

# Comparison of the Insect Repellent Property of the Cotton and Wool Dyed with Walnut Kernel and Finished with Natural Extracts

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**Abstract:** Natural dyes are the colorants derived from plants, invertebrates, or minerals. Most of the natural dyes are vegetable dyes. Generally, natural fibres are prone to insect attack. This project deals with the dyeing of cotton and wool fabric using the walnut kernel and finishing with the natural extracts of Neem and lemon grass for imparting the additional properties and comparing the results. The dye extracted from the walnut is used for dyeing which has naturally occurring quinine. Since for the better affinity of natural dyes it requires mordant for dyeing, pomegranate extract is used as mordant for dyeing. In addition to dyeing with the walnut extract the fabrics are finished using natural extracts which have antimicrobial property in addition to insect repellent property. The natural extracts of neem and lemon grass are used for finishing purpose. The insect repellent property of the finished fabric is evaluated through AATCC test method 24. The main aim of the product is to provide the fabric with insecticidal property for the manufacturing of valuable home textiles.

**Keywords:** AATCC test method 24, insect repellent, natural extracts, walnut kernel.

## 1. Introduction

Over the past few years, a widespread interest has emerged around the globe in the dyeing of cotton, silk, and wool with natural colorants. Natural colorants are mostly biodegradable, non-allergic, and less toxic. Walnuts are a valuable crop consumed as fruit worldwide and their shells are produced as waste. Various parts of this plant including leaves, husk and shell have been tested as potential dyeing materials for different textile substrates. The chief coloring compound present in walnut dye is juglone having molecular formula  $C_{10}H_6O_3$ . The walnut dye extraction has insect repellent property over the wool fabrics. The wool and cotton fabric dyed with the walnut kernel extraction and tested for insect repellent property and the fastness property. The insect repellent property of the wool and cotton fabric dyed with the walnut kernel extract is finished with the natural finishing agents such as Lemon grass extract and Neem oil and thus evaluating the insect repellent property by using AATCC method 24.

## 2. Materials and Methods

### A. Materials

The gray wool fabric and the cotton fabric purchased from The Saint fabrics in Amritsar, the walnut is purchased in the local market, Lemon grass and the neem oil used for finishing purchased online. The pomegranate and the hibiscus were collected from the local farm.

### B. Methods

The gray fabrics were subjected to the pre-treatment process such as desizing, scouring, bleaching to make it ready for dyeing. The extracts from the walnut, hibiscus, pomegranate and lemon grass are carried out using the Soxhlet apparatus. The walnut extract generally has the affinity for the wool fabric, to improve the affinity for the cotton mordanting is carried out in three stages and thus compared for the depth of the shade then further processed to finishing, the mordanting agents used are extract from pomegranate and hibiscus. After the completion of the dyeing process the fabrics are subjected to finishing. The finishing process is done by the application of the three-bowl padding mangle with the expression of 80%. The finished fabric is then subjected to testing for the quality parameters to evaluate the efficiency of the finishing and comparing the results.

## 3. Results and Discussion

### A. Washing Durability Test-AATCC TM61

These accelerated laundering tests are to evaluate the colorfastness to laundering of textiles which are expected to withstand frequent laundering. The fabric color loss and surface changes resulting from detergent solution and abrasive action of five typical hand or home launderings, with or without chlorine, are roughly approximated by one 45 min test. Specimens are tested under appropriate conditions of temperature, detergent solution, bleaching and abrasive action such that the color change is like that occurring in five hand or home launderings. The laundering cycles of the finished fabric

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were analyzed using a wash durability test. The natural extract finished fabrics sustained insect repellent activity until 11-15 washing. At the same time, we are not applying any chemicals for durability. Because we planned to make an eco-friendly product. The below results are based on the test method requirement.

Table 1

Fabric \ Test	Walnut Dyed Wool Fabric (Per Wash)	Finished Wool Fabric (Per Wash)
Wash Durability Test	11	15

Table 2

Fabric \ Test	Walnut Dyed Cotton Fabric (Per Wash)	Finished Cotton Fabric (Per Wash)
Wash Durability Test	10	12

