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Research Article

DEVELOPMENT OF CURATIVE TEXTILES FOR PILES, FISTULA AND ANAL FISSURE USING MICROENCAPSULATED HERBS IN NON-WOVEN TEXTILE MATERIAL

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ABSTRACT

The innovative technologies invented to produce fibres, yarns and fabrics have been paved way for the use of them in various fields other than clothing sector. Performance apparel represents one of the fastest growing sectors of the international textile and clothing industry. The medicines made from natural herbs are mostly not having any side effects as such in the case of chemically formulated drugs. The objective of this project is to develop curative textiles using natural herbs to heal the stage – I piles (Hemorrhoids), fistula and anal fissures in human being with the modern nanotechnology (i.e. microencapsulation Techniques). Microencapsulation is a technique where in tiny droplets/particles of liquid/gas/solid particles are applied to textile materials to achieve various effects. Garment gets unique property due to Micro encapsulation process. Micro capsules filled with Particles with active ingredients when applied to the fabric or garments give a functional finish with long lasting effects because the particles get penetrated to the fibre core. As the wearer moves, the capsules are activated producing a slow release of the active ingredient. In this research work an attempt has been made to articulate a controlled delivery of drug release which was extracted using natural herbs which inturn used to heal piles and fissure. For this purpose, the Core - substance prepared from the herbs are encapsulated in a Shell - Cyclodextrin or Alginate using microencapsulation technique. Cellulosic nonwoven fabric is treated with microencapsulated herb and dried. Then the colony of cultured Staphylococcus aureus & Escherichia coli bacteria is placed over the treated and untreated fabric under standard testing condition in a laboratory. After a week's study, the antibacterial activities were studied and systematically analysed.

Key words: Piles, fissure, microencapsulation, nonwoven fabric, haemorrhoids, herbs

INTRODUCTION

The innovative technologies invented to produce fibres, yarns and fabrics have been paved way for the use of them in various fields other than clothing sector. Performance apparel represents one of the fastest growing sectors of the international textile and clothing industry. The medicines made from natural herbs are mostly not having any side effects as such in the case of chemically formulated drugs

Curative textiles was developed by using Pad dry cure method to impart the extracts[1] of Aloe barbadensis, bitter gourd, Cuminum cyminum Linn and ginger on a single jersey knitted fabric using micro encapsulation method. The copper content present in the extracts of the above said plants leads to a very good resistance to for microbes which is proved by using agar diffusion test which confirm the antimicrobial efficacy. The garments made from those encapsulated fabric showed better results in curing skin diseases like scabies, inflammatory skin disease, seasonal skin disease, urticaria and eczema. Novel attempt has been made through research work to develop medicinal herb extracts treated garments[2] using alternate medical concepts to cure selected diseases. About 16 medicinal herbs such as neem, turmeric, holy basil, sandal wood, etc. have been selected for curing 7 different diseases such as allergic dermatitis, psoriasis, asthma, liver disorders, headache, joints pain, sinus trouble/ cold. Cotton woven fabrics were treated with the selected medicinal herb extracts. The antibacterial assessments of the medicinal herb extracts treated fabrics confirms the correlation between the curative performance and its antibacterial activity. A critical review has been done to assess the development of aroma therapeutic applications[3] in textiles. Recent academic research shows that aroma enhanced textiles are being developed in the areas of sustainability, reveals that. Some essential oils, which can be used to infuse textiles with aromas, are also known to contain antimicrobial properties that can be useful for medical textile applications. A number of epidemiological [4] and animal model studies have been investigated for cellular and subcellular targets of these antivirals and promising results have been observed. Still a lot of work has to be done to further investigation in to its actual potential for human use. This review has revealed a rich source of medicinal and potential targets of many plants extracts. Advanced herbal formulas leads to less side effect, with less cost than the synthetic drugs. A study was undertaken to investigate Bergenia ciliata, Jasminum officinale, and Santalum album for their potential activity[5] against human bacterial pathogens. Among the three medicinal plants, B. ciliata extracts displayed potential activity against bacterial pathogens. Microencapsulation[6] of anti-microbial agents is mostly used in sportswear and medical textiles because of incorporating functional properties. It has been found that the compression garments[7] with activated curative finishes can be used for the management of hypertrophic[7] scarring after severe burns.

