

## Review on Plant Fibers used for Making Sanitary Napkins

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### ABSTRACT

*This abstract investigates the incorporation of natural fibers into composite materials and their impact on various industries. It discusses the rising demand for sustainable and environmentally friendly solutions, driving interest in natural fiber composites as alternatives to traditional synthetic reinforcements. The abstract explores the mechanical properties, thermal stability, and biodegradability of these composites, showcasing their potential in applications such as automotive, construction, and consumer goods. It explores the utilization of natural fibers in the production of sanitary pads. It discusses the growing awareness of eco-friendly and sustainable alternatives to conventional napkins, highlighting the benefits of using natural fibers like banana tree, Papaya tree, jute, cotton, flax, etc. It delves into the absorbent properties, comfort, and biodegradability of these fibers, emphasizing their potential to address environmental concerns and promote women's health. Additionally, it touches on challenges and considerations in manufacturing and market adoption of such pads. The results showed that the napkins are environmentally friendly and have no negative impact on the women in the town.*

**Keywords:** *Natural fibers, hygienic materials, biodegradable, Bio absorbent agents, Composite technology.*

### INTRODUCTION

Today, everyone is focused on eliminating environmental issues and nature degradation in order to create an eco-friendly environment, to maintain good health and hygiene. The textile, dye, and healthcare industries produce the most airborne pollutants<sup>[1]</sup>. Also, the production and elimination of sanitary napkin products is one significant issue. The napkins made by these businesses are hazardous for women and not biodegradable. Every woman's wellbeing and way of life should be bettered through the use of sanitary napkins in addition to

offering a secure and comfortable manner. These napkins have been placed next to the softest, most sensitive tissue in the human body by women. Not less than 20% of the life of a female is spent using sanitary napkin. India is a developing country with a population of 1.34 billion, of which 323.6 million are female that exists between the ages of 15 and 49<sup>[2]</sup>.

Papyrus, moss, grass, and cloths were once commonly used during monthly periods, and these materials may lead to discomfort and inflammation. Skin rashes, allergic reactions, and other factors that cause

severe illnesses due to the presence of microbial organisms. Companies additionally incorporate chemicals in the fragrant napkins that may make difficult issues for ladies wearing them in addition to the infants while they are still foetuses in case of pregnant women. Here, we present biodegradable sanitary napkins as a solution to these is use by using various natural resources for making of sanitary napkins. The aim of the current project is to create sanitary napkins using banana tree fibre, Papaya tree fibres, jute fibers, cotton, flax, etc.

This are the naturally absorbent fibre& impart antimicrobial properties<sup>[3]</sup>. To improve women's health condition during the menstrual cycle, good menstrual hygiene practises must be adhered to sanitary napkins must meet a number of functional characteristics in order to be effective, including the ability to absorb and hold blood without leaking, as well as to be comfortable and wick away moisture<sup>[4]</sup>.

Only 12% of Indian women use sanitary napkins, with the remaining 88% preferring unclean linen or rugs, and other items, according to an AC Nielsen analysis titled "Sanitary Protection: Every Woman's Health Right." RTIs (reproductive tract infections) are 70% particularly common in women who follow unsanitary habits during their menstrual cycle<sup>[5]</sup>.

Menstrual waste production is on the rise, and it is difficult to remove this trash anywhere in the world. If not removed, menstrual waste build up will negatively impact the land, seas, and human wellbeing. Single women produce 150 kilogrammes of non-biodegradable waste annually.

In India, 113,000 tonnes of menstrual waste are generated annually, adding to the country's overall waste load <sup>[6]</sup>. We don't care about our health in our everyday busy lives. The finest example is a health problem caused by using unapproved medicine, and now we're hearing about a problem caused by using sanitary napkins. It contains inorganic substance and hazardous chemical substance. It can cause cervical and vaginal cancer.

