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Eco-friendly Antimicrobial Finishing on Cotton Fabric by using Stinging Nettle Leaf

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***Abstract*: Antimicrobial Finishing prevents or inhibits the growth of microorganisms or microbes. Antimicrobials do not all work the same. The vast majority of antimicrobials work by leaching or moving from the surface on which they are appletinis is the mechanism used leaching antimicrobials to poison a microorganism. Such chemicals have been used for decades in agricultural applications with mixed results. Besides affecting durability and useful life, leaching technologies have potential to cause a variety of other problems when used in Garments. These include their negative effects because, they can contact the skin and potentially affect the normal skin bacteria, cross the skin barrier, and/or have the potential to cause rashes and other skin irritations. In this project the leaves, extracted from the stinging nettle leaves is used as an antimicrobial agent, and is applied on the fabric. Cotton fabric is used and the stinging nettle leaves extraction is applied by pad-dry-cure method. The finished fabric was assessed for the antimicrobial property.**

***Keywords*: anti-microbial, stinging nettle leaf.**

1. Introduction

Certain textile material treatments are applied to improve the look and qualities of textile goods. These treatments are called finishes. A finish is a treatment given to a piece of fabric to change appearance, handling/touch, or performance. The purpose is to make the fabric more suitable for its end use. The finishes may be basic or functional. Basic finishes, also called aesthetic finishes, are applied to almost all the fabrics to improve their appearance, feel, and body. Functional finishes are applied to improve the performance of fabric for some specific purpose, for example, fireproof, waterproof, bulletproof, crease-resistant, and antimicrobial finishes.

Bacteria, either pathogenic or not, are normally found on human skin, nasal cavities, and other areas, such as the genital area. Typically, pathogenic bacteria like Escherichia coli and Staphylococcus aureus have been found on textiles. The negative role of microorganisms in the textiles leads the researchers to the development of textiles with antibacterial properties. With this growth in health awareness, many people focused their attention on educating themselves about and protecting themselves from harmful pathogens. It soon became more vibrant for antibacterial finished textiles to protect the user from bacteria rather than simply protecting the garment from fibre degradation. Requirements for antimicrobial agents on textiles concern safety (producer and user), wash, and heat fastness and applicability without negative effects on the textile properties.

Besides, antimicrobial textiles should maintain textile properties such as appearance, feel, and durability to laundering as new functional treatment is fabricated because these are important to the consumer. Therefore, new, advanced, and innovative technologies are required. Several chemicals have been employed to impart antimicrobial activity to textile goods. Many of these chemicals, however, are toxic to humans; they do not easily degrade in the environment. Although chemical antimicrobials are effective against a wide range of microbes, they are cause of concern due to the associated side effects and water pollution. The use of synthetic products is becoming increasingly problematic leading to microbial resistance, product withdrawal, undesirable environmental problems, and animal toxicity. Hence, there is a great demand for antimicrobial treated textiles based on eco-friendly agents helping to effectively reduce the ill effects associated with microbial growth on textile material. The use of natural plant products for antimicrobial finishing of textile materials has been widely reported. The research on their use in textiles is very limited and not well documented. These natural products are associated with various benefits like lower incidence of adverse reactions and reduced cost, compared to synthetic pharmaceutical products, and can be exploited as an attractive eco-friendly alternative to synthetic antimicrobial agents for textile application.

2. Material

A. Materials Required

1) Cotton

100% Cotton scoured fabric is used in the process. Cotton fabric is free from toxins & irritations.

GSM	: 125
Type	: 100% Woven Cotton fabric.
EPI	: 54
PPI	: 40

B. Stinging Nettle Leaf

Urtica dioica, often known as common nettle, stinging nettle

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or nettle leaf, or just a nettle or stinger, is a herbaceous perennial flowering plant in the family Urticaceae. Originally native to Europe, much of temperate Asia and western North Africa, it is now found worldwide, including New Zealand and North America.