About haemorrhoids, fistula and anal fissure

Haemorrhoids are normal vascular structures in the anal canal which help with stool control. If the haemorrhoids get swollen or inflamed known as piles. In normal state Haemorrhoids act as cushions composed of arterio-venous channels and connective tissue that aid the passage of stool. Internal haemorrhoids leads to painless rectal bleeding while external haemorrhoids leads to pain in the area of the anus. External haemorrhoids occur outside the anal verge. It will cause pain, and accompanied by swelling with irritation. External haemorrhoids lead to thrombosis and it becomes a thrombosis haemorrhoid. Internal haemorrhoids are usually not painful and most people are not aware that they have them. Internal haemorrhoids, however, may bleed when irritated. Untreated internal haemorrhoids can lead to prolapsed and strangulated haemorrhoids. If the anal sphincter muscle goes into spasm and traps a prolapsed haemorrhoid outside the anal opening, the supply of blood is cut off, and the haemorrhoid becomes a strangulated haemorrhoid

MATERIALS AND METHODS

Coating herbs on fabric using micro encapsulation method

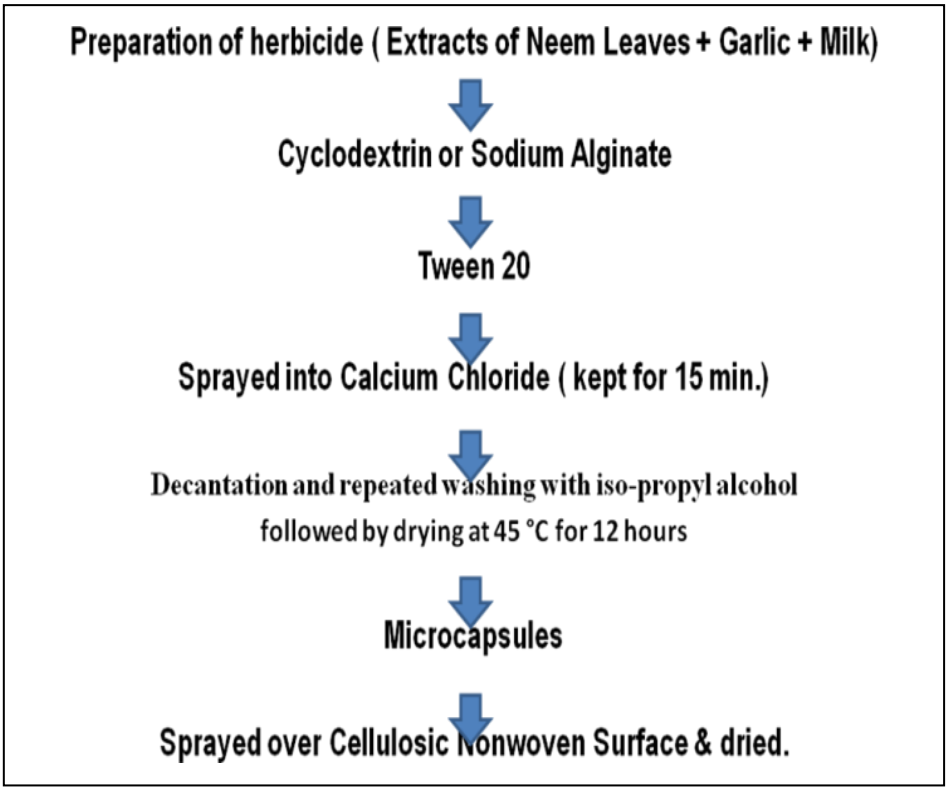

Figure 1: Microencapsulation process

The herbs Neem Leaves, Garlic boiled in Milk are ground into fine paste and the juice of the same was extracted. Then the extract of herbs is mixed with Cyclodextrin or Sodium Alginate and Tween 20. The mixed solution (Figure 1) of all the above were sprayed into Calcium Chloride solution and kept for 15 minutes. Capsules which is formed inside the solution are decanted and washed with iso-prophylalcohol and dried at 450 °C for 12 Hours. The resulting microcapsules are then applied over cellulosic nonwoven fabric along with a binder and dried. The treated fabric is then evaluated for its antibacterial activity quantitatively using colony counting method (AATCC 100-1999) against both Gram-positive (S. aureus) and Gram-negative (E. coli) bacteria. Two control samples were tested in which the untreated fabric was taken as control-I & treated was taken as control-II.

