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Eco Friendly Disposable Sanitary Napkin Development

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A B S T R A C T

Sanitary napkins are made up of several layers, and each layer serves a specific function. Wood pulp fluff is the most commonly used absorbent material. To increase the absorption and also reduce the thickness of the sanitary napkin super absorbent polymer (SAP) is used along with wood pulp fluff. These super absorbent polymers are allegedly harmful to the environment and human health. The current study uses banana fibre, viscose,cotton, as absorbent and cotton spunlace fabric, canvas fabric, malabarneem wood powder, vetiver paste, and Indian madder extract as herbs, and bioplastic as a barrier sheet in the sanitary napkin. Hence, the developed napkin is both user-friendly and environment-friendly.

Keywords: Sanitary napkins, Eco- friendly, Biodegradable, Herbal finishes, Almond gum

1. Introduction

Indian women now have access to biodegradable sanitary napkins, which contain very little or no plastic at all. There is no extra fragrance, and these pads are free of pollutants and chemicals. These plastic-free, all-natural, eco-friendly pads, that are manufactured in India are safe and do not irritate skin or cause infections or allergies.

In recent years, a large number of like-minded people and businesses have begun to produce biodegradable, natural, chemical-free, and plastic-free sanitary napkins for women who look for alternatives to synthetic pads. These sanitary napkins are safe for the user and kind to the environment.

Young girls and women have been educated about their right to a safe and trouble-free period as well as the importance of taking care of their bodies and removing the stigma and shame associated with periods as well as the taboo associated with discussing menses and sanitary pads.The following are the unique qualities and benefits of bio-degradable sanitary napkins

- Chlorine-free, pH-compatible, and no plastic usage
- No chemicals are used
- Free from allergies, itchiness, or infections
- Natural fragrance
- Packaged with biodegradable materials
- Each pad comes with a handy recyclable bag

2. Material and methods

The sanitary napkin design is based on the conventional four-layered design with a transferable top layer. For the top sheet, a thin layer of non-woven cotton spun lace fabric (50 GSM) finished with madder extract is used. Under the top sheet a bamboo non-woven strip coated withvetiver paste is placed for odour control. To increase the absorbancy, almond gum is sandwiched between natural fibres such as cotton,viscose,and banana fibre (25:25:50) which is the absorbent core. Beneath,malabarneem wood powder (1 gram) is sprinkled. It acts as an antimicrobial agentthat promotes hygiene. Biodegradable low-density bio plastic film is used as a barrier layer; this makes the entire sanitary napkin eco-friendly. The following experimental steps were adopted for the study.

2.1 Preparation of herbal extract

Indian madder root is purchased from anayurvedic shop and ground into a fine powder. This madder powder is mixed with distilled water in a ratio of 1:5 and placed in an ultrasonicator for 45 minutes at 60°C. Then the extract is cooled and filtered using filter paper.

2.2 Treatment of extract on top sheet fabric

Cotton-spun lace non-woven fabric is purchased for top sheet. It has the dual role of passing fluid through it quickly into the absorbent structure and keeping the top surface dry. The hydrophilic top sheet of sanitary pad is dipped in the madder extract at an MRL of 1:10 for 30 minutes and dried in shade at room temperature.

Table 1- Composition of sanitary napkin

Top layer	Absorbent core	Barrier sheet
Cotton spun lace non-woven	Banana fiber+Cottonfiber+Viscose fiber+ Almond gum	Biodegradable plastic

Malabar neem wood powder is a natural substance used in this sanitary napkin. To receive the benefits of Malabar neem wood, add 1 gram of powder between the cores. Barrier layer selected for sanitary pad is 100% biodegradable plastic manufactured using bio plastic enzyme based chained-bio-degradation technology with LLPE as base polymer. It is designed to biodegrade within 6-12 months in open atmosphere and landfills.

