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Research Article

A COMPARISON OF PHYSICAL PROPERTIES BETWEEN PLAIN KHADI COTTON FABRIC WITH BABOOL DYED AND CITRONELLA OIL FINISHED KHADI COTTON FABRIC USING ALUM AS A MORDANT

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ABSTRACT

As dyed khadi cotton fabric has more acceptance than plain khadi cotton fabric and scoured khadi cotton fabric. Application of natural dye is always beneficial as synthetic dyes are more harmful to skin. So, in this study babool is used as a natural dye and alum as a mordant. Citronella oil is used as an antimicrobial finish. Physical properties were changed when babool was used as a dye material and citronella oil used as antimicrobial finished and those changes in physical properties were tested and concluded in this study. Comparison of physical properties between plain khadi cotton fabric, dyed khadi cotton fabric and citronella oil finished khadi cotton fabric were shown in this research study. These comparative effects of natural dyeing using babool and alum as a mordant on the physical properties of plain khadi cotton fabric is the aim of this study. As synthetic dyes show environmental and dermatological hazardous effect their natural alternatives are gaining popularity. This study involved dyeing plain khadi cotton fabric with babool bark extract using alum as a mordant and citronella oil used for antimicrobial finished. This experiment analyzed main physical properties, those are tensile strength, elongation, tearing strength, bending length and crease recovery. Result of this experimental work shown different physical properties with increased, decreased and stabled effects. In this way physical properties of plain khadi cotton fabric, babool dyed khadi cotton fabric and citronella oil finished khadi cotton fabric compared in this research study.

Keywords: Khadi cotton fabric, Babool dye Alum, Citronella oil, Physical properties.

INTRODUCTION

The name "Khadi," which comes from the word "khaddar," refers to a hand-spun and woven natural fibre textile that was first employed by Mahatma Gandhi in 1918 during the Indian subcontinent's freedom struggle. The phrase is used in Bangladesh, Pakistan, and India. In 1917–18, the Sabarmati Ashram produced the first piece of the hand-woven fabric. Gandhi called it 'khadi' because of the coarseness of the fabric. Cotton is typically spun by hand and woven into the fabric. But it might also comprise wool or silk, which are all spun into yarn on a Charkha, a type of spinning wheel. This fabric is warm in the winter and cool in the summer. Khadi/khaddar is occasionally starched to give it a firmer feel and to enhance its appearance. Colour substance derived from natural sources are known as natural dyes. Up until the middle of the nineteenth century, natural dyes were utilized to dyeing and printing many kinds of fabrics. The introduction of synthetic dyes, which were affordable and had superior fastness qualities, led to a decrease in the usage of natural dyes. Natural dyes are becoming more popular, nevertheless, as a result of stricter environmental regulations, global environmental concerns, and rising consumer awareness of the harmful effects of synthetic dyes. Although plants are the primary source of natural dyes, these dyes are essentially components of natural resources and are often categorized as plant, animal, mineral, and microbial dyes according to their place of origin. Because they are biodegradable and renewable, natural dyes are sustainable. The babool tree, also known as Acacia Nilotica, is a medium sized tree with golden yellow flowers and long white thorns. The bark of the tree is rough and is dark brown, wood reddish brown, hard and strong, useful for agriculture and much other purpose. The bark of the tree gives light brown colour which in combination with different mordants, gives different shades. Babool is

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suitable for Khadi cotton fabrics. It produces black, brown and khaki shades. Considering the toxic and carcinogenic effects of synthetic dyes, eco-friendly natural dye Babool, were selected and used for the study. (Mrs. V. Rajeswari, 2020). In order to set (i.e., bind) dyes on textiles, a chemical known as a mordant or dye fixative forms a coordination complex with the dye, which subsequently adheres to the fabric (or tissue). It can be used to enhance stains in cell or tissue preparations or to dye textiles. Directs have generally replaced mordants in industry, however they are still used, particularly by small batch dyers. (Wikipedia). The most often used mordant is alum. There are two kinds of this naturally occurring metallic mordant: aluminum potassium sulfate and aluminum ammonia sulfate. Potassium aluminum sulfate is inexpensive, accessible, and secure. Colour is unaffected. It enhances and intensifies the finished color. Textiles with more alum seem harsh and sticky. Cream of tartar, which aids in evenness and somewhat brightens, is typically added with it. (Prakash)

