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THE EFFECT OF DIFFERENT MORDANTS ON DYEING OF COTTON FABRIC WITH HENNA

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ABSTRACT

The importance of natural dye is increasing day by day to maintain ecological balance. In this experiment we have tried to use natural dyes instead of synthetic dyes. We have also tried to produce different shades by using different mordants. It reveals the technique of dyeing of cotton with Henna *(Lawsonia ineremis L.,)* leaves, effects of different mordants such as Alum, Potassium dichromate, Cooper sulfate and Ferric chloride on dyeing of cotton fabric with henna and color fastness properties of dyed sample. We have got different shades by using different types of mordants and different techniques of mordanting. The color fastness with respect to rubbing was very good for most of the samples but color fastness to wash was quite satisfactory for most of the samples but some samples showed good color fastness to wash properties.

KEYWORDS: Natural Dye**,** *Lawsonia ineremis L.,* Mordanting, Cotton, Color Fastness

INTRODUCTION

Natural dyes are colorants that obtained from natural sources without any chemical processing. It covers all the dyes derived from the natural sources like plants, animals and minerals. Most of the natural dyes have no substantivity. That's why it must have applied on textiles with the help of mordants. There are different types of natural dyes like henna, onion, turmeric, marigold, betel nut which had been widely used from ancient times for dyeing carpets, rugs and clothing by using roots, stems, barks, leaves, berries and flowers of various dye plants [1].

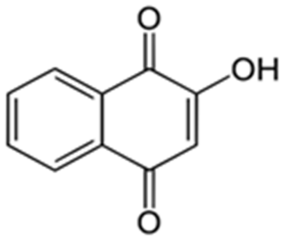
In 1856 Perkin filed a patent on a method for making mauveine by the oxidation of aniline sulfate with potassium dichromate in hot water [2]. Then the use of natural dyes for textile dyeing purposes had been decreased to a large extent. In recent past synthetic dyes have been widely used as compared to natural dyes due to their lower prices and wide range of bright shades with improved color fastness properties and wide range of shade [3-4] . Although Synthetic dyes have many advantages but it has one negative side that submerges all advantages and the negative side is that it is very much harmful to our environment. For this bad effect of synthetic dyes and to save our environment, it is the high time to rethink of natural dyes. Natural dyes have better biodegradability and higher compatibility with the environment. Natural dyes are non-toxic, non-allergic to skin, non-carcinogenic, easily available and renewable [5] and it produces very uncommon, soothing and soft shades as compared to synthetic dyes as well. Henna is one of the best choices for cotton dyeing.

Lawsonia ineremis L., commmonly known as "henna". It is an ancient dye, evidence beingthe Egyptian mummies found in the tombs that had their nails dyed with henna [6]. The name of henna varying between regions of the world, including mehedi, mendi or mehendi, henna, henne, al-khanna, al-henna, maruddhaani, gorintaaku, Jamaica mignonette,

Egyp-tian priest and smooth lawsonia [7]. It is a well branched shrub or small tree frequently cultivated in many tropical and warm temperature regions of Pakistan, India, Egypt, Sudan, Iran, Yemen and Kenya. Large scale cultivation for the sake of leaves which yield dye confined to India, Egypt, Pakistan and Sudan. Powdered leaves of this plant (aqueous paste) are used as a cosmetic for staining hands and hairs [8]. The phenotype of plant is given in Figure 1.

Figure 1: Henna Leaves

In Bangladesh farming of mehedi is growing day by day. It seems that mehedi farming can add a new dimension in the national economy of Bangladesh. Mehedi can be grown almost all over the country, because the land and climate are suitable for its cultivation [9]. The dyeing property as well as the UV light absorption, antibacterial, antispasmotic and corrosion inhibitor were attributed to the presence of Lawsone, 2-hydroxy-1,4-naphthaquinone. This colouring component has following structural formula with colour index number 75486 [10].



Lawsone (2-hydroxy-1, 4-naphthoquinone)

MATERIALS AND METHOD

Colorant and Substrate

Henna (*Lawsonia ineremis* L.,) leaves were collected from the garden and washed with water and then dried at room temperature. Then the leaves were meshed and extracted the color by heating with water at 60 degree Celsius temperature for one hour. Knitted cotton fabric was used as substrate for dyeing.

