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DEVELOPMENT OF SUSTAINABLE ECO FRIENDLY SANITARY NAPKINS USING NATURAL FIBRES (BANANA FIBRE, COTTON, LINEN)

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ABSTRACT:

The vast amount of menstrual-related non-biodegradable waste produced in a nation like India, where women make up nearly 50% of the population, has serious environmental consequences. The bulk of the population in the country comes from low-middle class origins, therefore maintaining healthy menstrual hygiene practises with eco-friendly products calls for taking into account accessible and highly sustainable options. Furthermore, women are turning to the market for reusable products for inexpensive and durable alternatives because period poverty is now more prevalent than ever due to the COVID-19 pandemic. As a result, we investigated the Feasibility and Acceptability (FA) of a novel menstruation pad made of banana fibre in both rural and urban settings.

Keywords: Cotton, Banana fibre, Linen, Polyethylene film

INTRODUCTION:

One of the strongest natural fibres is banana fibre, sometimes referred to as Musa fibre. This strong natural fibre is made from the bark of the banana plant and is biodegradable. The thicker, more durable fibres emerge from the outer sheaths, while the softest fibres are found in the interior sheaths (figure 1), yet its It mostly consists of lignin, hemicelluloses, and cellulose.

The fibres can be coloured and are removed from the banana stem. After being washed, they do not shrink and the colour does not change. Politicians might prefer the cloth because of its rigidity even without starch. The fabric might be made entirely of banana fibre (figure 1), but for best durability, it should also contain 60% cotton.

It is simple to sort banana fibre by thickness (figure 1). The strongest and thinnest stalk fibres are on the inside, where as the softest and most flexible stalk fibres are on the outside. The process of turning woody bamboo, hemp, or flax stalks into textile-grade fibres is relatively labor- and time-intensive and the opposite of the process of turning banana stalks into textiles.

Fabric made of linen has a cooling sensation, is breathable, stronger, and more glossy than cotton. It becomes softer the more times it is washed. Wet linen is more durable than dry linen. Additionally, it is dirt- and clothing- moth-resistant. As an acquisition and distribution tool, it is utilised in the second layer of napkins.

Cotton is utilised in top sheets because it has excellent liquid retention Capabilities, is kind on the skin, and has no irritating properties. It provides comfort and dryness and is soft and breathable.

Figure 1-BANANA FIBRE

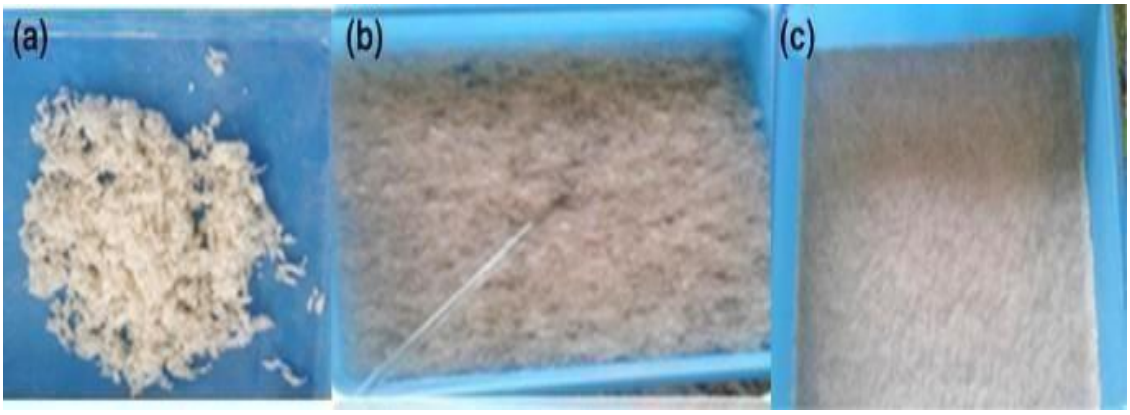
METHODOLOGY:

MATERIAL EXTRACTION:

Cotton fibre extraction:

We start by processing it through a machine that separates the thick fibre tufts from the ginned cotton bales (figure 2). The fibre is fed into a hopper that mechanically separates the fibre tufts, and the separated fibre is then fed into a series of highly sophisticated cleaning technologies that we called EVC (shorthand for Enhanced Visual, Opening, Cleaning system) (figure 2). These technologies remove a significant amount of plant matter, such as stalk, stem, and leaves, as well as extraneous matter and trash.

The goal is to eliminate all non-lint material, but in practise, mechanical cleaning methods can never completely eradicate it. The remaining steps of the procedure take place in enormous containers known as kiers. To hasten the wet purification procedure, these kettles can be heated and pressured.Cotton is wet out and packed into large cakes with a hole in the middle (for a perfectvisual,imagine a Bundt cake). The cotton cakes are then lowered down into the kier and it is closed (figure 2).



