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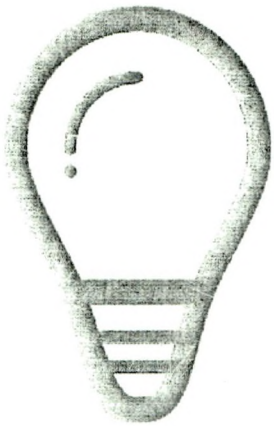

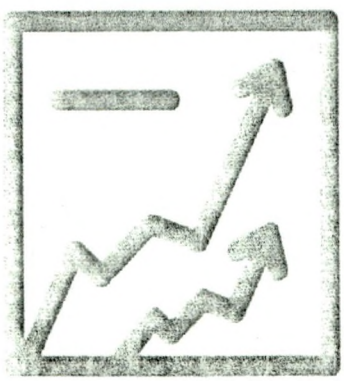

"RESEARCH HIGHLIGHTS by AVINSAHILINGAM UNIVERSITY"

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EXTRACTION, MICROENCAPSULATION, APPLICATION AND DEVELOPMENT OF ANTIMICROBIAL FINISHED SANITARY NAPKIN USING *COLEUS AROMATICUS* LEAF EXTRACT

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ABSTRACT

Ethanolic leaf extract of *Coleus aromaticus* plant was microencapsulated and treated on polypropylene nonwoven fabric. The treated fabric was used as top layer for development of sanitary napkin. Control (untreated) and treated sanitary napkins were assessed for its antimicrobial activity, physical properties-tensile strength, elongation and stiffness and its absorbency parameters. The present study reveals that, maximum of 30mm and 28mm of zone formation was observed for *S.aureus* and *E.coli.* The result confirms that the treated fabric shows maximum absorbency than untreated sanitary napkins.

Keywords: Absorbency test, Antimicrobial activity, ethanolic extraction, Karpuravalli, Microencapsulation, Sanitary napkin

Introduction

The fundamental determinant of quality of life is sanitation. Recently the World Health Organization (WHO) includes personal hygiene, home sanitation, safe water, garbage disposal, excreta disposal and waste-water disposal as the definition for sanitation (WHO Sanitation. 2011). As per the estimation of UNICEF only 31 per cent of India's population use improved sanitation(UNICEF

India, 2008). The result of the survey carried out by AC Nielson reveals that, poor financial condition does not allow majority of the women to buy quality sanitary pads, in addition the use of unsterilized cloth increases the chance of infections and diseases. Also the research states Reproductive tract Infection was 70 per cent more common among those with unhygienic sanitary practices(Shrivastava, 2013).With respect to the financial condition and infections caused due to poor hygiene the present study was focussed on the preparation of low cost sanitary napkins coated with microencapsulated herbal plant extract for giving antimicrobial finish. The use of herbal plant extract prevents odour formation and infections caused by microbes. Nature has been a source of medicinal agent for thousands of years.

Many of modern drugs isolated from natural sources are based on their use in traditional medicine. Plants produce a diverse range of bioactive molecules, making them a rich source of different types of medicines. In order to search antibacterial activity agent *Coleus aromaticus* was selected for the present study. *Coleus aromaticus* belongs to the family Lamiaceae. It is also known as oregano, as Karpuravalli in Tamil. *Coleus aromaticusbenth,* commonly known as an Indian Borage, is a medicinal plant and several medicinal properties are attributed to this plant in the Indian system of medicine.

Materials and methods

Collection of plant source

Coleus aromaticus belongs to the family *lamiaceae* or *labiatae.* It is tender, fleshy and highly aromatic. This aromatic smelling medicinal plant contains many phytochemicals such as carvacrol (menoterpenoid), caryophyllene (bicyclic sesquiterpene) and flavonoids and is used in traditional medicine because of their antimicrobial, antioxidant, antiseptic and other pharmacological activities. The leaves of Karpuravalli plant was collected from in and around Vadavalli area, Coimbatore. Leaves were washed thoroughly with soft water for two to three times and then in distilled water. Fresh leaves were used for extraction of bioactive compounds.

