir	175	4-6	30	(Ramesh et al. 2017)
Cotton	287-800	5.5-12.6	7-8	(Ramesh et al. 2017)
Bamboo	140-230	11-17	-	(Faruk et al. 2012)
Sisal	400-700	9-38	3-7	(Simbana et al. 2020)
Pineapple leaf fibre	400-627	1.44	14.5	(Faruk et al. 2012)

4. Applications:

1. Absorbent core material: Banana fibers can serve as an effective absorbent core material in sanitary pads, efficiently soaking menstrual fluid while ensuring comfort and optimal performance.
2. Biodegradable barrier layer: The utilization of banana fibers in biodegradable barrier layers can serve as a substitute for conventional plastic-based materials, resulting in decreased environmental harm.
3. Composite materials for sanitary pads can be formed by combining banana fibers with other biodegradable materials, such as bioplastics or starch-based compounds [1-7].

5. Scope for future work:

Although banana fibers have demonstrated remarkable potential in the production of biodegradable sanitary pads, additional research and development are necessary to improve their performance and broaden their range of use.

1. Enhancing fiber extraction and processing procedures to optimize fiber quality and improve absorbency quality.
2. Investigating antibacterial characteristics: Examining the potential antibacterial properties of banana fibers and their efficacy in reducing the likelihood of infections.
3. Creating novel pad designs: Integrating banana fibers into inventive pad designs that enhance comfort, absorbency, and leak resistance.
4. The long-term biodegradability and environmental consequences of sanitary pads made from banana fibers were evaluated through comprehensive investigations.
5. Advancing consumer consciousness and acceptance: Enhancing consumer knowledge of the advantages of sanitary pads made from banana fiber and promoting their broader utilization [1-7].

6. Conclusions:

Utilizing banana fibers as a substitute for traditional materials in sanitary pads is a highly favourable option, offering a more sustainable and environmentally friendly choice for managing menstruation hygiene. Their capacity to decompose naturally, ability to soak up liquids, level of comfort, and ability to inhibit the growth of bacteria make them valuable materials for this specific use. Through ongoing research and advancement, the utilization of banana fiber in sanitary pads holds the promise of transforming menstrual hygiene practices by diminishing environmental consequences and offering women all over the globe both comfort and protection.

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