International Journal of Recent Advances in Multidisciplinary Topics
Volume 4, Issue 10, October 2023
https://www.ijramt.com | ISSN (Online): 2582-7839

Analysis of Cassia Fistula Finish on Cellulosic Fabric for Healthcare Products

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***Abstract*: The medicinal plant Cassia fistula, sometimes referred to as the golden shower tree, has been employed in Ayurvedic and other traditional medical systems for its healing characteristics. The utilisation of Cassia fistula extracts in the creation of healthcare goods, notably in the area of wound healing, has recently attracted more and more attention. Flavonoids, tannins, and anthraquinones, which have been proven to have wound-healing, anti-inflammatory, and antibacterial activities, are among the bioactive substances found in cassia fistula. These characteristics make Cassia fistula a desirable choice for use in surgical gowns and other medical supplies.**

***Keywords*: Anti-microbial, Cassia Fistula, Cellulosic Fabric.**

1. Introduction

The tropical plant Cassia fistula, often called the Golden Shower tree, is renowned for having a wide range of pharmacological effects. The antibacterial, anti-inflammatory, and wound-healing qualities of this plant are highly valued in traditional medicine. Recent studies have looked into the prospect of utilising these inherent qualities to improve the functionality of fabrics used in healthcare, particularly those used to make surgical gowns.

The effectiveness of Cassia fistula extract as a cellulosic fabric finish, with a particular emphasis on its relevance to medical products like surgical gowns. We intend to assess the potential effects of Cassia fistula on a number of important aspects, such as antibacterial qualities, liquid repellency, tensile strength, and durability. The final objective is to determine whether fabrics finished with Cassia fistula can provide benefits over conventional textile finishes in the harsh environment of healthcare. One of the main goals is to examine the antibacterial effectiveness of Cassia fistula coating on cellulosic fabric. Enhancing the safety of surgical gowns and other healthcare textiles requires evaluating their capacity to prevent bacterial growth and reduce the possibility of contamination. The fabric's capacity to repel liquids, especially bodily fluids like blood and other pollutants, can be examined in detail. Superior liquid resistance is needed in surgical gowns to preserve the sterility of the operating room.

To make sure that the treated fabric does not have negative effects when in touch with the skin, it is essential to evaluate the biocompatibility of the Cassia fistula finish. In hospital settings, where patients' safety and comfort are of the utmost importance, this is especially crucial. It is crucial to assess the practical clinical applicability of surgical gowns made using Cassia fistula. This involves determining if the treated gowns improve patient outcomes, healthcare staff comfort, and infection control. It is crucial to comprehend how well fabric finished with Cassia fistula withstands repeated washing and sterilisation cycles. Healthcare textiles must sustain their performance over time, thus durability is essential.

The investigation can go as far as comparative studies, in which the performance, cost-effectiveness, and environmental impact of fabrics finished with Cassia fistula and fabrics finished normally are contrasted. The scope can also involve investigating potential adjustments or improvements to the Cassia fistula finish, such as enhancing the extraction procedure or mixing it with other organic finishes for synergistic results.

A crucial consideration is determining whether the application of Cassia fistula finish corresponds with legal requirements and recommendations for healthcare textiles. By doing this, it is made sure that the finished item can be utilised in healthcare facilities legally and safely. It is important to look at the market potential and acceptance of healthcare textiles made from Cassia fistula. Its practical application may depend on how ready healthcare facilities are to adopt this innovation.

The examination of the Cassia fistula finish on cellulosic fabric used in healthcare products like surgical gowns has a wide range of potential applications. It includes issues that are technological, environmental, clinical, and market-related and can help to improve healthcare textiles as well as support ethical and secure healthcare practices.

2. Methodology

A. Material Extraction

First, we had looked into how key fabric qualities are affected by the Cassia fistula finish. This involves comparing the weight, thread count, thickness, and tensile strength of the material before and after the finish has been applied. The goal is to ascertain whether the finish modifies the fabric's physical properties, which are crucial to the functionality of surgical gowns [1]. The antibacterial capabilities of the Cassia fistula-finished cloth are our second goal.