Extraction method

The active compounds from herbs were extracted by hot continuous Soxhlet extraction method (Egwaikhide and Gimba2007). This method was selected because this requires only minimum amount of solvents and the solvents can be reused for the extraction of the same plant source. Thirty grams of the plant source was weighed and 300ml of ethanol solvent (Green, 2004)was used for

extraction of bioactive compounds. Six cycles were allowed for extraction and then the source was removed from the extractor, filtered and poured in the Petri plates for evaporation of the ethanol solvent. After evaporation the crude extracts were weighed.

Yield of the plant extract = A – B

$$\% \text{ Yield of the plant extract} = \frac{A-B}{A} \times 100$$

Where A-Weight of the empty Petri plates,
B-Weight of the Petri plate with the evaporated extract

Test organisms for antimicrobial assessment

The bacterial and fungal strains were procured from NICM, Pune that included one gram positive (*Staphylococcus aureus* NICM 2079) and one gram negative (*Escherichia coli* NICM 2065) and two fungal organisms (*Aspergillus niger* NICM 596 and *Candida albicans* NICM 3471). They were immediately sub cultured by inoculating a loopful in the respective broths for both bacteria and fungi. The bacterial sub cultures were incubated at 35°C-37°C for 18-24 hours and the fungal subcultures were kept at room temperature for 72 hours. Then they were streaked onto nutrient agar and potato dextrose agar plates and the plates were incubated and were stored at 4°C till use.

Assessment of antimicrobial activity of the treated fabric

Treated and untreated control fabric samples placed in contact with agar plates, which have been previously inoculated with inoculums of test organisms. After incubation, a clear area of uninterrupted growth underneath and along the sides of the test material indicates antimicrobial effectiveness of the fabric (Pandya et. al, 2011).

Microencapsulation process

Microencapsulation was done using *Cassia auriculata* flower extract as core material and gum acacia as wall material. Ten gram of wall material was allowed to swell for half an hour by mixing with 100ml of hot water. To this mixture, 50ml of hot water was added, stirred for 15 minutes maintaining the temperature between 40°C and 50°C. Ten millilitre of core material was added

and stirred at 300-500rpm for further 15min followed by drop-wise addition of 20 per cent sodium sulphate 10ml for 5-10min. the stirrer speed was reduced and then 5ml of 17 per cent formaldehyde was added. The stirrer was stopped and the mixture was freeze-dried (Thilagavathi et al, 2007)

Finishing fabrics with microencapsulated compounds

- Microcapsules – 10g
- Citric acid (Binder) – 8%
- M: L ratio – 1:20

The microcapsule solution was applied onto the fabric by using ultrasonic atomizer at a flow rate of 1ml/min. After finishing the fabric was dried at 80°C in an oven for 5 minutes and cured at 180°C for 3minutes. The antimicrobial activity of the microcapsule treated fabrics was assessed by Agar Diffusion method.

Materials required for doing sanitary napkins

Wood pulp, polypropylene non woven fabric, polyethylene leak proof sheet, adhesive, release papers are the materials required to develop low cost sanitary napkins. Wood pulp is the core material, polypropylene fabric is the top layer on which the microencapsulated plant extract was coated.

Preparation of sanitary napkins

The development of sanitary napkin involves the following steps:

a. pulverizing is the process in which the wood pulp is made into soft fluffy in nature by grinding in pulveriser,
b. Shaping the fluffy wood pulp using template,
c. sticking leak proof sheet at the back of the shaped laps,
d. wrapping with polypropylene sheet and
e. finally sealing the open sides of the napkin and at the leak proof side pasting the release paper.

Preparation of microencapsules herbal extract treated sanitary napkins

Preparation of herbal antimicrobial treated sanitary napkin involves the process involved in the preparation of sanitary napkin except, wrapping with

normal polypropylene non woven fabric it is treated with microencapsulated plant extract and then wrapped.

Evaluation of sanitary pads

The physical parameters such as tensile strength, elongation, stiffness and absorbency of treated and untreated polypropylene non woven fabric was evaluated. Also the antimicrobial activity of the treated and untreated fabric was assessed by agar diffusion method.

Agar diffusion method

Treated and untreated control fabric samples placed in contact with agar plates, which have been previously inoculated with inoculums of test organisms. After incubation, a clear area of uninterrupted growth underneath and along the sides of the test material indicates antimicrobial effectiveness of the fabric.