Step Two: Scouring

Following that, a sodium hydroxide-containing solution is poured into the cotton scouring process during the processing of cotton (FIGURE 3). The alkali solution is continually pumped through the cakes as the kier is heated and pressured. The residual plant matter is softened, the waxes on the fibre are saponified (turned into watersoluble soaps), and the pectins and other non-cellulosic components are suspended so they may be washed away.

The saponified waxes and suspended debris are removed with freshwater after a set amount of time at a high temperature and pressure to enable a thorough scouring. (See Figure 4) The cotton fibre is absorbent after scouring, and any trace amounts of plant matter are softened.

FIGURE 3-SCOURING

FIGURE 4-PURE COTTON

FIGURE 4-PURE COTTON

Step Three: Purifying

A cleansing solution is injected into the kier after the scouring rinse has been drained. The only oxidising (purifying) agent used by Barnhardt is hydrogen peroxide, making our process completely chlorine-free (TCF).

The hydrogen peroxide whitens thefibers by oxidizing the coloring matter. The purifying chemical can permeate the residual plant matter more efficiently and make it white since the scouring process softens the remaining plant matter.In order to remove all colour bodies, the purifying solution is pushed through the cakes for a specific amount of time at a high temperature. After that, the tank is drained and the purifying solution is washed away with freshwater. At this stage of cotton processing, all impurities and colouring agents have been eliminated, leaving only pure cellulose in the cotton fibres.

Step Four: Fiber Finishing

Despite the removal of the natural fibre finish (wax), processing the fibre might be challenging because of the high amount of fiber-on-fiber friction. Therefore, a fibre finish (lubricant) must be applied to enable efficient processing on high-production webforming machinery.

Depending on the use required, a variety of fibre coatings can be used. The necessary level of finish can be imparted to the cotton fibres by pumping these finish solutions through the cakes. The completed solution is drained once the target level has been reached.

Step Five:

Opening and Drying: The wet cakes are split open once more into tufts of fibre in this final process, and the fibre is dried to a predetermined moisture level.

TABLE-1 - PROPERTIES OF NATURAL FIBRES (BANANA FIBRE, COTTON, LINEN)

S.N o	Properties	Banana	Cotton	Linen
1	Length	1-1.5 meters	0.5" – 2.5”	18”-30”
2	Strength, tenacity(gm per denier)	29.98 g/denier	3 – 5	5.5-6.5gms/den
3	Dimensional stability	Maximum	medium	Adequate
4	Moisture regain	13.00%	7-10% (standard 8.5%)	10-12%
5	Stiffness:	70.35g/d	57-60 g/d due tohigh crystallinity	2.7-3.5
6	Elasticity	1.35-1.45%	1.50- 1.58%	2.7-3.5%
7	Resiliency	Maximum	low	Maximum
8	Abrasionresistance	low	medium	more
9	Density (gm/cc)	750-950 kg/m	less than bothsilk and wool but more than linen.	5.5-6.5gm/density
10	Color	Dull yellowish	cream or yellowish like clean white	Warm grey
11	Specific gravity	1.35	1.52-1.55	1.50

BANANA FIBRE EXTRACTION:

Banana fibres can be removed from bananas using a variety of techniques, including chemical, mechanical, and biological ones. Previous research has shown that biological approaches take at least a month before the fibres can be recovered while chemical procedures frequently harm the environment (FIGURE 5). However, the mechanical approach is simple and affordable, and it is very common in underdeveloped countries.

Layers of fibre that are firmly wrapped make up the outside sheath of the trunk. The fibre can be pulled off in strips that are 5 to 8 cm broad and 2-4 mm thick and is primarily found next to the outer layer. Tuxying the strips, sometimes known as tuxies, is the term for the stripping procedure. The tuxies are packed and transported to the stripping knife for cleaning after being removed from the sheath. The tuxedos are pulled under the knife during this procedure. The plant tissue between the fibres is scraped away by pressing the blade firmly against a wood or stone block.

The clean fibre bundles are then dried by hanging them. Hand stripping can be substituted with simple machines. They are made up of two rolls, one of which has a scraping blade on it (figure 5). The trunk is split into portions that are between 120 and 180 cm long once the darker outer sheath has been removed. The rotating drums receive these parts as input. The tissue that is pulpy is removed by the scraping blade. After drying, the pulp can be utilised in the same way as tuxedos.

FIGURE 5-BANANA FIBRE EXTRACTION

Linen extraction: In the scutching process, the woody plant stalk is cut into pieces called shives without damaging the flax fibre, and then the machine pulls it through huge rollers to further break the stalk into shives but keep the fibre intact. The flax finally makes it to the drums in the last stage. (Figure 6)

Figure 6-LINEN EXTRACTION

FIGURE 7-LINEN **LAYERS:**

1. Top sheet:(figure 7)

Non woven (Cotton fibre blended with Banana fibre) cotton fibre -25% water holdup Banana fibre -13 per moisture regain