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Thirdly, we want to assess the fabric's ability to repel liquids, especially when it comes to bodily fluids like blood. This is necessary to determine whether the Cassia fistula finish can improve the ability of the gowns to preserve sterility [2]. Finally, we want to evaluate how durable and washable the fabric is. This entails repeatedly washing the treated cloth and assessing any changes in its characteristics to make sure it can survive the severe requirements of healthcare environments.

B. Preparation of Cassia Fistula Sample

Took 50g of fresh cassia fistula seed and put them in a blender and grind into a fine powder and store it in an airtight container [3]. Take a vessel and boil the hot water at 60- 80 degree. Now put the grind seed in the boiled water. Boil the seed for 10 min after that filter the starch like extract from the solution.

Then took 404.9ml of water and boil it at 80 °C– 100 °C. Then add the grind cassia fistula seed in the boiled water. Now add the binder with it. Boil for 10 min to ready the finishing paste.

Check whether the fabric is sized or not then took the desized grey fabric and take the weight of the fabric.

Wash the fabric with hot water and cold water. Now the fabric is ready for the experiment. Took the finishing paste in the applying brush and applied the paste in the fabric. Dried the fabric for half an hour and tested the fabric.

(a) Cassia Fistula Seed

(b) Grinding

(c) Seed paste extract

(d) Starch paste applied on fabric

(e) Fabric dried

Fig. 1.

3. Procedure

A. Prepare the Soxhlet Apparatus

Assemble the Soxhlet extractor, condenser, and round-bottom flask. Place the extraction thimble in the Soxhelt extractor.

B. Loading the Sample

Weigh an accurately measured amount of the dried and ground Cassia Fistula sample and place it inside the extraction thimble.

C. Solvent Selection

Pour a sufficient amount of the selected solvent (methanol) into the round-bottom flask. This solvent will be used for the extraction.

D. Start Extraction

Heat the round-bottom flask with the solvent, causing it to vaporize and rise into the condenser.

The solvent vapor condenses in the condenser and drips onto the Cassia Fistula sample in the extraction thimble. The solvent dissolves the target compounds from the sample and carries them back down into the round-bottom flask.

E. Cycle of Extraction

The Soxhlet extraction operates in a continuous cycle [4]. As the solvent level in the round-bottom flask rises, it eventually siphons out the thimble. The solvent then continues to circulate, extracting compounds from the sample. This cycle repeats until the target compounds are thoroughly extracted or until a set extraction time is reached.

F. Collect Extract

After several cycles, the extracted compounds accumulate in the round-bottom flask.

G. Concentration

Remove the round-bottom flask from the apparatus and concentrate the extract by evaporating the solvent, [5] typically using a rotary evaporator or similar equipment.

4. Final Product

Once the solvent is completely evaporated, you will be left with the concentrated extract from Cassia Fistula, containing the desired compounds.

Soxhlet extraction is known for its efficiency in extracting compounds, especially when dealing with materials that have low solubility in the chosen solvent [6]. It ensures a high degree of contact between the sample and the solvent, leading to effective extraction. However, safety precautions [7], such as proper ventilation and the use of appropriate solvents, should be observed during the process.

Fig. 2. Final product

5. Finishing

A. Padding Method for Finishing the Fabric

Using natural extracts like Cassia Fistula to finish textiles is a standard practice known as padding. Here is a step-by-step tutorial [8] for utilizing the padding approach to apply the Cassia Fistula finish:

B. Materials and Equipment

- Cassia Fistula extract
- Padding machine
- Squeeze rollers
- Drying equipment (e.g., drying oven)
- Testing equipment (for characterization)
- Cellulosic fabric

6. Procedure

A. Prepare Cassia Fistula Extract

Apply the proper technique (such as solvent extraction) to Cassia fistula to extract the active ingredients [9]. For finishing, concentrate the extract to the appropriate level of active components.

B. Fabric Preparation

Make sure the cellulosic fabric is spotless and devoid of any impurities or sizing agents [10]. If pretreatment is required, do so to increase the fabric's ability to adhere to the Cassia Fistula finish.