MATERIALS AND METHODS

Pure khadi cotton fabric (100%) was selected for the study. Alum (aluminium sulphate) was used as the metal mordant, while babool (Acacia nilotica) root powder served as the natural dye source. Citronella oil was incorporated as a natural finishing agent. Sodium chloride (NaCl) and sodium carbonate (Na_2CO_3) were used as auxiliaries during the dyeing and pre-treatment processes. The dyeing procedure consisted of four main stages: pre-treatment, dye extraction, mordanting, and dyeing, all performed under controlled conditions to maintain uniformity. The fabric was first subjected to pre-treatment through scouring with a mild alkaline solution containing sodium carbonate, which helped remove natural impurities, oils, and sizing materials. The fabric was then rinsed thoroughly and air-dried. For dye extraction, babool root powder was soaked in water and heated to release the natural colorants, and the resulting mixture was simmered for a specific duration before being filtered to obtain a clear dye extract. Mordanting was carried out by immersing the pre-treated fabric in an alum solution, allowing the metal ions to interact with the fiber under controlled temperature and time. After mordanting, the fabric was rinsed and dried. The dyeing process involved immersing the mordanted fabric in the prepared babool dye bath, to which sodium chloride was added to enhance dye absorption. The dye bath was maintained at a controlled temperature with continuous agitation to ensure uniform color uptake. After dyeing, the fabric was rinsed and dried. Finally, citronella oil was applied as a natural finishing treatment using an appropriate padding or immersion technique, followed by drying to complete the process.

Preparation of raw Material

Mordanting

Mordanting of the fabric was performed using alum 15% of weight of fabric. Material to liquor ratio 1:20 was taken. Mordant bath was maintained at 40°C temp and then added plain fabric. Temperature was maintained at 80°C with constantly stirring for about 30 minutes. Then fabric taken out from dye and fabric was dried without washing.

Dyeing

Mordanted khadi cotton fabric was dyeing with extract using material to liquor ratio was 1:30. Some drops of sodium carbonate for pH value. maintained pH value 5. Dye bath was at a temperature 40° C and salt was added 10 gm per liter, after adding mordanted fabric. Then temperature was maintained at 60° C with continuous stirring for about 30 minutes. Fabric was taken out from the dye bath and dipped in regular water and then washed gently in non-ionic soap solution. Then dyed fabric was dried at normal room temperature.

Physical Properties

Tensile Strength (kg) and Elongation (%)

The specimens were tested as indicated by the IS 1969:1985 test method used. The test specimens were gripped between two clamps of the tensile testing machine in such a manner that the same sample of fabric was gripped by both the clamps. A continuous increasing load was applied longitudinally to the specimen by moving one of the clamps until the specimen was ruptured. The value of breaking load and elongation was read in the warp and weft directions and recorded in computer.

Tearing Strength

The tearing strength of the fabric in both the warp and weft directions was examined. Tearing strength was determined by measuring the “tearing strength” as specified in IS 6489:1993, using a “Paramount tearing strength tester.”

Bending Length (cm)

The selected fabric sample’s stiffness as indicated by the bending length in the warp and weft directions was measured as per IS: 6490-1971 (Cantilever Test) standard test method using Fabric Stiffness Tester for fabric specimen of 20 cm x 2.5 cm size.

Crease Recovery

The crease recovery in both the warp and weft directions of the selected fabric samples was assessed. Crease recovery was determined by measuring the “crease recovery angle.” The crease recovery angle was measured according to IS 4681:1981 using a “Presto crease recovery tester.”