Table 2- Composition of sanitary napkin

Dimensions (mm)			Top sheet	Absorbent core	Barrier sheet	Total weight (gm)
Length	Width	Thickness	Cotton spun lace non-woven	Banana fiber+Cottonfiber+Viscose fiber	Biodegradable plastic	
280	195	9	50 GSM	50:25:25	0.418gm	16.06

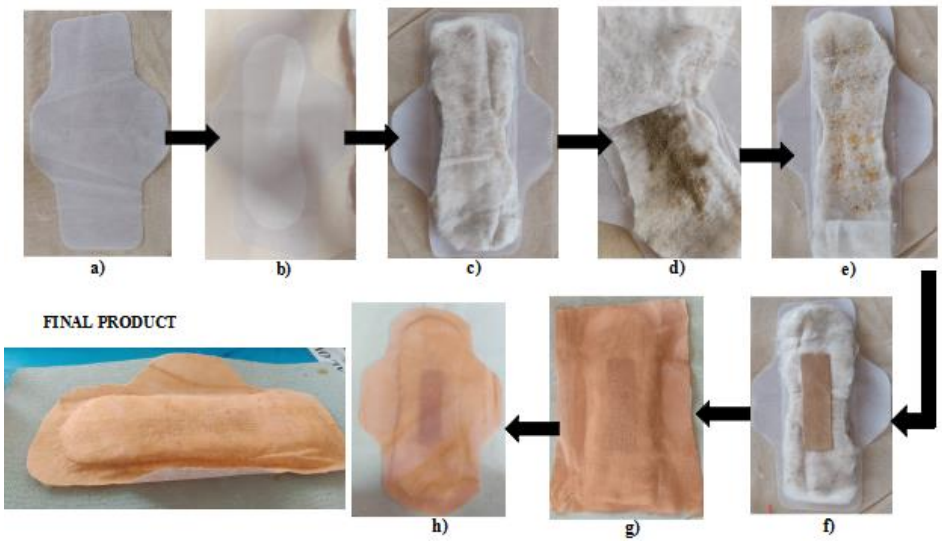


Figure 1- Composition of sanitary napkin (a)back sheet;(b)barrier sheet;(c)absorbent core(d)malabarneem wood powder and almond gum;(f)vetiver coated strip;(g)finished top sheet;(h)shape cutting

3. Test methods

3.1 Absorbency capacity

The absorbency capacity is evaluated in accordance with the EAS 96:2008-Annex C standard. The sample is first weighed in dry state, and then fluid is added until saturation is attained. When the pad reached saturation, a 3.4 kg weight is placed over it, and the excess liquid is wiped off using filter paper and then the pad is weighed. The following formula is used to determine the absorption capacity:

$$\text{Absorption capacity} = (W\text{-}X)\ \text{gm.}$$

where

X is the dry weight of the pad expressed in grams

W is the final weight of the pad after saturation underweight expressed in grams

3.2 Wet back ability

It is a method of testing a napkin's resistance to the transport of a liquid that has already permeated the cover stock back onto the skin. A pre-weighed filter paper is placed over the napkin sample, 20 ml of test fluid is poured onto it, and then 3.4 kg of weight was applied to it for 3 minutes and then the filter paper is weighed again. Wet back is the difference in filter paper weight, measured in grams.

3.3 Leakage proof test

According to EAS 96:2008, Annex B, the test is conducted to analyze the efficiency of the barrier layer. A barrier sheet of 6.5 cm by 6.5 cm specimen size is cut, folded into a cone shape, and placed in a funnel. The test fluid is poured in it. After 24 hours, the test fluid-filled funnel is retained and checked for leaks.

3.4 Vertical wicking rate test

According to the AATCC TM 197-2011 standard, the test is conducted. It determines the napkin's capacity and the top sheet's ability to absorb fluid at a specific rate while fighting gravity. One end of the test specimen (25mm x 170mm) is clamped vertically and the other end is submerged in test fluid to a depth of roughly 2mm. At intervals of 1, 2, 5, 10, 20, and 30 minutes, the rate of fluid wicking (distance travelled per unit time) along the specimen is visually inspected and recorded.

