

YRF Summary Report

Development of Patterns from Nature through Contact Dyeing/Printing

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Introduction

According to the elements cycle, the chemicals present in synthetic dyeing, transfer from soil to plants to the animal to humans and on using these substances regularly are accumulated in the underground waters, air, and soil which harm human and ecology. Hence it becomes evident that the green chemical approach is given to the textile industry and thus came in the new era of natural dyes. The colourants present in natural dyes are obtained from animal, vegetable or mineral matter without chemical processing. Despite all the practical disadvantages, the use of natural dyes has found itself well-rooted in the textile industry (Lellis et al., 2019).

The present study was undertaken to produce natural random patterns using marigold flowers on cotton and silk fabric following the contact dyeing/printing method. This method is an alternative and more sustainable method for natural dyeing using natural mordants which has the potential for reducing wastewater and requires less equipment. Contact dyeing/printing using natural dyes is still very limited, due to poor colourfastness, colour strength and lack of standard colour retention.

In this method, random and complex patterns were produced using marigold flowers on cotton and silk fabrics. Alum, Vinegar and Iron mordants of different concentrations and treatment times were applied to improve the colour strength (K/S) and colourfastness of naturally dyed/printed fabrics.

Null hypothesis of the study were set as follows-

1. Varying concentration of mordants do not affect colour strength of fabrics.
2. There is no significant difference in the colour strength of dyed/printed fabrics in relation to time exposed to boiling and steaming heat.

Delimitation

1. Study was limited to the marigold flower saffron colour and Alum, Vinegar and Iron mordants.
2. Light weight cotton (100 %) and light weight silk (100%) were used for this study.

Objectives:

1. To produce complex, random natural patterns on different fabrics using natural dyes
2. To apply various mordents on dyed fabric to improve colour strength and colourfastness properties
3. To test colour strength, colourfastness to washing, rubbing and sunlight of printed/dyed fabric
4. To develop product using naturally dyed/printed fabric

Methodology

Commercially available cotton and silk fabric were bundled with marigold flower petals individually, immersed in naturally prepared iron mordant. To create natural patterns, one part of the prepared bundles of cotton and silk were steamed for 1 hour, 1.5 hours and 2 hours and the other part were boiled for 15 minutes, 30 minutes and 45 minutes.

Eco-printed/dyed cotton and silk fabrics were post-mordanted with varying concentration of aluminium potassium sulphate – 5%, 10%, 15%, and natural white vinegar - 1%, 3% 5%. On this background, the effect of boiling, steaming time as well as the concentration of mordants on colour strength (K/S) and colourfastness properties were studied with standard procedures. To test the hypothesis One Way ANOVA was applied. Different products like silk scarves and cotton cushion covers were also produced.

Data Analysis and Results

Cotton and silk both fabrics have different characteristics. Vinegar and potassium aluminium sulphate both have different chemical compositions, so they influenced the colour strength and colourfastness properties of cotton and silk fabrics differently.

The effect of varying boiling and steaming time and constant mordanting concentration on colour properties was studied. The Colour strength of cotton and silk fabrics increased markedly on increasing the boiling and steaming time. The Colourfastness properties of both the fabrics were also found to improve. The influence of boiling and steaming time on the colour strength of eco-printed silk fabric was noted slightly well than cotton fabric. The increase in colour strength in silk fabric was due to the presence of multiple functional groups like -OH, -SO₃H, -COOH, -C₆H₅OH, -NH₂. These reactive groups are helpful for the good dyeing and k/s values in silk (**Jeyaraj et al., 2015**).

Cotton fabrics eco-printed through boiling and steaming method were evaluated with increased colour strength (K/S) when post-mordanted with alum 5% as compared to 1% vinegar. In case of silk fabric, similar results were found on post-mordanting with 5% alum and 1% vinegar. These mordanted cotton and silk fabrics presented improved colourfastness properties compared to the control sample.

The effect of varying mordant concentration and constant boiling and steaming time of eco-printing on colour properties was also studied. Cotton and silk both fabrics have exhibited decreased K/S value on increasing the concentration of mordants. These fabrics showcased better K/S value on 5% alum and 1% vinegar treatment in both the cases of contact dye/printing techniques boiling-45 minutes and steaming -2 hours. Much difference was not seen in colourfastness properties of cotton and silk fabrics, post-mordanted with increased concentration of mordants- alum and vinegar.

According to one way ANOVA result, effect of boiling time & steaming time on colour strength of contact dyed/printed cotton and silk fabric as well as the effect of varying

mordant percent on colour strength of both dyed/printed fabrics were found significant at 5 % level. It is clear p value was < 0.05 , so null hypothesis was rejected. Hereby, it can be concluded that varying concentration of mordants do affect colour strength of fabrics and there is a significant difference in the colour strength of dyed/printed fabrics in relation to time exposed to heat.

Conclusion

The combination of boiling and steaming technique for contact printing and mordant concentrations showed good colour strength (K/S) and colourfastness properties in cotton and silk fabrics. Hence, this study will be helpful to garment manufacturers and designers as it will help them in developing new styles of garments from naturally dyed/printed fabrics. The study will increase the marketability of contact dyed/printed fabrics and will attract the consumer towards naturally dyed garments.

In this study, marigold flower natural prints were also developed on silk scarves as well as on cotton fabric cushion covers. Fashion accessories, handbags, pouches/clutches and other useful products can also be designed.

Suggestion/Recommendations:

1. Similar study can be done with other flowers/leaves and mordants.
2. A similar study can be tried with other mordanting procedures.
3. Many different products such as garments, fashion accessories, handbags/ pouches/ clutches and like can be developed.



Plate 1: Preparation of fabric samples for contact printing



Plate 2- Marigold petal sprinkled over the fabric and bundle preparation



Plate 3- Boiling and steaming



Plate 4- Bundles after boiling and steaming



Plate 5- Eco-printed fabric samples



Plate 6- Marigold flower printed silk scarves

**Contact Dyed/Printed Fabric Cushion Cover
&
Block printed Marigold Tissue paper**



Plate 6- Marigold flower printed cotton cushion cover and block printed tissue papers