The microencapsulated herb containing bandage is made to stick to the anus, where the presence of piles, fistula and fissure found. The 'Shell' (Calcium alginate) will get opened by Gelation due to exudates, Temperature at wound (Ranging 33 – 37 ° C), Wound pH – 8 & Abrasion. The 'Core', herbal extracts releases and slowly diffuses through the skin to enhance the healing process. The herbal extract 'Nimbin' of Neem leaves controls the temperature at endoderm and inhibits the bacterial activity; while 'Allicin' from Garlic, functions as an anti-biotic and anti-fungal activity. Alginate is a natural polysaccharide extracted from brown seaweeds. Alginate fibres can be made by extruding the water-soluble sodium alginate solution into an aqueous calcium chloride bath, using a simple wet spinning process. Alginate fibres have a unique ion exchange property. On contact with wound exudate, the calcium ions in the fibre exchange with the sodium ions in the body fluid and as a result, part of the fibre becomes sodium alginate. Since sodium alginate is water soluble, this ion-exchange leads to the swelling of the fibre and the in-situ formation of gel on the wound surface. This unique property makes alginate fibre one of the ideal materials for the production of 'moist healing' wound dressings. It is clear that as the sodium content increases, the fibres are capable of holding more water within the fibre structure. This is important in two respects. First, as the fibres hold more water, the dressings are capable of absorbing more wound exudate, hence extending the duration of the dressing. Second, when the fibre absorbs water into the fibre structure and swells, the spaces between the fibres in the dressing are closed, thus prohibiting

liquid from lateral spreading and preventing the maceration of the areas surrounding the wound surface. The adherence of the herbs in the fabric and fibre core is confirmed using SEM images shown in Figure 2.

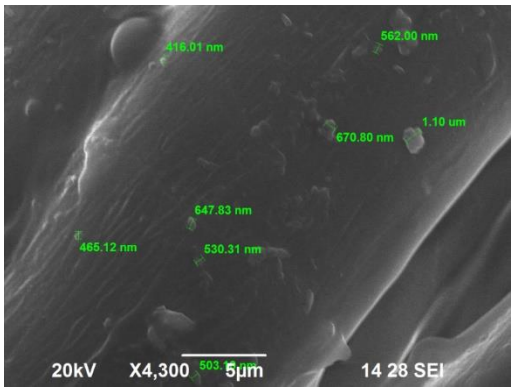

Figure 2: SEM image after microencapsulation

The presence of Nimbin, Alicin, a-L-guluronic acid and b-D-mannuronic acid were confirmed using FTIR Technique. (Figure3,4)

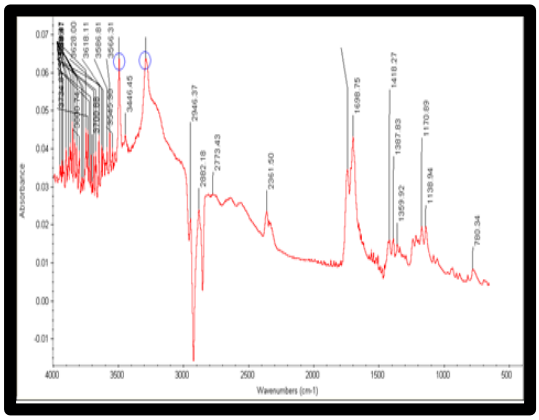

Figure 3: FTIR of viscose non-woven fabric

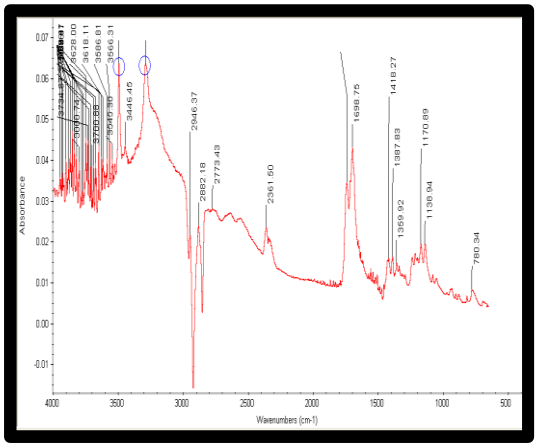

Figure 4: FTIR of micro encapsulated viscose nonwoven fabric

Testing of antibacterial activity

The Antibacterial activity is a means to describe the ability of a textile to suppress the spreading of microorganisms. Antibacterial testing of capsule coated nonwoven fabric samples were tested for antibacterial activity by 'Agar Diffusion Method' (AATCC 100; 1999). Activity against a gram positive bacterium (Staphyliococcus aureus) and a gram negative bacterium (Escherichia coli) was tested.