Determination of absorbent capacity of the sanitary napkin

Liquid strike through time

In this method a specific quantity of simulated urine is discharged at a specific rate under specific conditions onto the top layer of treated and untreated polypropylene non woven fabric which is placed on a reference absorbent pad. The time taken for all the liquid to penetrate the fabric is measured electronically Indian (Standard, 2012).

Wetback method

A top layer is placed over a standard absorbent medium which is then loaded with a specific quantity of simulated urine. A standard weight is placed onto the top layer and absorbent medium to ensure even spreading of the liquid.A pre-weighed pick up (blotter) paper is then placed on the top layer and the weight is again placed on top. The mass of absorbed liquid by the pick up (blotter) paper is weighed and is recorded.

Run-off method

This test was carried out to quantitatively to determine the surface effect of non-woven sanitary napkin. About 0.9 per cent saline solution was prepared. The sanitary napkin samples were weighed and their weights recorded. The fluid dosing position was marked 10 cm above the top edge of the masking

tape. A separatory funnel was clamped with the spigot 1cm above the premarked dosing position and the timer was set for 10 min., 25 ml of 0.9% saline solution was dispensed into the separatory funnel. The balance was positioned at the bottom of the 30° incline table with a folded paper towel on the weighing surface to contain any fluid that runs off. The scale was set at zero and the separatory funnel tap was opened. The paper towel absorbed any fluid that run-off. The run-off weight was recorded to the nearest 0.01grams. This is called the primary run-off value. After 10 min. interval, the steps were repeated with a new paper towel and the run-off weight was called the secondary run-off value. After another 10 minutes interval, the process was repeated with a new paper towel and this run-off weight is called the tertiary run-off value. The average run-off value and the standard deviation of the run-off values were calculated(Lawal and Dowyaro, 2012)

Free swell absorbency capacity

The sample (wood pulp) is weighed and placed in a tea bag. The tea bag is submerged in the fluid to be absorbed and allowed to soak for a defined soaking period, after which the bag is removed. Excess fluid is allowed to drip away and the sample is weighed to determine the amount of fluid absorbed (Edana Doc. Standard procedure)

Centrifuge retention capacity

The core material wood pulp is weighed and placed in a tea bag. The tea bag is submerged in the fluid to be absorbed and afterwards centrifuged for a specified time, at a specified centrifugal force, to determine the amount of fluid retained(Edana Doc. Standard procedure)

Absorbency under pressure

The absorbent pad is weighed and spread on the bottom filter screen closing a specified cylinder. A uniform pressure is applied on the absorbent pad. The cylinder is then placed on a filter plate, which is placed in a Petri dish filled with saline solution. After an absorption contact time of 1 hour, the cylinder is removed from the filter plate and weighed to determine the amount of fluid absorbed in g/g.

Results and Discussion

From the table 1 it is clear that, the mean tensile strength and stiffness of treated fabric shows slight decrease of about 2.8 lbs and 2.1cm when compared to the control untreated fabric in which it has 3lbs and 2.9cm. The elongation

of the treated fabric shows increase of 4.2 inches whereas for untreated fabric it was only 3.1 inch. After finished with plant extract the treated fabric shows very good absorbency within five seconds whereas the untreated fabric takes 53 seconds to absorb.

Table 1 Physical Parameters of Control (Untreated) and Treated Polypropylene Non Woven fabric

S.No	Testing parameters with units	Mean values	
		Untreated (Control) fabric	Treated fabric
1.	Tensile strength (lbs)	3	2.8
2.	Elongation (Inches)	3.1	4.2
3.	Stiffness (Cms)	2.9	2.1
4.	Absorbency (Sec)	53	5

