

To Study the Effect of Clove Oil on Physical Properties of Khadi Cotton

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Abstract: *The study focused on the development of bacteria resistant khadi cotton fabric by treating it with clove essential oil. In this study an attempt has been made to produce eco-friendly khadi cotton fabric which is bacteria resistant and safe for human use. Herbal extracts were applied to grey khadi cotton fabric in three concentrations (1%, 3% & 5%). The samples were tested for physical properties such as crease recovery, bending length, breaking strength and tearing strength of treated and untreated khadi cotton fabric.*

Keywords: Eco-friendly, Essential Clove oil, Crease Recovery, Bending Length

1. Introduction

Clothing and textile materials are in permanent contact with human skin but they are also carriers of micro-organisms such as pathogenic bacteria, odour-generating bacteria and fungi because of the adhesion of micro-organisms on the fabric surface [Deepti G, (2007)]. These bacteria not only cause fibre damage, discolouration and stains but also lead to unpleasant odour in humans. To protect the wearer from infection from microbial attack, textiles can be given finishes with antimicrobial agents. Anti-microbial fabrics are thus developed by either binding anti-microbial agents to fabrics or by allowing the anti-microbial agents to penetrate into outer surface of fibres. The major classes of synthetic anti-microbial agents used for textiles include organo-metallics, triclosan, metal and their salts which are currently used by the consumers. Though these synthetic anti-microbial agents are durable yet they cause side effects as they are toxic and non-biodegradable. [Sun G and Worley SD (2005)]

Researchers are finding alternate ways to impart anti-microbial finish to textiles by using plant extracts. These finishes are durable, have wide range of activity towards micro-organisms and are non-toxic to humans. [Lewin.M.et.al. (1983)]. Plant extracts are a reservoir of pure compounds that have an enormous therapeutic potential to treat many infections. They can be used for development and production of naturally finished fabrics. Sarkar.et. al. (2003) studied the application of clove, neem, tulsi and karanja oil on cotton fabric for their anti-bacterial property. Joshi.et. al. (2009) studied the application of various natural herbal extracts, chitosan and natural dyes on textiles with emphasis on their anti-microbial behaviour. They critically analyzed their future prospects keeping in mind their durability, shelf life and anti-microbial efficiency and found that these agents can be used for imparting finish to the fabrics. Sundarajan and Rukmani (2012) studied antibacterial properties of limonene after applying it to cotton through microencapsulation by using gum acacia as wall material. It was found that limonene microcapsules were fixed to the fabric by using cross linker citric acid

which formed covalent bonds with the fabric due to which the fabric retained the antibacterial property even after 5 washing cycles. Rathianamoorthy and Thilagavathi (2014) studied the application of Terminalia Chebula finish on knitted cotton structures for in vivo analysis. They found that odour formation in textiles is related to thickness and mass per square meter. The finish was applied and tests were conducted to analyze the intensity of odour. It was concluded that higher percentage of anti-bacterial agent leads to odour reduction giving an eco-friendly way of finishing textile material.

It is seen that fabric is the most receptive surface for microbial growth and is in continuous contact with human skin. For this reason scientist and researchers are finding novel ways to solve this problem and make fabric that is bacteria and odour free. Further specialized fabric that does not allow growth of micro-organisms is useful for clothing of babies as their skin is sensitive and more prone to bacterial infections. Such type of special fabric can be made by applying anti-odour finishes that suppress odour perception by controlling the metabolic by products of bacteria. This finish not only imparts medicinal properties but also relieves mental stress in humans by simulating sense organs.

Based on literature reviews, herbal extract clove oil was applied to khadi cotton fabric by pad-dry-cure-method.

Objectives of the Study

The main objective of the present study is to make an eco-friendly, functionally protective eco-friendly fabric.

- To study the behavioral properties of khadi cotton fabric.
- To apply anti-odor finish on this fabric.
- To study the effect of this finish on behavioral properties of this fabric.

Significance of the study

Babies, people older in age and patients in general are more prone to infections because of their low immunity and delicate skin. The developed fabric can be used safely for clothing and linen for this sensitive population. This material

would not only fight against germs and microorganisms it would at the same time be environment friendly and sustainable in several ways.