1) Sources of nettle leaf

Scientific name : Urtica dioica
Higher classification : Nettels
Family : Urctiaceae
Rank : Species
Order : Rosales
Kingdom : Plantae

The plant is common in herbal medicine, and young leaves can be cooked and eaten as a nutritious potherb. Additionally, stinging nettle has been used as a source of bast fibres for textiles and is sometimes used in cosmetics.

Fig. 1. Stinging nettle

Stinging nettle is an herbaceous plant and often grows to about 2 metres (6.5 feet) in height. The plant can spread vegetatively with its yellow creeping rhizomes and often forms dense colonies. The toothed leaves are borne oppositely along the stem, and both the stems and leaves are covered with numerous stinging and non-stinging trichomes (plant hairs). The plants can be dioecious (an individual produces only female or male flowers) or monoecious (an individual bears both male and female flowers), depending on the subspecies. The tiny green or white flowers are borne in dense whorled clusters in the leaf axils and stem tips and are wind-pollinated.

The fruits small achenes and the plants produce copious amounts of seeds.

The stinging trichomes of the leaves and stems have bulbous tips that break off when brushed against, revealing needle like tubes that pierce the skin. They inject a mix of acetylcholine, formic acid, histamine, and serotonin, causing an itchy, burning rash in humans and other animals that may last up to 12 hours. Hunting dogs running through stinging nettle thickets have been poisoned, sometimes lethally, by the massive accumulation of stings. This defense mechanism is an effective deterrent against most large herbivores though the plant is important food for several butterfly species and aphids. The dried plant can be used as livestock feed, and heating or cooking the fresh leaves renders them safe for consumption.

Stinging nettle has a long history of use as a medicinal herb and is still used in folk medicine for a wide array of disorders, though there is limited clinical evidence supporting its efficacy. The rootstock is used as a diuretic and as an herbal treatment for benign prostatic hyperplasia (prostate enlargement) and other urinary disorders.

Tea made from the leaves has been used to treat hay fever, diabetes, gout, and arthritis, and fresh stinging leaves are sometimes applied to arthritic joints in a process known as urtification, which is said to stimulate blood flow. Topical creams have also been developed for joint pain and various skin ailments, including eczema and dandruff.

3. Methodology

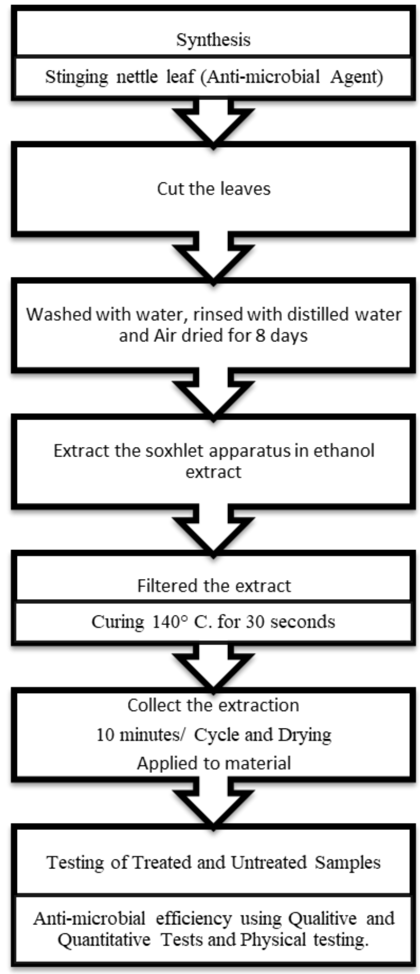

Fig. 2.

Soxhlet extraction, also known as continuous extraction, Soxhlet extraction, is a method of extracting compounds from solid materials. Soxhlet extraction for the determination of crude fat content. Fat is widely found in the seeds and fruits of many plants. The determination of fat content can be used as an indicator to identify its quality.

By using the solvent reflux and siphon principle, the solid matter can be extracted by a pure solvent every time, so the extraction efficiency is high. The solid material should be ground fine before extraction to increase the area of liquid immersion. The solid material is then placed in a filter paper holder and placed in an extraction chamber. Install the instrument as shown. When the solvent is heated to boil, the vapour rises through the air tube and is condensed into a liquid that drip into the extractor. When the liquid level exceeds the highest point of the siphon, siphoning occurs and the solution is refluxed into the flask, so that a portion of the substance dissolved in the solvent can be extracted. In this way, the solvent reflux and siphoning are used to enrich the soluble matter.