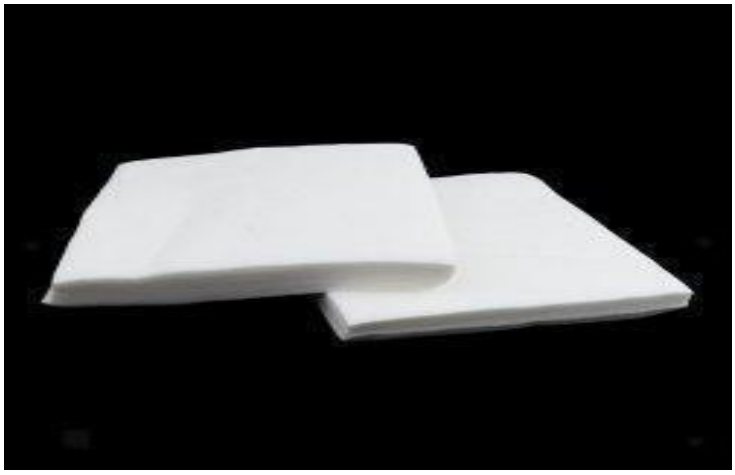


FIGURE 8-NON WOVEN(COTTON BLENDED WITH BANANA FIBRE)

Fluid acquisition and distribution layer:

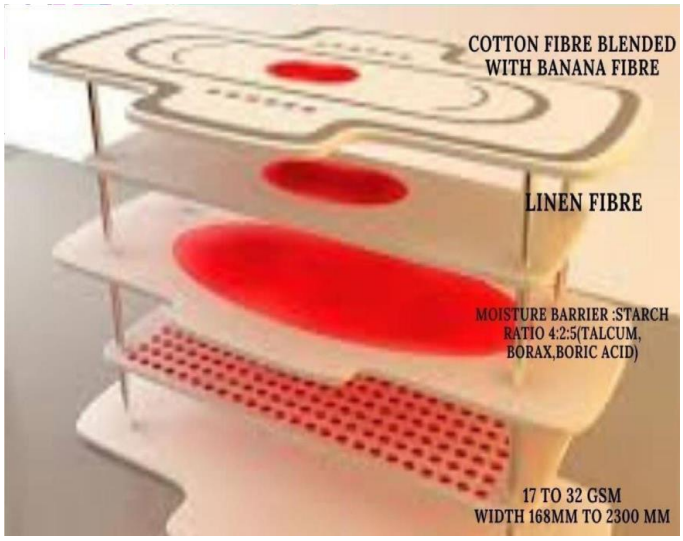
Have excellent hydrophilic properties and consequently can accelerate the absorption

Linen fibre –Known for freshness in hot weather

–Durable and dries quickly

–Allergy free

–20% water hold up



1. Absorbent core :(figure 8)

- Chlorine bleached wood pulp (sucks up liquid quickly)

-Moisture barrier:Starch ratio- In the first take talcum,borax,boric acid(4:2:5)

-In the second take talcum,borax,boric acid(8:11:3)

FIGURE 9-ABSORBENT CORE

Backsheet:

Breathable film:Polyethylene film

FIGURE 9-POLYTHENE FILM

Basic weight:17-32GSM

Width:168mm-2300mm

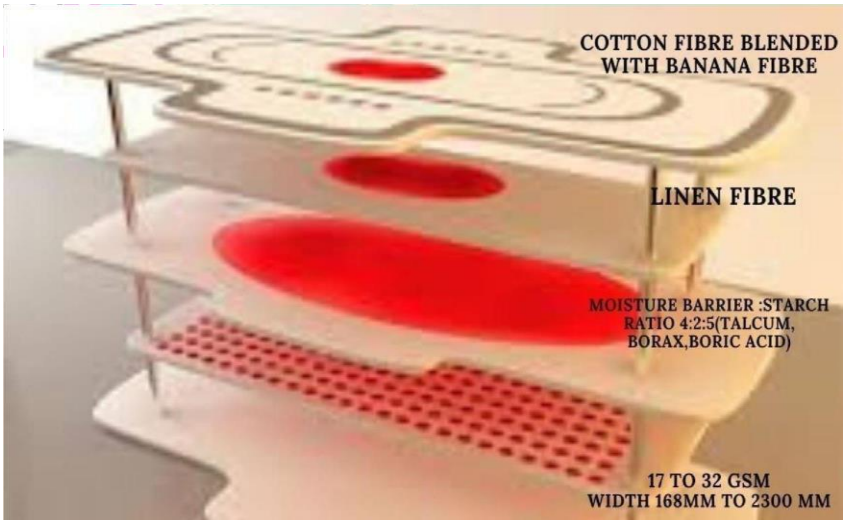


FIGURE 11

CONCLUSION

Banana fibre is one of the most environmentally friendly raw materials for sanitary pads due to the monocarpic replantability of banana plants and the use of agricultural waste as their pseudo-stem. They are both energy- efficient and simple to mass-produce. The superior absorption qualities of banana fibre allowed us to create sanitary pads that are hygienic, simple to wash, and quick to dry. The prolonged life of these sanitary napkins can greatly reduce the environmental risk provided by discarded sanitary pads.

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