2. Methodology

To achieve the above purpose clove oil was applied on khadi cotton fabric by pad-dry-cure method and the changes in properties of the fabric were studied. Clove oil was taken with 7% of citric acid as crosslinker. Fabric was dipped in the solution for 30 minutes at room temperature, pressure: 1.5 bar, M.L.R 1:40 followed by padding. The samples were dried at 80°C for 4minutes and cured at 140°C for 2minutes. Clove oil was selected due to its anti-odour and anti-bacterial properties. Eugenol is the main constituent of clove oil which is extracted from the bud of clove plant *Syzigiumaromaticum* through steam distillation. It has the property of repelling various microorganisms. The samples were coded according to concentrations of the solution and then they were subjected to padding and functional tests (Tearing Strength, Tensile Strength, Bending Length, Crease Recovery) were performed. The finish was applied in three concentrations i.e. P₁- 1%, P₃- 3% and P₅- 5% of clove oil and P_c- Control sample. Citric acid was used as crosslinking agent for the process.

3. Results and Discussion

The results show the changes in the fabric properties after application of anti-odour finish.

- **Tensile Strength**-It is the term used to measure the fabric strength in kg per square mm or Newtons per square meter. It is determined as the force required to break a fabric in cross-sectional mass equivalent to one unit of the measure used. The tensile strength showed reduction with increase in concentration of finish. The tensile strength ranged from 364.11N to 325.211N in weft and 403.004N to 326.95N in warp for 1%-5% concentration of finish respectively. It can be said that application of finish in higher concentrations reduces the tensile strength as compared to lower concentrations.

Table 1: Tensile strength of finished cotton samples

Sample Code	Concentration of Clove Oil (%)	Load Warp (NEWTON)	WEFT
P _c	0	423.5	394.5
P ₁	1%	403.004	364.537
P ₃	3%	378.4	340.5
P ₅	5%	326.95	325.211

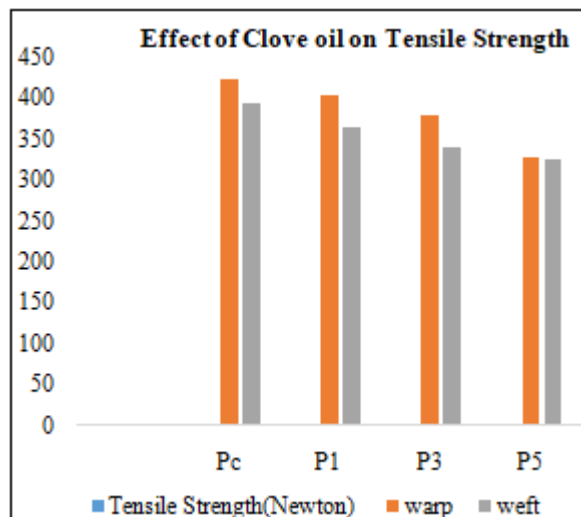


Chart 1: Showing Effect of Clove oil on Tensile Strength

- **Tearing Strength**-The tearing strength also showed a reduction of 10-20% with increase in concentration of finish. Initially, when the finish was applied in low concentration (1%) the requirement of load was 533gm but it reduced to 487.5 gm in warp and 525.5 gm to 510.5 gm in weft with increase in concentration (5%). It can be said that application of finish in higher concentrations reduces the tearing strength as compared to lower concentrations.

Table 2: Tearing strength of finished cotton samples

Sample Code	Concentration Of Clove Oil (%)	Load Warp (Gram)	WEFT
P _c	0	590	560.5
P ₁	1%	533	525.5
P ₃	3%	510	500
P ₅	5%	487.5	510.5