Chemicals and Machine

As chemicals we used Alum, Potassium dichromate, Cooper sulfate and Ferric chloride and here conventional sample (lab) dyeing machine was used for dyeing.

Fastness Properties

Washing fastness of dyed sample was done according to the ISO 105 C03 test method and rubbing fastness was done by ISO 105:12 test method.

Extraction Process of Henna

Extraction is usually used to recover a component either from a solid or liquid. Henna leaves can be extracted with water by heating. Henna leaves are collected, and then mixed with water and heated 60 minutes at 65 °C (degree Celsius) temperature. Finally the liquid dye was separated by filtration. The process was repeated for the same solid material to extract the dye portion as much as possible.

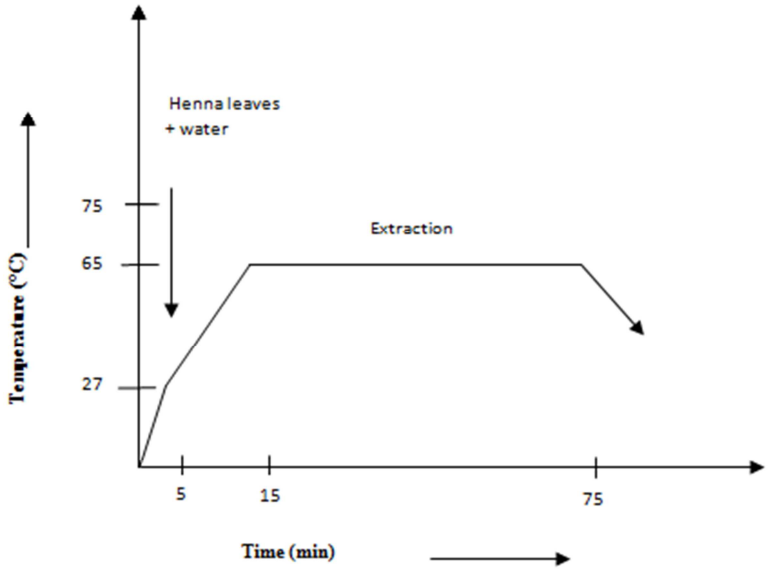


Figure 2: Extraction Process of Henna

Mordanting Process

Mordants are chemicals which are used to fix a dye to the fibers. There are commonly three types of mordanting techniques named pre-mordanting, meta-mordanting and post-mordanting that are used for coloration with natural dyes. In pre-mordanting the substrate is treated with the mordant and then dyed, in meta-mordanting the mordant is added in the dye bath itself and in post-mordanting the dyed material is treated with a mordant.

In this experiment four types of mordants were used with different concentration of mordants and pre, meta and post mordanting was done. In this experiment 0.5 to 2% mordant was used in all pre, meta and post-mordanting techniques.

Dyeing Process

In pre-mordanting technique, pre-mordanted cotton sample was immersed in liquid extracted henna dyes at a liquor ratio of 1:50. Then dyeing was done by sample (lab) dyeing machine. It carried out 60 minutes at 70 °C temperature and the p^H was around 4.5 in the dye bath. Then the dyed material was washed with cold water and dried at room temperature. Finally dyed sample was found.

For meta and post-mordanting the dyeing process was same but mordant was used in dye bath during dyeing for meta mordanting and after dyeing for post mordanting.