After hearing that, I became very nervous. Because we are aware that our family members use the same type of common sanitary pads. Then, I thought to make pads out of natural resources; therefore I chose the Banana tree, papaya tree, jute fibers, cotton, flax, wool, etc. It naturally contains fibre and is edible to absorb and retain water. In the early years, menstruation bleeding is traditionally managed by using old garments, paper, cotton, wool pieces, and even leaves, all of which have inconsistent levels of absorbency.

This type of inconsistent absorbent materials feels uncomfortable. It keeps girls away from attending schools. Naturally made sanitary pads from plant fibers which is the comfortable product can reduce fears of soiling outer clothes & also allowing better school attendance<sup>[7]</sup>.

Women with low and middle income budget have struggle with maintaining good menstrual hygiene. Poor menstrual hygiene can make yourself more at risk for urinary and reproductive tract infections, which can lead to infertility and other reproductive organ problems<sup>[8-9]</sup>. The naturally made sanitary pads may solve this problem.

Plant fibres are bio based fibres that have become more and more popular because of their many benefits, including being

biodegradable, ecological friendliness, and natural abundance. Plant fibres are primarily categorised according to their shape, source, structure, and functions<sup>[10-11]</sup>.

Combined with lignin, pectin, oil, wax, cellulose and hemicelluloses compose the majority of plant fibres<sup>[12]</sup>. Cellulose, a linear polymer of D-glucopyranose units

connected by 1,4-glycosidic linkages, is the primary constituent of plant fibres<sup>[13]</sup>.

## NATURAL FIBRES

### Banana Tree

#### Biological source

Obtained from plant namely musaparadisiaca & musacavendish belonging to family musaceae.



*Fig. 1: Banana fibre extraction.*

Banana fibre originates from banana plant pseudostems. The extraction procedure entails removing the pseudostem's outer layers and then separating the fibres using various mechanical and chemical methods. Banana fibres can be combined with other natural or synthetic fibres to create unique fabrics with enhanced qualities. This blending can improve the final product's strength, durability, and comfort. Banana fibres have inherent properties like weather resistance, retention of moisture, antioxidant, ultraviolet (UV) defence, and biodegradability<sup>[14]</sup>.

Banana fibre pads are one of the environmentally friendly raw materials that may be utilised to make feminine hygiene pads because of their unique properties<sup>[15]</sup>. While the quantity of CO<sub>2</sub> released from a BFP is predicted to be below 0.01 kg CO<sub>2</sub>, the amount of CO<sub>2</sub> released from a single discarded sanitary pad is roughly 0.041 kg CO<sub>2</sub><sup>[16]</sup>.

The pH of sanitary pads is one of the key factors. Banana fibre pads are harmless for

women because their pH is discovered to be within a level of 6-8.5, which is ideal. Within this range, microbial development is not seen<sup>[17]</sup>. They are regarded as an ecologically conscious fibre and don't harm women or the ecosystem<sup>[18-19]</sup>.

SHE (Sustainable Health Enterprises) is an organisation that is non-profit that produces sanitary pads made of banana fibre that are affordably priced, high-quality, and environmentally friendly for girls and women in developing nations<sup>[20]</sup>. An association called "Saathi" makes reasonable, harmless to the ecosystem banana cushions for rustic ladies. These banana cushions corrupt totally in something like a year and are 100% biodegradable<sup>[21-22]</sup>.

### Uses

Banana fibres are an ideal raw material for natural bio absorbent agents, bioremediation agents for water purification, tea bags, and handicrafts, as well as for mushroom cultivation, quality paper cards, and fabric material due to

their exquisite and incredibly adaptable character. Banana fibre is also used to make drilling cables, currency paper, and packing material for agricultural items.

They can be found in many different things, including floor mats, wall hangings, baskets, and home furniture. The main applications for banana pseudostem fibre are the production of specialised and

superior sanitary goods like newborn diapers, fabrics, and papers like currency notes.

### **Papaya Tree**

#### **Biological source**

It is cultivated fruiting tree known as *Carica Papaya*, belonging to family *caricaceae*.