3.5 Strike through

One drop of test solution is dropped on the test specimen (125mm x 125mm).The time takenby the solution to travel from the top layer to the interior layers of the sanitary napkinis measured. Using a star-shaped aperture at the bottom of the well that rests on the test piece, the instrument delivers a standard 5 cc test solution into the cavity. The liquid then drains through the test piece and into an absorbent pad. The duration of the time travel is measured in seconds.

3.6 pH of top sheet

A pH meter is an instrument used to measure hydrogen ion activity in solutions; in other words, this instrument measures the acidity or alkalinity of a solution. The degree of hydrogen ion activity is ultimately expressed as the pH level, which generally ranges from 1 to 14.

The pH meter is calibrated with pH 4 and 7 buffer solutions. One gram of test specimen is taken and cut into small pieces, added in a conical flask with 100 ml distilled water and kept in a rotary shaker for 20 minutes. Then the extract is filtered and the pH analyzed using the calibrated pH meter.

3.7 Wear study

To study the consumer opinion, sample sanitary napkins were given to 40 participants and feedback is obtained through questionnaire method.The product has an absorption capability of 6 to 8 hours.

4. Result and discussion

4.1 Absorbency capacity

Table 3 Absorbency test

No of time tested the same sample	Napkin Size	Before Weight	After Weight	Liquid Absorbency
First time	Regular	16.13 grams	42.33grams	20ml
Second time		42.33grams	68.63grams	40ml

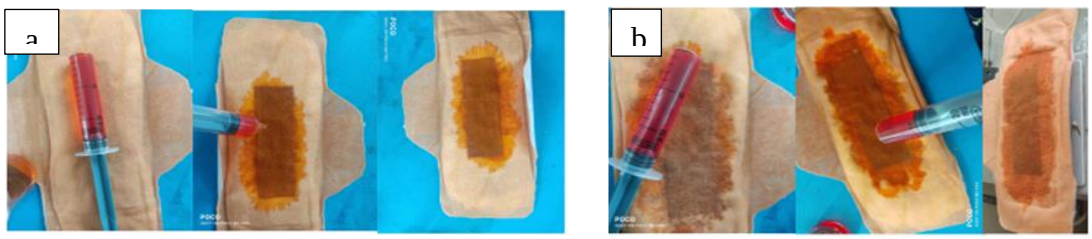


Figure 2-Absorbency test (a) First time; (b) Second time

4.2 Wet back test

Table 4 - wet back test

Napkin Size	Filter paper weight (dry)	Filter paper weight (wet)	Wet back Level
Regular	1.100g	2.620g	1.520g

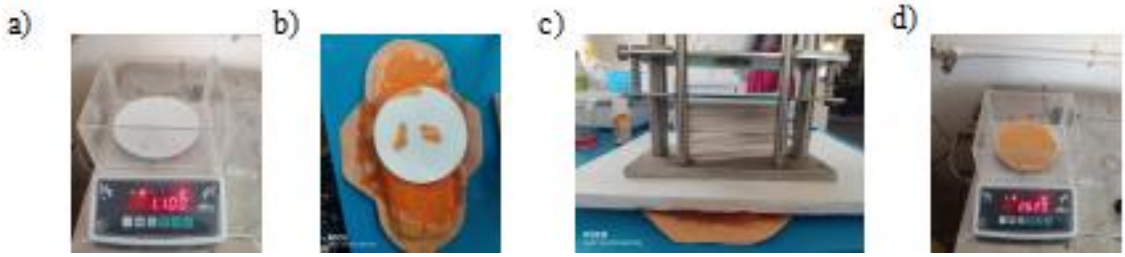


Figure 3- Wet back test (a) before weight;(b) place filter paper;(c)weight loaded;(d)after weight.