Since the extract of the organic solvent contains more or less fats such as free fatty acids, sterols, phospholipids, waxes, and pigments, the results of the Soxhlet extraction method can only be crude fat.

A. Determination of Add On (%)

To estimate the actual amount of nettle leaf extract absorbed by the fabric, the actual weight add on % of the treated fabric was calculated using the following formula,

Add on (%) = [(W2-W1)/ W2] * 100

Where,

W1= weight of fabric before treatment (g)

W2= weight of fabric after treatment (g)

Procedure:

The sample was immersed in nettle leaf extraction for 30 minutes

↓

After the sample was taken out and padded on two bowl pneumatic

Padding mangle at a pressure of 2.5 PSI

↓

The fabric was dried

↓

Cured at 120 C for 5 minutes

Table cover, a cast liner, a splint liner, padding

Antimicrobial Activity Assessment:

Antimicrobial activity was evaluated by both qualitative and quantitative test methods. The following are the descriptions of test methods employed for this study.

Antimicrobial Test:

Table 1
Bacterial reduction test on the pad- dry- cure treated fabric

S.No.	Sample Details	Zone of inhibition in (mm)	
		S.aureus	***E.coli***
1	Sample A	100	99.72
2	Sample B	100	100

The schematic diagram shows that the wetting time 20 mins, the bacterial reduction on Staphylococcus aureus in 100% and Escherichia coli in 99.7%.

The wetting time 30 mins, the bacterial reduction on staphylococcus aureus in 100% and Escherichia coli in 100%.

The wetting time 40 mins the bacterial reduction on staphylococcus aureus in 100% and Escherichia coli in 100%.

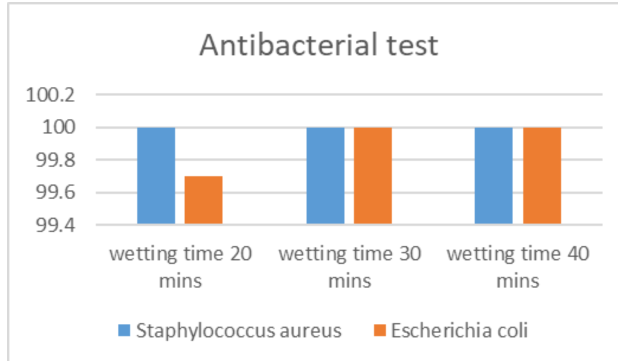

Fig. 3. Bacterial reduction test on pad-dry-cure treated fabric

Durability To Laundering:

The schematic diagram shows that the reduction in the bacterial count for staphylococcus aureus and Escherichia coli.

The washing cycle 5, showed a gradual decrease in antimicrobial property with reduction on staphylococcus aureus in 97% and Escherichia coli in 92%.

The washing cycle 10, showed a gradual decrease in antimicrobial property with reduction on staphylococcus aureus in 88% and Escherichia coli in 80%.

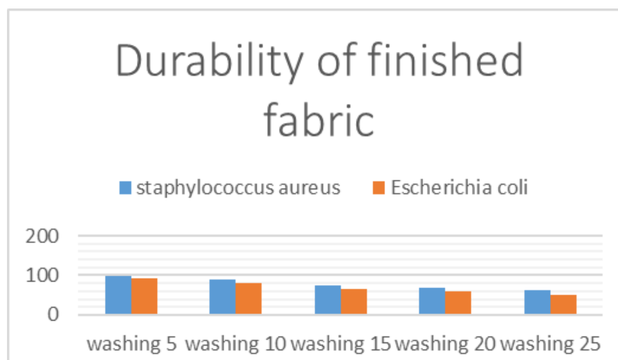

Fig. 4. Reduction in the bacterial count for washing

Effect of Tensile Strength:

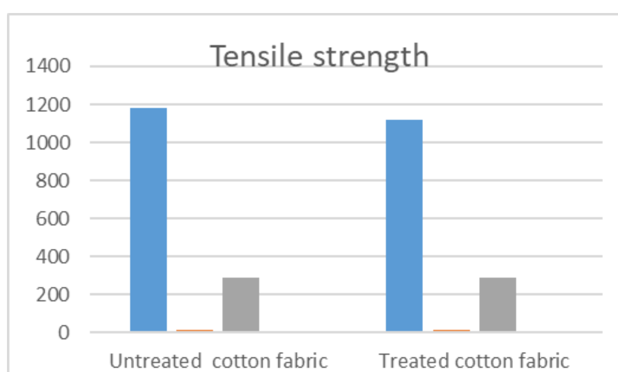

Fig. 5. The tensile strength on untreated and treated cotton fabric

The schematic diagram shows that the untreated cotton fabric compared to Pad-dry-cure treated cotton fabric warp elongation decrease in 0.66%.

The weft elongation in untreated cotton fabric compared to pad-dry-cure treated cotton fabric decrease in 1.17%.

Itching of Finished Fabric:

The Nettle are plants with sharp hairs and their leaves. The Stinging Nettle leaf contains histamine, formic acid, acetyl choline. Histamine is involved in the inflammatory response and has a central role as a mediator of itching.

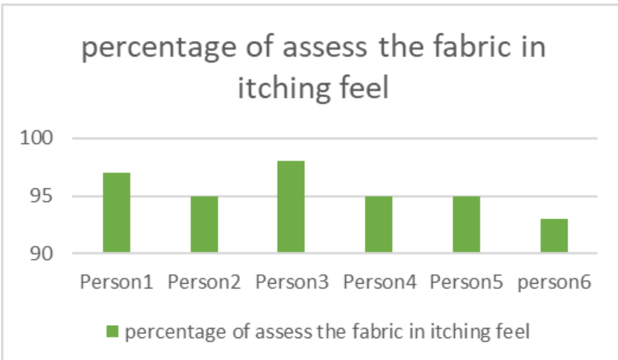

Fig. 6. Percentage of assess the fabric in itching feel

Physical Testing:

Antimicrobial Test:

Table 2
Bacterial reduction test on the pad- dry- cure treated fabric

Sample	Wetting time (minutes)	Staphylococcus aureus (AATCC 6538)	Escherichia Coli (AATCC-4352)
1	20	100	99.72
2	30	100	100

Durability to laundering:

Table 3
Reduction in the bacterial count for staphylococcus aureus and Escherichia coli

Washing cycles	Staphylococcus aureus%	Escherichia coli%
5	97	92
10	88	80

Effect of tensile Strength:

Table 4
Tensile strength on untreated and treated cotton fabric

Fabric	Untreated Sample	Treated Sample A	Treated Sample B
Warp	75°	81°	95°
Weft	92°	82°	98°

4. Conclusion

In conclusion, antimicrobial textiles have gained much attention and popularity in the market and in day- today life during the last two decades. The textile industries continue to introduce different methods in their production to enhance the quality of their products and to satisfy their customers.

The aim of this paper is to explain the details of antimicrobial finishing property for the future cotton material to increase the softness, smoothness and comfort property of the cotton material. It can replace synthetic softeners. The testing methods evaluate were antimicrobial test, durability of laundering, tensile strength, itching on finished fabric and it is observed from the results that the comfort property is found to be good in all aspects observed.

From the results and discussion, it is observed that the comfort property of the cotton fabric is found to be better in all aspects. As the antimicrobial test rating of finished fabric is in the range of Staphylococcus 100 & Escherichia coli 99.72 no growth in the fabric and durability of laundering, it shows that it is fast decrease the bacterial growth the results at various time intervals. The tensile strength property warp elongation decrease in 0.66% weft elongation in 1.17%. Itching of finished fabric test is the fabric gives soft feel in finally 97%. So, it can be concluded from the above test results that the stinging nettle along with can be used as antimicrobial agent for cotton fabric.

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