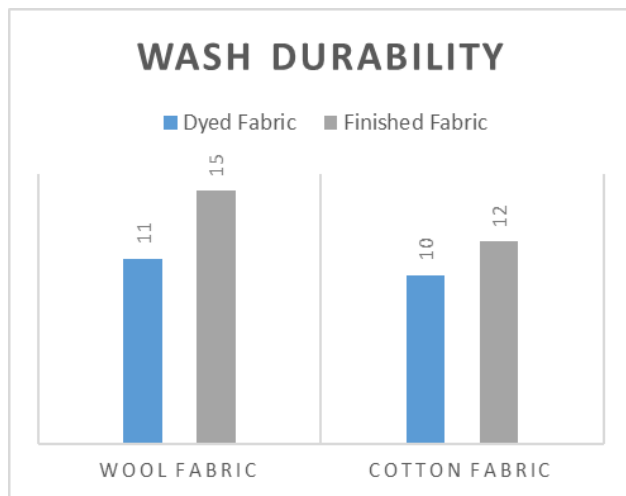


Fig. 1. Wash durability

**B. Color Fastness to Washing-ISO-105-C06**

The mordanted walnut-dyed woolen fabric samples have been found to have good to very good wash fastness ratings of 4-5 on grey scale than the cotton fabric. Staining on adjacent test samples of cellulose acetate, cotton, nylon, and polyester fabrics has been found to vary from very light to no stain ratings of 4-5 on grey scale; no staining on adjacent acrylic fabric test sample was observed having ratings of 5 on grey scale and staining on adjacent wool fabric test sample has been found to vary from very light to no stain ratings of 4-5 on grey scale. Staining on adjacent test samples of cellulose acetate, cotton, nylon, and polyester fabrics has been found to be very light to no stain ratings of 4-5 on grey scale, and no staining on adjacent acrylic and wool fabrics has been observed. For most of the samples, no staining on adjacent cotton fabric test samples was found to vary from very light to no stain ratings of 4-5 on grey scale. In most of the samples, no staining on adjacent test samples of nylon, polyester, acrylic and wool fabrics has been observed having ratings of 5 on grey scale; only one on nylon fabric ranging between very light to no stain ratings of 4-5 on

grey scale. Since the affinity of the cotton is low towards the walnut exhibits the lower grades towards washing.

Table 3

Fabric \ Test	Walnut Dyed Wool Fabric	Finished Wool Fabric
Washing Fastness	4.0	4-5

Table 4

Fabric \ Test	Walnut Dyed Cotton Fabric	Finished Cotton Fabric
Washing Fastness	3-4	3



Fig. 2. Colour fastness to washing

**C. Color Fastness to Rubbing-AATCC TM8**

This test method is designed to determine the amount of color transferred from the surface of colored textile materials to other surfaces by rubbing. It is applicable to textiles made from all fibres in the form of yarn or fabric whether dyed, printed or otherwise colored. It is not recommended for use for carpets or for prints where the singling out of areas may be too small using this method. As washing, dry cleaning, shrinkage, ironing, finishing, etc., may affect the degree of color transfer from a material, the test may be made before, after, or before and after any such treatment. A colored test specimen is rubbed with white crock test cloth under controlled conditions.

Color, transferred to the white test cloth is assessed by a comparison with the Gray Scale for Staining or the Chromatic Transference Scale and a grade is assigned. The Woolen samples dyed with the walnut have found to have good fastness to rubbing with the crock meter. It shows the gray scale rating of 4-5 while comparing the stained testing white cloth with the gray scale for both the wet rubbing and dry rubbing. Since the affinity of the cotton is low towards the walnut exhibits the lower grades towards rubbing.

Table 5

Fabric	Walnut Dyed Wool Fabric(Wet Rub/Dry Rub)	Finished Wool Fabric(Wet Rub/Dry Rub)
Test		
Rubbing Fastness	3.5	4

Table 6

Fabric	Walnut Dyed Cotton Fabric(Wet Rub/Dry Rub)	Finished Cotton Fabric (Wet Rub/Dry Rub)
Test		
Rubbing Fastness	3	3.5

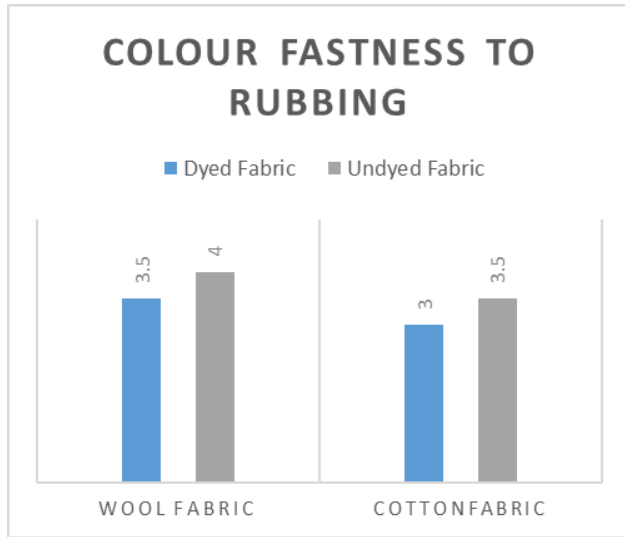


Fig. 3. Colour fastness to rubbing

**D. Color Fastness to Light-AATCC 16.3**

This test method provides the general principles and procedures for determining the color fastness to light of textile materials outdoors under glass. The test options described are applicable to textile materials of all kinds and for colorants, finishes and treatments applied to textile materials. The dyed Woolen samples and Cotton samples were found to have better light fastness property. The fading of the color is comparably low. The fading of the color is assessed by using the K/S value. The dyed Woolen sample, Cotton samples and tested Woolen samples, Cotton samples are compared for the color difference. Thus, both the samples exhibit a similar fastness towards the light.

