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DYEING OF SILK WITH LAWSONIA INERMIS [HENNA] EXTRACT AND STUDY ON THEIR FASTNESS PROPERTIES

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ABSTRACT

The main focus of the project was to dye the silk fabric using Lawsonia Inermis dye (Henna). Dyeing of silk using henna would be possible using mordant. Potash Alum was chosen as the mordant because of its environment friendly nature. Four dyed samples were prepared as follows- sample dyed without mordant, sample dyed premordanted, sample dyed post mordanted, and simultaneous mordented. Better results were obtained when dye extraction was carried out in alkaline condition (pH 9) and dyeing in acidic medium (pH 5). Different hues were obtained on silk fabric samples from the same dye extract. Their fastness properties were studied and it was found that the simultaneous mordanted samples displayed a better fastness properties compared to the others.

Keywords:
Lawsonia Inermis, Potash Alum, Mordant.

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1. INTRODUCTION

People have added color to cloth for thousands of years. It is only recently (the first artificial dye was invented in 1857) that the textile industry has turned to synthetic dyes. Today, many are rediscovering the joy of achieving color through the use of renewable, non-toxic, natural sources. David A. Katz., has stated that, there are many plant materials that can be used for dyeing yarns and materials: roots, bark, leaves, berries, seeds, twigs, branches each capable of producing a range of colors with various mordants and yarns. In addition, when properly applied, natural dyes are fast, resisting fading due to exposure to sunlight.[4]

M. M Alam et al., has stated that, Natural dyes exhibit better biodegradability and generally have a better compatibility with the environment. Henna is harmless and causes no irritation to skin. [1]

Md. Koushic Uddin et al., has stated that, Silk is a natural protein, like wool fibre, due to this, mechanism of dyeing silk is dependent not only on free amino and carboxyl groups but also on phenolic with accessible –OH group. [7]

Babili et al., has stated that, the coloring matter contained in henna leaves, fixes well with wool, silk and tenaciously by the skin.[3]

Muhammad Ahsen Khan., has stated that, However, when used along with metallic mordants they produce bright and fast colours. The use of metallic mordants is not always ecofriendly, but the pollution problems created by metallic mordants are of very low order and can be easily overcome. Therefore, instead of using unsustainable technology for producing colours one can use mild chemistry to achieve almost similar results. Recently, dyes derived from natural sources for these applications have emerged as an important alternative to potentially harmful synthetic dyes and pose need for suitable effective extraction methodologies. [8]

Ashis Kumar Samanta et al., has stated that, among all types of alum, potash alum is cheap, easily available and safe to use as mordant. [2]

Sujata Saxena et al., has stated that, in the case of dyes having affinity for the fiber, the use of mordants increases the fastness properties by forming an insoluble complex of the dye and the mordant within the fibers, which also improves the color. [9]

The general reactions to be achieved by plasma treatment are the oxidation of the surface of a material, the generation of radicals, and the etching of the surface; when using special gases a plasma-induced deposition polymerization may occur. For the treatment of textiles this means that hydrophilization as well as hydrophobization may be achieved; moreover, both the surface chemistry and the surface topography may be influenced to result in improved adhesion or repellence properties as well as in the confinement of functional groups to the surface. [5]

Crystallinity of the silk fibres decreased after plasma treatment. It probably can be explained that the polypeptide chain was broken and macromolecules recombined during plasma treatment. [6]

2. MATERIALS AND METHODS

Collection of substrate (silk fabric):
The degummed silk fabric was purchased from the Sarvodhaya Sangham store, Coimbatore.

Collection of henna leaves:
The Henna leaves were collected from a farm land in Gobichetti palayam, Tamil Nadu.

Shadow drying of henna leaves:
Collected plant materials were first dried in shade at a low temperature in order to reduce their water content to about 10–15 % or less.

Grinding into fine powders:
Dried material is then powdered in a pulverizer to reduce particle size and to facilitate better dye extraction. These powdered and dried materials in most cases can be stored in airtight bags and containers for at least a year and can be used for dyeing whenever required.