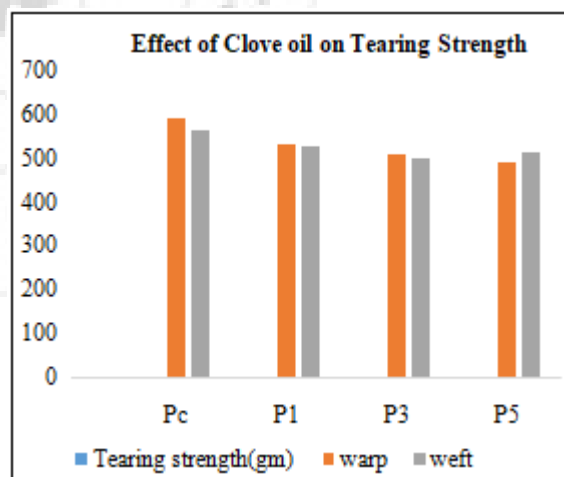


Chart 2: Showing Effect of Clove Oil on Tearing Strength

- **Bending Length**-Bending length gives the fabric property of comfort in wearing. The bending length decreases with high concentration i.e. 2.27 cm to 1.65 cm in warp and 2.02cm to 1.55cm in weft. It can be concluded that application of finish in low concentration with cross linker is recommended.

Table 3: Bending Length of finished cotton samples

Sample Code	Concentration of Clove Oil (%)	Bending Warp	Length (cm) WEFT
P _c	0	2.27	2.025
P ₁	1%	2.05	1.74
P ₃	3%	1.75	1.65
P ₅	5%	1.65	1.55

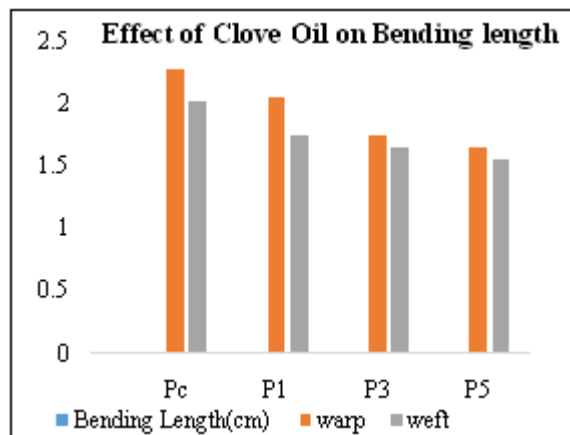


Chart 3: Showing Effect of Clove Oil on Bending Length

• **Crease Recovery Angle**-The ability of a fabric to retain its crease where wanted and to recover from wrinkling is an important property especially in case of apparel fabrics. The crease recovery angle increases with treatment. Initially the angle measured is 101 degrees but with increase in concentration of finish with citric acid as cross linker it increased to 103 degrees in warp and from 89 to 92 degrees in weft. It can be concluded that usage of finish can be done at low concentrations.

Table 4: Crease recovery angle of finished cotton samples

Sample Code	Concentration of Clove Oil (%)	Angle Warp (Degrees)	Weft (Degrees)
P _c	0	101	89
P ₁	1%	101.5	90
P ₃	3%	102	91
P ₅	5%	103	92

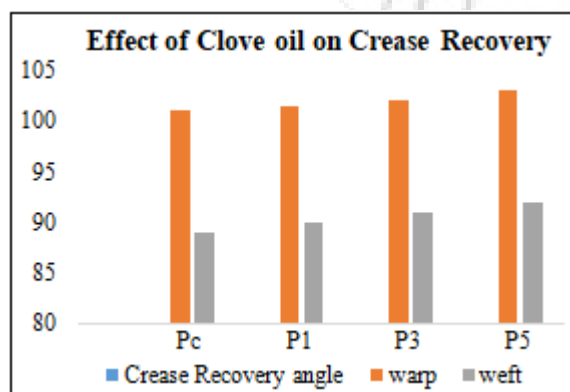


Chart 4: Showing Effect of Clove Oil on Crease Recovery

4. Conclusion

Following the above methodology, the results from study showed that application of finish in higher concentrations makes the fabric low in tensile and tearing strength but the use of cross linking agent decreases the stiffness and

increases crease recovery angle thus making the fabric wrinkle free. Based on the findings of this experimental study it can be said that application of Clove Oil finish in low concentration with cross linker helps develop a textile that has desired functional utility.

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