*Fig. 2: Papaya tree fibres.*

Papaya fibres, commonly known as “papain fibres,” are derived from the papaya tree’s stem. Plant stands may become multi-stemmed when damaged, but it typically develops as a single stemmed tree with a crown of enormous palmate leaves rising from the top of the trunk<sup>[23]</sup>. Papaya trees, which are edible and naturally contain fibre, can be used to store and absorb water. Because papaya fibers have natural absorbent characteristics, they can be used in sanitary pads to manage menstrual flow. Every element of a tree is made of white latex. Because of its widespread availability, papaya tree fibre can be easily used to make pads. For extract papaya fibres, the leaves must be stripped to expose the fibres within. The fibres are then separated, cleaned, and further processed as needed. Papaya fibres, like other plant fibres, can be combined with other fibres to create fabrics with improved properties such as increased strength, flexibility, and comfort.

#### **Uses**

Papaya fibers are used widely in folk medicine for many ailments; the juice for warts, corn, cancer, tumors, thickened skin. The roots or their concentrates for tumors of the uterus, syphilis, the tropical contamination, hemorrhoids, and to eliminate mineral concretions in the urine. The unripe fruit to induce breastfeeding, labour, or abortion and as a mild laxative or diuretic. Ripe fruit is used to treat rheumatism and to alkalize the urine. The seeds that cause menstruation, abortion, or intestinal worms. The leaves can be smoked to treat asthma or used as a treatment for nerve aches and elephantoid growths<sup>[24]</sup>.

### **Jute Fibers**

#### **Biological source**

It comprises of phloem fibers of stem of numerous species of *Corchorusolitorius*, *Corchoruscapsularis*, belonging to family *Tiliaceae*.



**Fig. 3:** *Jute fibers.*

Because of its silky and lustrous texture, jute is one of the most adaptable, inexpensive, and long-lasting fibres that can be spun into long, strong, and coarse threads<sup>[25-26]</sup>. Jute fibres, often known as “golden fibre,” have a silky sheen, are 1 to 4 metres long, and are glossy and golden brown in colour<sup>[27]</sup>. Jute is resistant to microbes and acts as a barrier due to the presence of lignin. Jute fibres are 100% biodegradable, recyclable<sup>[28]</sup>. Tossa and white jute are two types of jute species from which jute fibre, a bast fibre, is derived. It has excellent properties and a safe composition. Jute materials have excellent moisture retention qualities and are lightweight to transport<sup>[29]</sup>. Jute is the least expensive, breathable, environmentally friendly, and skin-friendly fibre. Fabrics made of jute biodegrade, break down naturally, and neutralise carbon dioxide. They are easily recyclable and regarded as an eco-friendly fibre that can be used in feminine hygiene products like sanitary pads. IIT Kharagpur students

have created a sanitary pad made of jute to replace cotton. Jute has a high percentage of cellulose nearly 65% and a strong capacity to absorb water. Using these qualities, jute can be used to create sanitary pads<sup>[30-31]</sup>.

#### **Uses**

They can be used in a variety of items, including paints, beauty products, and medicinal products. Jute fibre is typically used in a sack, packaging material, carpet backing, food processing, curtains, furnishing cloths, & geotextiles. Hessian or gunny cloth is made from the plant's harvested jute fibre. You may turn burlap into powerful threads.

#### **Cotton**

##### **Biological source**

Cotton consists of epidermal trichomes or hairs of seeds of cultivated species of *Gossypium* *hirsutum*, *Gossypium* *barbadense*. Belonging to family Malvaceae.