Dye extraction in alkali condition:
100 g of dried leaf's powder sample was taken and added to water containing Na2CO3 as solution and kept for 24 hours at pH 8.5-9.2 in room temperature. The solution becomes reddish orange in colour. Then the solution is filtered using a fine nylon cloth. The reddish orange colour was developed due to the presence of alkali. [1]

Neutralizing pH:
The alkali reddish orange colour solution was acidified with acetic acid at pH 4-5. After acidification the colour of solution change from reddish orange to yellow orange. This colour is developed by the action of acid.

Dyeing:
The extracted dye from the leaves was sparingly soluble in cold water with an orange yellow colour. Two dye baths were prepared by adding required amount of dye (0.9 % on the basis of fabric). Four different dyeing procedures were followed the details are as follows,

Without mordant:
In this process the sample is subjected to dyeing without mordant.

Pre-mordanting:
Here the process involves treatment of sample with mordant before dyeing.

Post-mordanting:
The sample is treated with mordant only after dyeing.

Simultaneous mordanting:
In this method the mordant and the dyestuff are mixed in a common bath and the sample treatment is initiated.

The process parameter are given in the table as follows,

Table 1: Dyeing process parameters

Without Mordant	Pre-Mordanting	Post Mordanting	Simultaneous Mordanting
Dyeing: MLR-1:30 Temp-90° Time-90 min	**Mordanting:** Mordant-3% MLR-1:20 Temp-60°c Time-30 min	**Dyeing:** MLR-1:30 Temp-90°c Time-90 min	**Dyeing:** MLR-1:30 Mordant-3% Temp-90°c Time-90 min
	Dyeing: MLR-1:30 Temp-90°c Time-90 min	**Mordanting:** Mordant-3% MLR-1:20 Temp-60°c Time-30 min	

Plasma:
The Sample size taken for Plasma Treatment was 20×20 cm with 450v in 10 secs, at distance of 4cm and Atmospheric air were used for the surface modification on the silk substrate. By this Hydrophilicity of the silk fabric would be improved.

3. RESULTS AND DISCUSSIONS

The following table displays the results obtained from the tests.

Table 2: Test Results

Sample id	Without Mordant	Pre Mordanting	Post Mordanting	Simultaneous Mordanting
1.Dry cleaning Change in color/staining of solvent	4-5/4	4-5/3	4-5/4	4-5/4
2.Rubbing Dry/wet	4-5/4	3-4/3	4/3-4	3-4/3
3.Perspiration Acid/alkali	2-3/2-3	3-4/3-4	3-4/3-4	4/4
4.Light Fastness Xenon arc lamp	2.5	2.5	2.5	2.5
5.ΔE	10.33	4.57	5.91	1.35

The results obtained for dry cleaning change in color and light fastness are nearly the same.

However there is a mass variation of the results when it comes to perspiration fastness which may explain that the dye absorption varies from sample to sample and better results are displayed in the case of simultaneously mordanted samples. Varying results were obtained in the case of rubbing fastness. From the table it can be noticed that the simultaneous mordanted sample results were found to be better among other samples by comparison.

However, the rub fastness and ΔE value was poor in simultaneous mordanted sample.

To overcome the poor rubbing fastness and ΔE issue, the silk fabric was treated with atmospheric plasma and again dyed with simultaneous mordanting method. The following table shows that the results obtained for rubbing fastness and ΔE were found to be at par with the other samples and so it can be inferred that the plasma treatment on the sample has made a significant effect and has caused the fabric to increase the absorption of the dye and as a result it produced a better ΔE and rub fastness values.

Table 3: Spectrophotometer

S.No	Determination of Colour Difference (ΔE) Using Spectrophotometer	
1.	ΔE Value	12.7
2.	ΔL Value	+9.2
3.	Δa Value	-4.7
4.	Δb Value	-7.3

Table 4: Color Fastness to Rubbing after Plasma Treatment

S.No	Mordant Technique	Rating (Dry/Wet)
1.	Simultaneous Mordant	4-5/4-5

4. CONCLUSIONS & RECOMMENDATIONS

It may be concluded that the absorption of dye molecules by the samples vary based on the method of dyeing and further it was observed that the simultaneous mordanted samples displayed satisfactory results and plasma treatment also complements the fastness performance of the samples.

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