C. Padding Machine Setup

Set the padding machine up based on the desired finish concentration and cloth breadth. For the right pressure, speed, and liquor application, adjust the machine settings.

Fig. 3. Padding machine setup

D. Application of Cassia Fistula Finish

Fill the reservoir of the padding machine with the Cassia Fistula extract. Make sure the fabric is evenly saturated with the Cassia Fistula extract before running it through the padding machine [11]. In order to produce a uniform and consistent application, adjust the machine parameters as necessary.

E. Squeeze Rollers

After padding, pass the cloth through squeeze rollers to drain extra liquid and make sure the finish is applied evenly.

F. Drying

To evaporate the solvent or carrier liquid and set the Cassia Fistula finish onto the cloth, hang, lie, or use a drying oven with the padded fabric [12]. To protect the fabric, adhere to the suggested drying time and temperature.

G. Curing

Apply heat or a curing procedure to further establish the Cassia Fistula finish if necessary. This might make the finish more durable.

7. Testing and Characterization

Perform the necessary tests to define the completed cloth after drying and curing [13]. This involves evaluating the material's antibacterial, colorfast, tensile, and other pertinent qualities.

A. Quality Control

Check the fabric after it has been completed for flaws or inconsistencies [14]. Make that the cloth is well-adhered to the Cassia Fistula finish and that the finish satisfies the required quality criteria.

B. Documentation

Maintain thorough records of the padding procedure, including the materials' concentrations [15], the machines'

settings, and the drying circumstances.

C. Safety Precautions

When handling Cassia Fistula extract and any chemicals used in the procedure, adhere to safety precautions [16]. As needed, make sure you use personal protective equipment (PPE) and sufficient ventilation.

D. Further Processing

Once the fabric passes quality control tests, it can be further processed into surgical gowns [17] or other healthcare textiles.

8. Silver Nitrate Finish

After the completion of all processes, fabric is dipped in silver nitrate solution for increasing the antibacterial property [18].

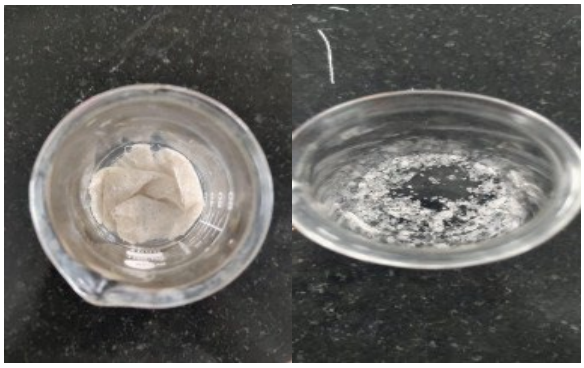

Fig. 4. Silver nitrate finish

9. Agar Diffusion Test (Anti-Microbial Test)

Prepare the nutrient medium (nutrient agar) for E.coli inoculation. Sterilize the required glass wares and medium in Autoclave at optimum condition.

Also sterilize the given cloth sample and other components (L-rod, forceps, scissors) in UV light. After autoclaving, pour the medium in petri plates and allow to solidify to form solid medium.

Inoculate the E.coli culture by spread plate technique using L-rod [19].

Cut a small piece of circles from the given cloth samples and place them at the center of the petri plates using forceps.

Label the plates and incubate at 37°C for 24 hours.

Fig. 5.

Fig. 6. Test results

10. Conclusion

The potential for Cassia fistula-infused fabrics in healthcare products is promising. These fabrics have been developed to possess antimicrobial, anti-inflammatory, and wound healing properties, making them suitable for various medical applications. Advanced textile engineering techniques have been utilized to ensure the efficient integration of Cassia fistula compounds, enabling enhanced functionality and durability. However, further research is necessary to establish standardized protocols and evaluate the long-term efficacy and safety of these fabrics for widespread utilization in healthcare products. As such, the development of Cassia fistula finished fabrics presents opportunities for innovation in the medical field, offering the potential to enhance patient outcomes and improve overall healthcare.

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