The results of the Wet back characteristics of samples are shown in fig 3 shows satisfactory values of wet back test

Wet back value= Wet filter paper weight - Dry filter paper

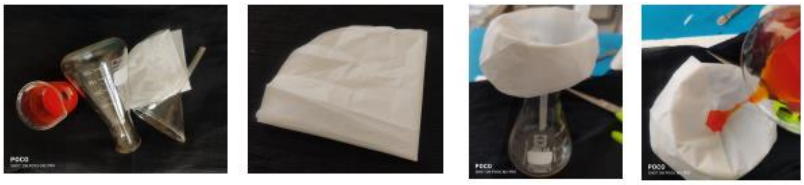
Lower wetback value means better the sanitary pad performance.

4.3 Leakage proof test

Table 5

Barrier sheet length	Barrier sheet width	Water (ml)	Time (Hrs.)
6.5cm	6.5cm	20	24

a)



Before 24hrs After 24hrs

Figure 4 - (a) Leakage proof test.

Leakage Resistance of the biodegradable material chosen for the sanitary pad's barrier layer has been tested to see how well it can prevent leaks. When the barrier sheet was folded into a cone shape and left with fluid for 24 hours, it is found that there is no evidence of leakage.The test results demonstrate good liquid resistance of the barrier sheet.

4.4 Vertical wicking rate experiment

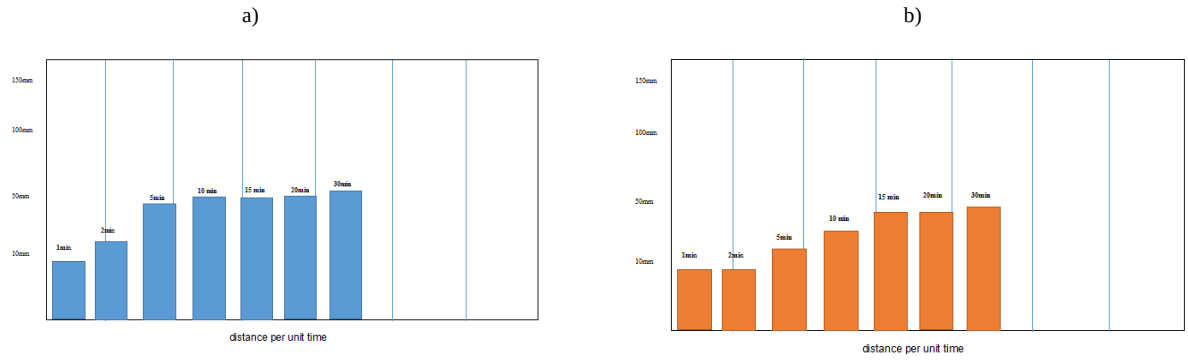


Figure 5-Vertical wicking rate experiment (a) Top sheet (b) Napkin

The primary goal of the vertical wicking test is to gauge a substance's capacity to absorb liquid. This is a crucial attribute for a top layer to have in order for menstrual waste to be quickly absorbed by the user.

The rate of vertical wicking of the top sheet when complete is higher than that of the napkin. Banana, cotton, and viscose fibre core materials cannot match the liquid absorption ability of cotton-spun fabric. Within five minutes of the top layer absorbing liquid, the foundation had grown to 50mm. The napkin took 30 minutes to reach 50mm.

4.5 Strike through

The top sheet of the pad determines whether a test will pass or fail. Figure5 depicts the strike-through of samples, which is assessed in terms of time. Additionally, it is suggested that the strike-through rate is unaffected by finishes. The fluid is quickly drawn in 8 seconds and transferred to the core structure by the cotton-spun lace non-woven intermediate layer.