The anti-bacterial activity on textile material was tested by using AATCC Test Method 100-1999: It is used to find the quantitative evaluation of a textile material for antibacterial properties. A swatch of the antimicrobial treated textile is inoculated with bacteria containing solution (either gram positive or gram negative) and incubated for 18–24 h at 37 ºC. The swatches (Figure 4,5) are then extracted and the number of bacteria in the extract determined by serial dilutions placed on sterile agar containing plates and incubated for 48 h at 37 ºC. Calculations are made to find the percentage reduction of bacteria found on the antimicrobial treated textile compared to the number of bacteria found on an untreated textile of similar construction. Care must be taken to ensure that bacteria actually grow on the untreated textile sample. This can be accomplished by incorporating a small amount of growth medium in the initial inoculating solution.

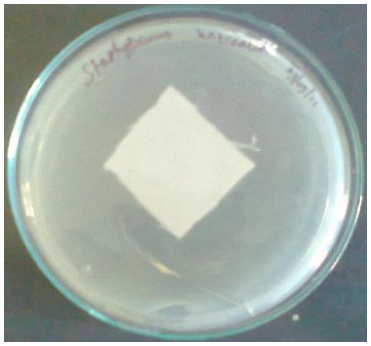

Figure 4: Untreated Sample

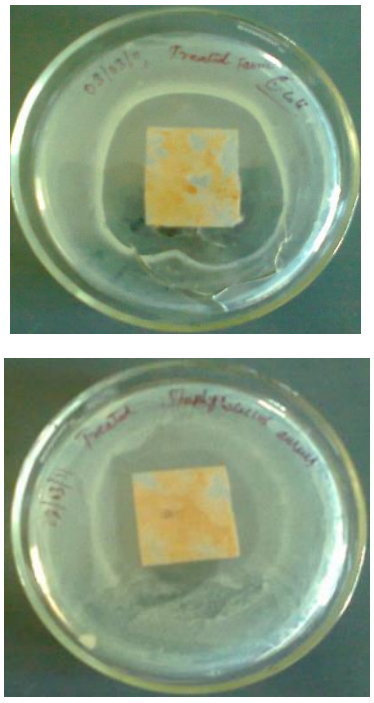

Figure 5: Treated Samples against E.Coli and S. Aureus

RESULTS OF TREATED SAMPLES AGAINST *E. COLI* & *S. AUREUS*

Zone	Against *E.Coli*	Against *S. Aureus*
Zone of inhibition on sample @ 24 hrs.	55 mm	25 mm
Zone of inhibition on sample @ 48 hrs.	55 mm	55 mm

From the table it can be observed that the zone inhibition on sample for 24 hours duration was found to be 55mm against E.coli and 25mm against S.Aureus. The same teat done for 48 hours duration shows a 55mm growth against E.Coli and 55mm against S.Aureus. We can conclude that there is no difference in the growth difference in zone inhibition on sample against E coli when the duration of time increased from 24 hours to 48 hours. But in case zone inhibition on sample against S Aureus when changing the time from 24 hours to 48 hours there is a 55% increase in the growth has been observed.

Clinical assessment of coated nonwoven fabric

Nonwoven fabric bandages containing microencapsulated herbs coating are being clinically evaluated at a nature cure hospital. The performance of the developed curative textile has been observed over a period of two weeks.

Figure 6: Clinical trial

The clinical trial shows a significant improvement in healing of piles over a period of two week

CONCLUSION

Microcapsules coated textile bandage could be used as or the curative textiles. The double functional interface with physical and chemical interactions will enhance the performance of the bandage and thus the efficacy of healing process becomes more effective. The herbal extract coated textile bandage exhibited antibacterial activity against S. Aureus and E.Coli. It was also screened positive signs for the presence of curative herbal products.

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