Application of citronella finish on fabric through pad-dry-cure method

Padding baths were prepared by taking 20% of microcapsules prepared from citronella oil in selected concentration with material to liquor ratio (MLR) 1:10 and adding 8% of acetic acid according to the weight of the fabric. Mixture was continuous stirred for 25-30 minutes

through mechanical stirrer. Then the fabric samples were dipped into the prepared mixture for 30 minutes and assigned through the padding mangle by applying pressure of 1.8 bars and speed 2m per minutes. The fabric samples were again immersed in the respective solutions for another 5 minutes and the padding and squeezing process was again repeated. After finishing the fabrics were removed. Drying and curing were carried out in hot air oven which was used for drying, condensation and fixation of finish. The fabrics were dried and cured at 50°C for 10 minutes.

RESULTS AND DISCUSSION

IS 1969:1985 test method was taken for assessment of elongation of plain khadi cotton fabric. As sample was dyed with babool using alum as a mordant and citronella oil finished it shown changes in their physical properties as per graph, I show that elongation of sample before dye i.e. plain khadi cotton fabric was 10.0% as warp and 8.2% as weft. But when the same sample was dyed with babool using alum as a mordant their warp become 9.8% and weft become 5.8%. Then after citronella oil finished sample become 5.6 on warp and 4.6 on weft. IS 1969-1989 test method was taken for assessment of tensile strength in kg plain, babool dyed and citronella finished khadi cotton fabric. When applied tensile strength test on same plain khadi cotton fabric, as per graph II tensile strength of warp was 78.89 kg and tensile strength of weft was 56.46 kg and after application of dye tensile strength of same dyed sample become 67.16 kg on warp and 49.97 kg on weft. Then after citronella oil finished sample become 85.96 kg on warp and 45.46 kg on weft.

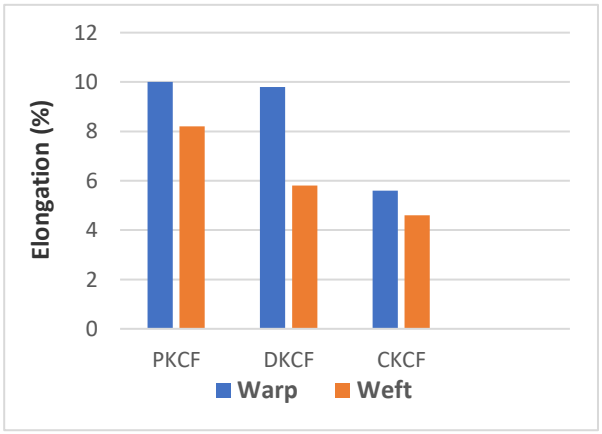

Figure 1. Graph showing assessment of Elongation of plain cotton khadi fabric.

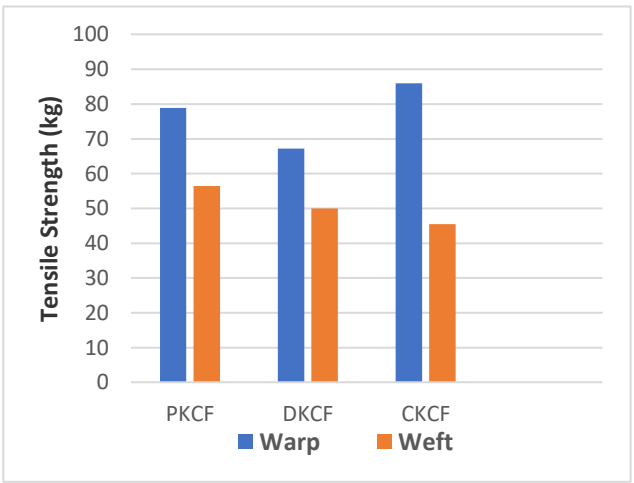

Figure 2. Graph showing assessment of tensile strength of plain cotton khadi fabric.