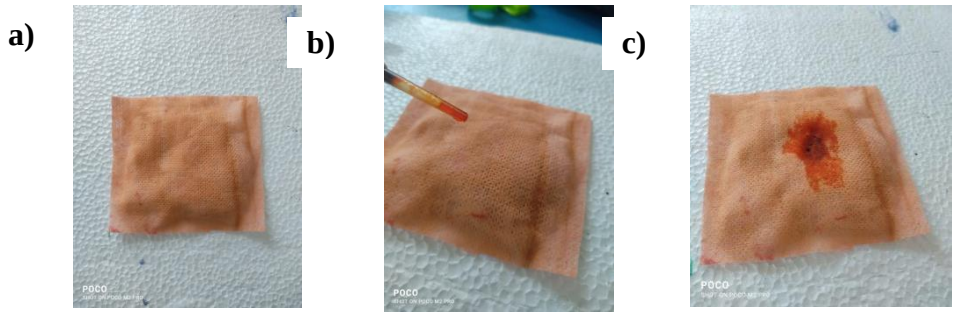


Figure 6-Strike through test (a) test sample;(b) pour fluid; (c) Strike through.

4.6 pH test

pH 4.0 calibration solution into a small beaker and insert the electrode. Once the meter is calibrated with the 4.0 solution, it will flash 7.0. Rinse the probe with distilled water, dry it and insert it into a beaker of 7.0 calibration solution. Once it stops flashing, it is calibrated and ready for use

Add 1 gram of test sample on 100 ml distilled water insert the electrode.wait until the readings become steady. The value of the tested sample is 6.37 pH**.** The pH of the top sheet of the developed sanitary napkin is found to **be 6.37 which is slightly acidic**.

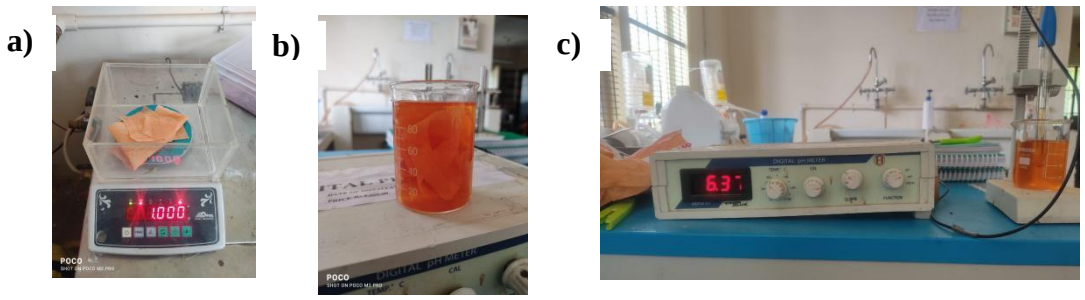


Figure 7- (a)weight;(b) dip in solution;(c) pH value.

4.7 wear study

The sample napkins were given to 40 participants, and feedback was frequently recorded. The product's absorbency capacity is between 6 and 8 hours, and no rashes or unpleasant odour were noticed. When asked for feedback, 43.5% of respondents said the product was extremely comfortable and soft, while 57.5% said it didn't leak, had excellent skin contact, was very comfortable to use, and didn't cause the wearer any odour.

V. Conclusion

The absorption capacity of the absorbent core made of cotton, viscose, and banana fibre in a 50/25/25 ratio as well as almond gum is found to be high. Cottonspun lace top sheet has a faster wicking rate than the core of the sanitary napkin.Strike-through testing revealed no noticeable change in the madder finish.In case of wet back, the core made of banana, cotton, or viscose (50/25/25) and top sheet demonstrates satisfactory wet back. The consumer opinion survey revealed that the bamboo strip applied with vetiver controlled the odour. Low-density biodegradable plastic acts as an excellent barrier layer and offers good fluid impermeability.

The top layer with madder finish demonstrates a good pH level.In general, it is noted that the sanitary napkin made of a 50/25/25 blend of banana fibre, cotton and viscose, with a core sprinkled with almond gum, and a top sheet finished with Indian madder has good hygienic performance and is also eco-friendly in nature.

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