Comparision of Nano Antimicrobial Finished Organic Cotton and Bamboo Knits

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ABSTRACT
Now-a-days there is a gaining attention for Knit fabrics to be used in wider range including Technical Textiles. Two different Fabrics of Single Jersey Knit, Organic Cotton and Bamboo were used for the study. The Antimicrobial finish of nanoencapsulated Organic Cotton and Bamboo knit fabrics were tested for their effectiveness.

Keywords: Antimicrobial, Organic Cotton, Bamboo, Knitted Fabric, nanoencapsulation

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1. Introduction
There is a vast potential in medical clothes with textile finishes and enormous application of antimicrobial finish in textiles. Nano technology is the most promising area in all disciplines. A lot of innovations are happening in every day but still there is a hope of new research work in nanotechnology. Nano encapsulation is a method wherein the interior core is surrounded with wall material and it is in nano size. Plant bioactive agents can be released with the help of Herbal nano encapsulated finish in the fabric. Studies notify that many plants posses antibacterial activity which can be used for Textiles (1). When Natural herbs are used for the extraction of eco-friendly finish, it lowers the cost and also its allergic reaction caused when compared with synthetic compounds (2). The present study aims at constructing Antimicrobial finished nanoencapsulated Organic Cotton and Bamboo knit fabrics using Herbal combinations and evaluating its effectiveness in standard test methods.
The objectives of the study are as follows:

- To choose suitable herbs and Fabrics
- To treat organic cotton and bamboo fabric using the best herbal finish
- To assess qualitatively the antimicrobial activity in antibacterial nanofinished organic cotton and bamboo knitted fabrics

2. Materials and Methods

2.1. Solvent Extraction of Collected Herbs and Fabric Selection:
The Fresh plant material of the three different plants (Punica granatum, Moringa concanensis, Psidium guajava) were washed twice in fresh water, air dried and powdered using a mortar and pestle and stored in air tight container. 6 gram of powdered plant material was combined in different ratios like (1:2:3) and added to 1000 ml of 80% ethanol solvent. The prepared composite kept in a reciprocating shaker for 24 h for continuous agitation at 150 rpm/min for thorough mixing and also complete elucidation of active materials to dissolve in the respective solvent. Then, extract was filtered by using muslin cloth followed by Whatman no.1 filter paper. Finally, the residues were collected and stored for further experiment. Bamboo and Organic Cotton Single Jersey Knit Fabrics were selected. By considering the ecofriendliness in them the above two fabrics were selected.

2.2. Wall and core materials
The herbal extract composite (Punica granatum, Moringa concanensis, Psidium guajava- 1:2:3 combination) prepared were encapsulated using bovine albumin fraction as the wall material and the nanoparticles as the core material.

2.3. Bacterial cultures used
Escherichia coli and Staphylococcus aureus are the Two bacterial cultures, which were commercially used and hence it was procured

2.4. Nanoencapsulation
The coacervation process of the herbal extract enclosed with Bovine serum albumin protein followed by cross-linking with glutaraldehyde. Then the Herbal composite was incubated with a requisite of 4% protein solution (W/V) for one hour in room temperature. The pH of the solution was adjusted to 5.5 by 1M HCL using digital pH meter. Then ethanol was added to the solution in the ratio of 4:1 (V/V). The rate of herbal extract addition was carefully controlled at 1 ml per minute. The coacervate so formed was hardened with 25% glutaraldehyde for 2 hours to allow cross-linking of protein. Organic solvents were then removed under reduced pressure by rotary vacuum evaporator and the resulting nanocapsule were collected and stored for further studies.

2.5. Fabric finishing with Nanoencapsules using Exhaust Method:
The selected fabric sample (Bamboo and cotton) was finished with the prepared composite of nanoencapsules according to the following recipe (3). About Two litre solution containing 1400g of nanocapsule was used to finish one meter of cotton and bamboo fabric. The fabric was immersed in the herbal nanoencapsulates along with binder solution (8% citric acid) for 30min under 50°C in an International Journal of Medicine and Pharmaceutical Research oven. After 30min, the fabric was removed and air dried in shade.

2.6. Antibacterial Activity By AATCC 147
Sample of the test material along with untreated test material is placed in close contact with agar surface that is already streaked with an inoculums of Escherichia coli and Staphylococcus aureus (4). The test material is checked for the clear area of growth under and in the sides after incubation for the antibacterial activity of the specimen. The middling width of a zone of inhibition with the streak on both the sides of the test specimen is measures for its effectiveness (5). To compute the effectiveness of antimicrobial textiles, examination methods adopted in controlled conditions should reproduce results wanted (6).