**Fig. 4:** *Cotton.*

Cotton is a fibre of natural origin that is surrounded by filaments and known as a cotton ball. Cotton and cotton balls can have up to 5 lakh cotton fibres. It contains completely cellulose & 6-7% moisture<sup>[32-33]</sup>. Cotton fibre plants require 100 cm of rainfall and a temperature of 25°C. A warm temperature and black soil are required for cotton cultivation<sup>[34-35]</sup>. Cotton plants typically grow to a height of 1-2 metres. Cotton is typically farmed in India from March to November<sup>[36]</sup>. Cotton fibre is categorised as per its length, strength, fibre length uniformity as well as fibre fineness, fibre hues, junk, leaf level, extraneous components, module averaging, and so on<sup>[37-38]</sup>. Almost all cotton production is white, Cotton fibre loses its luminescence and turns pale yellow due to constant exposure to sunlight and inadequate environmental circumstances<sup>[39]</sup>. The following are some environmentally produced cotton species: *Gossypium hirsutum*, *Barbadense* plant, *Gossypium arboretum*, *Gossypium herbaceum*<sup>[40-41]</sup>. Because of the above characteristics, it's easy to use cotton fibers in Making of sanitary pads.

Also cotton fibers are used in combination with other fibers to make sanitary napkin.

### Uses

Cotton fibres are used to make cotton yarns, which are then used to make various clothes and textiles. Cotton threads are used to stitch Garment items, while cotton fibres are used to make a variety of Fabrics. Used to make bed linens, curtains, and other embellishments. Cotton is used to make pillow covers, and duvet covers because of its softness. Blankets are made from cotton. Preparing towels, shower floor coverings, and wraparounds, to deliver a cotton cover, to make a mat. Cotton rolls are utilized as sponges in clinics and clinical facilities. Also used in manufacturing of bandages, ear buds, wipes, medical cotton pad, etc. used to make premium baby diapers & sanitary pads.

### Flax Seeds

#### Biological source

Linseed is the dried, ripe seed of *Linum usitatissimum* Linn. Belonging to family Linaceae.



*Fig. 5: Flax fibres.*

Fibers are derived from the stems of the flax plant. It is also referred as linseed or common flax and grows to a height of 1.2 m<sup>[42]</sup>. This industrial plant is referred as a “fibre plant” or “fibre crop” because it is primarily grown for its valuable fibre<sup>[43]</sup>. Flax fibre is softer, crispier, more rigid, shiny, flexible, and stronger to handle. It is

mostly used in the textile industry to make linen. Due to the fact that flax fibres are more reusable, biodegradable, and environmentally benign than synthetic fibres, more study is being conducted into utilising these plant fibres for multiple uses. As a result, these fibres could be adopted as a raw material in sanitary pads

in the future, which would create a sustainable ecological economy. Many research programmes are now being launched, Allow for a new perspective in which flax is viewed as a multiple purposes plant, or even a waste-free item<sup>[44]</sup>. Because of its high moisture absorption rate and quick water release, linen fabric is more comfortable in hot weather. Flax textile have a very high absorption power as it absorbs as much as 20% of its own weight in liquid while remaining dry. Furthermore, because to rapid evaporation, it provides a feeling of dryness and cool down. Covers used to wrap mummies in egypt<sup>[45]</sup>. The amount of lignin is not extremely considerable. This makes the flax fibre relatively hard and tough. Also, flax fibre is Nonstatic, nonallergenic, bugs repellent, and ultraviolet (UV) protection. Nearly 30% of fibre can be found in mature flax straw so

you should take good care of straws after harvesting<sup>[46]</sup>.

### Uses

Linen, a breathable and delicate texture, is produced using flax strands. Material is utilized in the development of clothing like shirts, pullovers, dresses, skirts, and suits. Because of its lightweight and moisture-wicking characteristics, it is especially popular for summer wear. Flax is likewise used as an unrefined substance in the predominant paper industry for the creation of printed banknotes, tea packs, and cigarette paper.

### Wool

#### Biological source

Wool is a natural fiber obtained from the fleece of animals such as sheep, goats, camels, rabbits, etc.