Table 7

Fabric	Walnut Dyed Wool Fabric	Finished Wool Fabric
Test		
Light Fastness	4	4

Table 8

Fabric	Walnut Dyed Cotton Fabric	Finished Cotton Fabric
Test		
Light Fastness	3	3-4

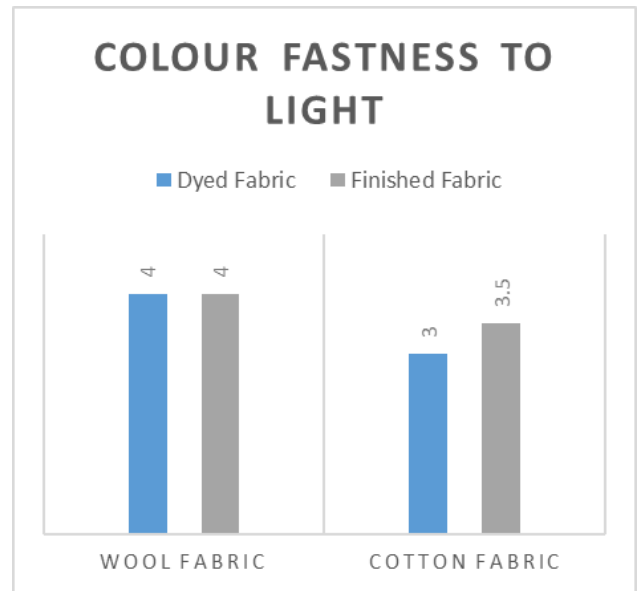


Fig. 4. Colour fastness to light

**E. Test for Insect Repellency-AATCC TM24**

Biological test methods are given for evaluating the resistance of textiles that contain wool or other susceptible fibres to webbing clothes moths and to carpet beetles. The test methods described here are not concerned with the various procedures for treating textiles [e.g., dyebaths vs. padding application of moth proofers] or with their subsequent handling, ageing, washing, etc. but only with the biological methods to be used to measure the resistance of the [treated or untreated] textiles to insect attack. Two methods are provided for determining the extent of damage to test specimens. The Excrement Weight Method is used only for tests with carpet beetles. The Fabric Weight Loss Method is used for tests with webbing clothes moths and may be used for tests with beetles when preferred and when comparative tests with both insects are made.

Table 9

Fabric	Walnut Dyed Wool Fabric	Finished Wool Fabric
Test		
Insert Repellency-Assessment by fabric weight loss	Original weight: 3gms Weight after test:2.52gms	Original weight:3gms Weight after test:2.7gms

Table 10

Fabric	Walnut Dyed Cotton Fabric	Finished Cotton Fabric
Test		
Insert Repellency-Assessment by fabric weight loss	Original weight: 3gms Weight after test:2.4gms	Original weight:3gms Weight after test:2.6gms

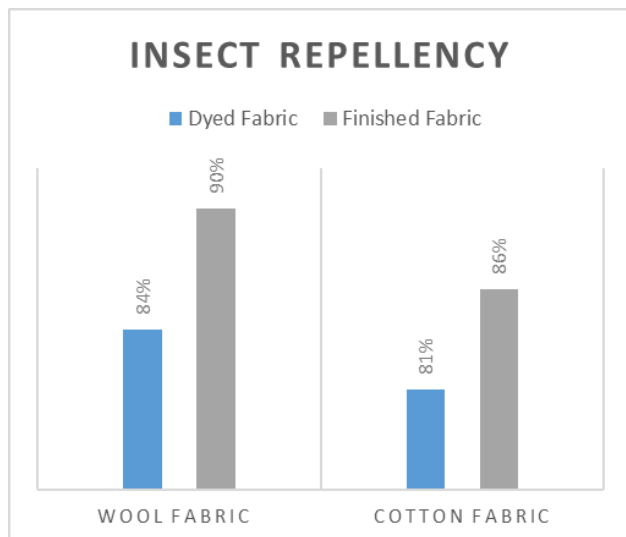


Fig. 5. Insect repellency

#### 4. Conclusion

In the increasing trend of sustainability and eco-friendly products, hereby we conclude that natural dyes and natural finishing agents can be used as a substitute for synthetic dyes and finishing agents' wool. The fastness properties obtained are found to be good for wool when compared to cotton. However walnut kernel dyes give good fastness properties and thus have good insect repellent property. And thus, the finishing with lemon grass extract has improved the insect repellent property further. Most of the dyed woolen fabric samples have been found to exhibit good light fastness rating of five on blue scale and good to very good wash fastness ratings on grey scale and

staining on adjacent fabrics has been found to vary from very light to no stain on grey scale than the cotton fabric. Therefore, the wool fabric has more affinity towards the walnut than the cotton and exhibits the good insect repellent properties and in other way the finished cotton fabric has good antimicrobial properties can be used in the application of home textiles to replace the toxic insect and mosquito repellents the home textile product with the inbuilt insect and mosquito repellent property can be incorporated.

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