Table 2 Absorbency Parameters of Treated and Untreated Sanitary Napkins

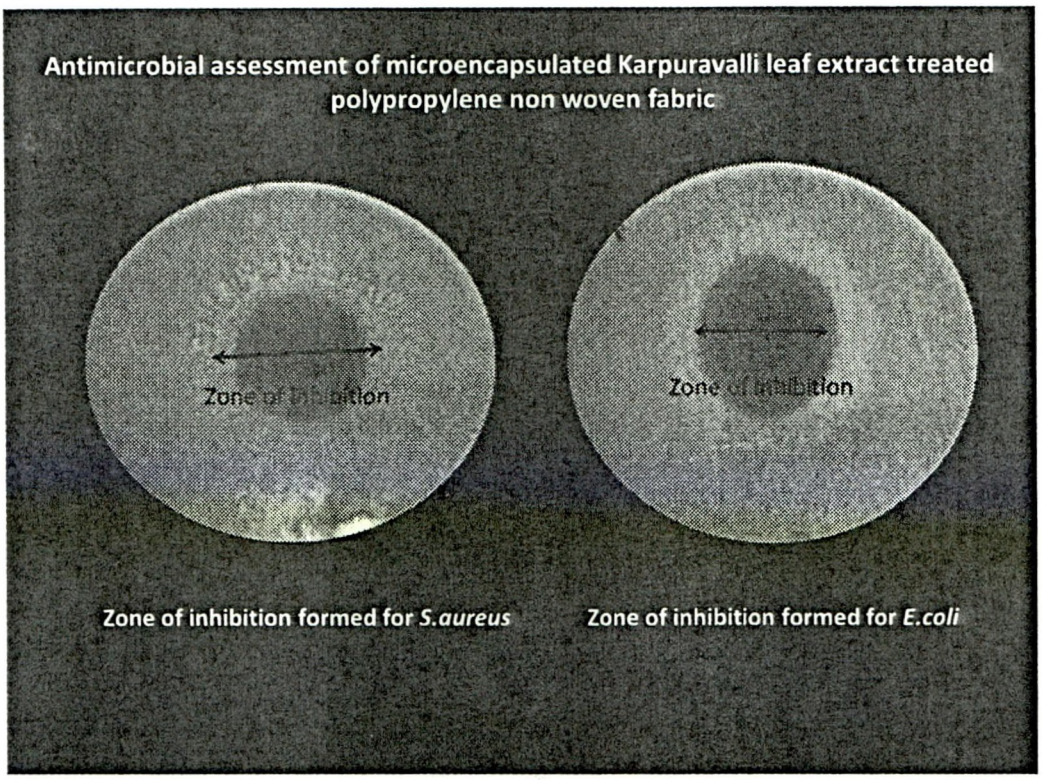
S.no	Test parameters	Standard	Unit	Result	
				Untreated	Treated
1.	Liquid strike through time	ISO 9073 – 8	Seconds	10.54	2.46
2.	Wetback	ISO 9073 – 14	Grams	0.41	3.56
3.	Run – off	ISO 9073 – 11	Grams	20	1.10
4.	Free swell absorptive capacity	WSP 240.2	Grams/grams	26.8	28.38
5.	Centrifuge retention capacity	WSP 241.3	Grams/grams	13	11.78
6.	Absorbency under pressure	WSP 243.2	Pass / Fail	Pass	Pass

Table 2 shows that treated sample have a quicker strike through time of 2.46 seconds as compared to the untreated sanitary pads (10.54 Sec) as they took a longer time for strike through. The sanitary napkin fluid run-off quantification which is the quantitative evaluation of the surface effect of the non-woven fabric, it also indicates the speed of absorption of fluid by the sanitary napkin. The result showed that treated polypropylene fabric had the least run-off value of 1.10g when compared to untreated which shows 20g. The best sample for this performance attribute is the one with the least fluid run-off values. The

results shown in Table 2, gives the sanitary napkin absorbent capacity which is the maximum amount of the liquid that can be soaked-up and held by the sample. The best sample for this performanceattribute is the one with the highest absorbent capacity. Thus, treated sample had the highest absorbent capacity of 28.38g/g which is greater than untreated sample in which it has 26.8g/g.

Antimicrobial assessment of treated sample

Figure 1 Antimicrobial Activity of Leaf Extract Treated Fabric



From the above figure it is clear that, microencapsulated Karpuravalli leaf extract treated polypropylene non woven fabric shows maximum zone of inhibition of 30mm for *S.aureus* than compared to the research work done by Shagal*et al.*, stated that, methanolic leaf extract of Karpuravalli showed zone formation of only 15mm for *S.aureus* and For *E.coli* was observed as 28mm.

Conclusion

Ethanolic crude leaf extract of Karpuravalli pronounces promising result for antimicrobial activity against *S.aureus*and *E.coli.* Due to the easy availability of Karpuravalli leaf in our country, still there is scope for many scientific studies to fully exploit its medicinal properties in the field of medical textiles. From the above work it has been concluded that the microencapsules treated fabric

shows good absorbency and antimicrobial activity of the developed sanitary napkin.

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