*Fig. 6: Wool.*

Wool is a fibre that is favourable for the environment<sup>[47]</sup>. Between the years 2000 and 2050, the global sheep population is expected to grow from 1.7 billion to 2.7 billion<sup>[48]</sup>. Wool has been used as a material to manufacture various apparel and high-quality fabric in the current textile industry since the ancient era<sup>[49]</sup>. Merino sheep wool, which was bred in Spain in the fourteenth century, was the finest wool. Sheep breeding began in Australia at the end of eighteenth century. Sheep can be found in every country in the world. Uruguay, New Zealand, China, South Africa, Australia, and Argentina are large

wool-producing regions<sup>[50]</sup>. Sheep breeds are categorised into 5 broad groups like: Medium, Fine, Long, Coarse, and Crossbred<sup>[51]</sup>. Wool fibers provides clothing comfort & serves as thermal insulator. Silky, combed yarns and fine wool fibres are so tightly cinched that they can hardly crimp. Because fine combed strands enclose less air, they provide less insulation. Bulky woollen yarns have a looser structure, allowing crimps that form inside the fibres to entrap a large enough amount to provide adequate cold protection<sup>[52]</sup>. The absorption of liquid water can be somewhat slow. This type of

behaviour is known as “hydrophobic.” The wet wool dries slowly<sup>[53]</sup>. Wool fibers are soft & comfortable for skin. Wool does not burn quickly, therefore it is beneficial for protective clothing. The fibres are made from the hair of sheep’s. Sheep will continue to produce wool as long as they eat grass. A sheep generates between 2.3 and 3.6 kilogramme of raw wool per year, which must be sheared<sup>[54-55]</sup>.

**Uses**

Wool is often used in the production of warm and pleasant apparel items including as sweaters, scarves, caps, coats, and socks. Wool blankets and bedding products such as mattress toppers and duvets are popular due to their warmth, breathability, and moisture-wicking properties. Wool’s natural antimicrobial characteristics make it useful in medical dressings, wound care treatments, and some medical textiles.

**Chemical Composition of Fibers**

	Banana fibers	Papaya fibers	Jute fibers	Cotton	Flax fibers	Wool
<b>Cellulose</b>	49-45%	58.71%	64.4%	88.97%	75%	75%
<b>Hemicellulose</b>	12-10%	11.8%	12%	7-9%	15%	
<b>Pectin</b>	5-4.28%	~95%	0.2%	0.9%	2.5%	
<b>Lignin</b>	13-15%	14.26%	11.8%	2.5-4%	2%	15-40%
<b>Ash</b>	2-3%	--	--	1.2%	--	
<b>Water soluble</b>	--	--	1.1%	--	--	11-14%
<b>Wax</b>	--	--	0.5%	1.2%	1-1.5%	

**Properties**

	Physical Properties			Mechanical Properties		
	Density(kg/m <sup>3</sup> )	Tensile strength (MPa)	Youngs Modulus (GPa)	Length(mm)	Diameter (µm)	Moisture Content (%)
<b>Banana fibers</b>	950-750	540-900	34.8	1000-5000	80-250	60
<b>Papaya fibers</b>	820-1130	101	10.7	5-20	600-767	24.20 ±0.03
<b>Jute fibers</b>	1100	200-460	20-55	0.8-6	120-180	12
<b>Cotton</b>	448	400-700	6-10	10-65	11-22	8.5
<b>Flax fibers</b>	1530	1339±486	48.3±13.8	25-150	40-80	10
<b>Wool</b>	1.307	1-1.7	2.3-3.4	90-115	13.8	10-24

**CONCLUSION**

The ongoing survey investigations the possibilities of regular fiber composite materials, underlining both physical and mechanical properties, as well as their compound piece. Properties of all the fibers are excellent. With the help of this combination technology, it is suitable to use and apply lower-cost materials in high-performance gadgets. This naturally

occurring fibers have a very bright future because they are less expensive, lighter, and ecologically sustainable than glass fibre or other artificially made fibres. This review shown that replacing non-biodegradable materials with biodegradable materials while manufacturing sanitary feminine products is both environmentally beneficial and financially effective. As a result of this



context, it is concluded that combinations are the most desired technology in the rapidly developing present trend.

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