2.7. Wash Durability Testing (AATCC 124-1996)
The samples were washed with 5% neutral soap solution for 20 mins and dried. The washed samples were tested for the retention of antimicrobial activity after every 10 launderings for 30 washes using standard procedures.

3. Results and Discussion

3.1. Antibacterial Activity By AATCC 147
The AATCC Bacteriostasis agar plates were prepared by pouring 15ml of AATCC Bacteriostasis agar media into sterile petri plates. The plates were allowed to solidify for 10min and the bacterial culture was inoculated as single line followed by the four lines without refilling the inoculation loop. The antibacterial activity of cotton and bamboo unfinished fabric, Nanocapsule finished fabric and its durability to washed including 10th, 20th and 30th were evaluated by cutting the fabric into 5 X 2.5 cm size with the diameter of 2.5 cm was placed over the inoculated bacterial species. The plates were kept for incubation at 37°C for 24 hours. The zone of inhibition produced was measured at the completion of incubation and it's noted in millimetre.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Fabric Sample</th>
<th>Zone of inhibition in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>E.coli</td>
</tr>
<tr>
<td>1</td>
<td>Nanocapsule finished</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Bamboo</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Nanocapsule finished</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Organic Cotton</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Antibacterial activity by AATCC 147
From the above Table 1 and Figure 1, it can be identified that Nanocapsule finished Bamboo posses the maximum Zone of inhibition in mm against S.aureus, and Nanocapsule finished Organic Cotton showed a lower Zone of inhibition in mm against E.coli.

From the Table 2 and Figure 2 it can be concluded that in nano Bamboo fabrics E.coli showed the highest Zone of inhibition in mm.

3.2. Antifungal Activity Assessment by AATCC 30 - 2003 Test Method: The antibacterial activity of cotton and bamboo unfinished fabric, Nanocapsule finished fabric and its durability to washed including 10th, 20th and 30th were placed in intimate contact with Antifungal agar medium, which has been previously swabbed with broth suspension culture of test organisms Aspergillus niger (ATCC 6275) and Trichoderma reesei (ATCC 28020). The antifungal effectiveness is measured by recording the clear area of uninterrupted growth below and in sides of the fabric, after incubation (5).

Table 2: Antibacterial activity by AATCC 147 (Wash durability)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Fabric Sample</th>
<th>E.coli</th>
<th>S.aureus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nanocapsule finished Bamboo 10th Wash</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>Nanocapsule finished Bamboo 20th Wash</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>Nanocapsule finished Bamboo 30th Wash</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>Nanocapsule finished Cotton 10th Wash</td>
<td>38</td>
<td>35</td>
</tr>
<tr>
<td>5</td>
<td>Nanocapsule finished Cotton 20th Wash</td>
<td>36</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>Nanocapsule finished Cotton 30th Wash</td>
<td>34</td>
<td>29</td>
</tr>
</tbody>
</table>

Table 3: Antifungal activity assessment by AATCC 30 - 2003 test method

<table>
<thead>
<tr>
<th>S.No</th>
<th>Fabric Sample</th>
<th>A.niger</th>
<th>T.reesei</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nanocapsule finished Bamboo</td>
<td>67</td>
<td>69</td>
</tr>
<tr>
<td>2</td>
<td>Nanocapsule finished Cotton</td>
<td>65</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 4: Antifungal activity assessment by AATCC 30 - 2003 test method (Wash durability)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Fabric Sample</th>
<th>A.niger</th>
<th>T.reesei</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nanocapsule finished Bamboo 10th Wash</td>
<td>0*</td>
<td>0*</td>
</tr>
<tr>
<td>2</td>
<td>Nanocapsule finished Bamboo 20th Wash</td>
<td>0*</td>
<td>0*</td>
</tr>
</tbody>
</table>
4. Conclusion
Clothing which was considered as mere has now changes its applications in Functional areas too. There are more researches happening in exploring new potential Antimicrobial finishes for the benefit of humankind. There is a lot of research focus and added value of technical textiles. Hence textile finishes with more add on value in it can be employed in Medical environment. It also paves way to a niche market in the global arena.

5. References