IS 6490:1971 test method was selected for assessment of bending length in cm for plain khadi cotton fabric, babool dyed khadi cotton fabric and citronella oil finished khadi cotton fabric. Graph III shows that bending length of plain khadi cotton fabric for warp was 1.36 cm and for weft was 1.45 cm. when it was dyed with babool using alum as a mordant its bending length for warp become 1.43 cm and for weft become 1.41 cm. After application of citronella oil bending length of same finished sample become 1.62 cm on warp and 1.6 cm on weft. IS 6489:1993 test method for assessment of tearing strength was taken for plain, babool dyed and citronella oil finished khadi cotton fabric. As per graph IV tearing strength of plain khadi cotton fabric was 3942.40 gm for its warp and 3532.80 gm for its weft. When same sample dyed with babool using alum as a mordant its tearing strength become 3174.4 gm for warp and 2841.6 gm for weft. Then after application of citronella oil tearing strength of same finished sample become 3916.8 gm on warp and 3714.4 gm on weft. IS 4681:1981 test method for assessment of crease recovery was selected for plain, babool dyed khadi cotton fabric and citronella oil finished khadi cotton fabric. As per graph V it shows that crease recovery of plain khadi cotton fabric was 56.40° for warp and 54.00° for weft. When the same plain fabric was dyed with babool using alum as a mordant its crease recovery become 60.8° for warp and 57.0° for weft. Then after citronella oil finished sample become 72.6° on warp and 69.4° on weft.

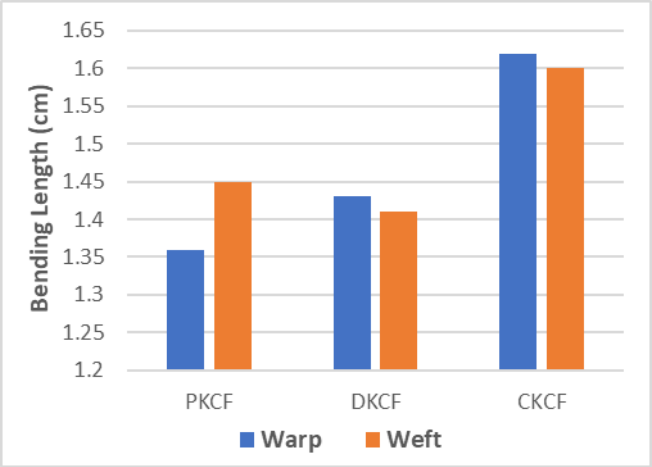

Figure 3. Graph showing assessment of Bending length of plain cotton khadi fabric

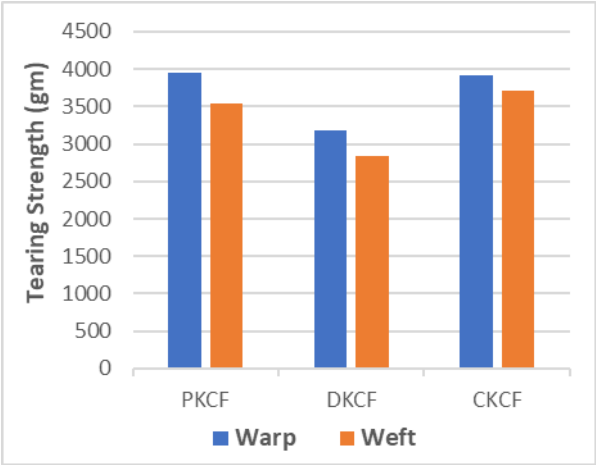

Figure 4. Graph showing assessment of Tearing strength of plain cotton khadi fabric

CONCLUSION

Different physical properties were tested on plain khadi cotton fabric, babool dyed khadi cotton fabric and citronella oil finished khadi cotton fabric. Combinedly result of all tests show different way of variation. Elongation of dyed khadi cotton fabric was reduced when it dyed with babool and used alum as mordant and citronella oil finished. Tensile strength is also an important physical property due to dyeing of plain khadi cotton fabric it shows decrease in tensile strength. When applied citronella oil finished on khadi cotton fabric it shows increase in warp and decrease in weft. Tearing strength of the fabric was observed in grams. Results of tearing strength test shows it decreased in

tearing strength as compared plain khadi cotton fabric with dyed khadi cotton fabric and increased in tearing strength as compared plain and dyed khadi cotton fabric. Bending length of both the samples were tested it shown increase in bending length as compared of plain khadi cotton fabric with babool dyed khadi cotton fabric and citronella oil finished khadi cotton fabric. Crease recovery of both fabrics was tested with specific tests to observe its change. It shows that crease recovery angle of plain khadi cotton fabric was increased when it dyed and finished.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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