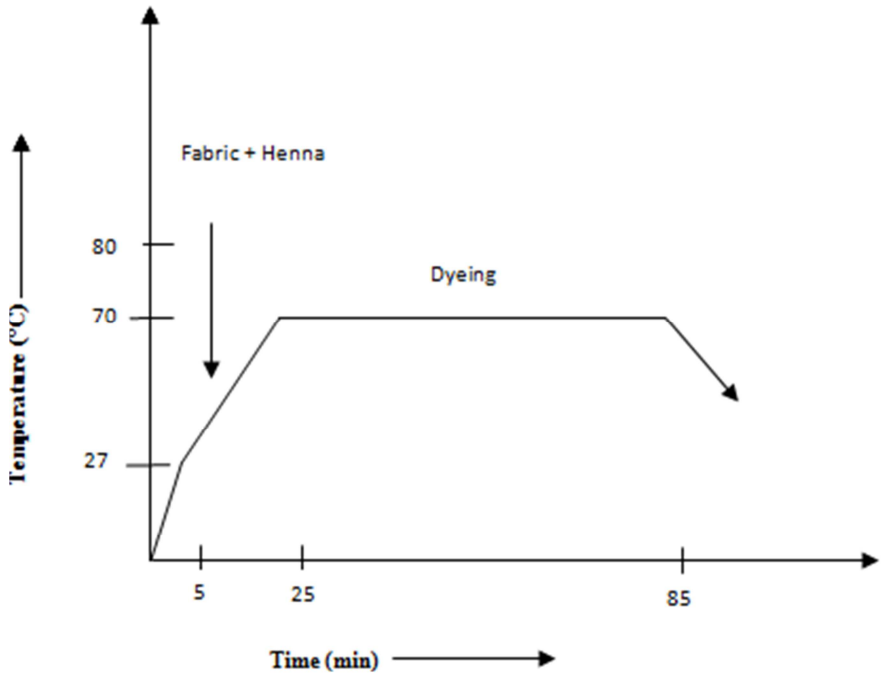


Figure 3: Dyeing of Cotton Fabric with Henna

RESULT AND DISCUSSION

Visual Comparison

Table 1: Dyed Samples

Mordants	Conc. (%)	Pre- mordanted	Meta-mordanted	Post-mordanted
Alum	0.5			
Alum	1			
Alum	2			
$K_2Cr_2O_7$	0.5			
$K_2Cr_2O_7$	1			
$K_2Cr_2O_7$	2			
$CuSO_4$	0.5			
$CuSO_4$	1			
$CuSO_4$	2			

Table 1: Contd.,				
$Fecl_3$	0.5			
$Fecl_3$	1			
$Fecl_3$	2			
Without Mordant				

Color Fastness to Wash

Table 2: Assessment Result for Color Change

Sl. No.	Mordants	Pre-Mordant	Meta-Mordant	Post-Mordant
1	Alum 0.5%	2	4	3
2	Alum 1%	2	4	2
3	Alum 2 %	3	2	2
4	$K_2Cr_2O_7$ 0.5%	2	4	3/4
5	$K_2Cr_2O_7$ 1%	4	3	4
6	$K_2Cr_2O_7$ 2%	2	3/4	3
7	$CuSO_4$ 0.5%	2	2	3
8	$CuSO_4$ 1%	1/2	2	2
9	$CuSO_4$ 2%	1/2	1/2	2
10	$Fecl_3$ 0.5%	1/2	2	4
11	$Fecl_3$ 1%	1/2	2	3
12	$Fecl_3$ 2%	1/2	3	2

Table 3: Assessment Result for Color Staining

Sl. No.	Mordants	Pre-Mordant	Meta-Mordant	Post-Mordant
1	Alum 0.5%	4/5	4/5	4/5
2	Alum 1%	4/5	4/5	4/5
3	Alum 2 %	4/5	4/5	4/5
4	$K_2Cr_2O_7$ 0.5%	4/5	4/5	4/5
5	$K_2Cr_2O_7$ 1%	4/5	4/5	4/5
6	$K_2Cr_2O_7$ 2%	4/5	4/5	4/5
7	$CuSO_4$ 0.5%	4/5	4/5	4/5
8	$CuSO_4$ 1%	4/5	4/5	4/5
9	$CuSO_4$ 2%	4/5	4/5	4/5
10	$Fecl_3$ 0.5%	4/5	4/5	4/5
11	$Fecl_3$ 1%	4/5	4/5	4/5
12	$Fecl_3$ 2%	4/5	4/5	4/5

Color Fastness to Rubbing

Table 4: Assessment Result for Color Fastness to Rubbing

Sl. No.	Mordants	Dry/Wet	Pre-Mordant	Meta-Mordant	Post-Mordant
1	Alum 0.5%	Dry	4/5	4/5	4/5
		Wet	4	4	4
2	Alum 1%	Dry	4/5	4/5	4/5
		Wet	4	4	4
3	Alum 2 %	Dry	4/5	4/5	4/5
		Wet	4	4	4
4	$K_2Cr_2O_7$ 0.5%	Dry	4/5	4/5	4/5
		Wet	4	4	4
5	$K_2Cr_2O_7$ 1%	Dry	4/5	4/5	4/5
		Wet	4	4	4
6	$K_2Cr_2O_7$ 2%	Dry	4/5	4/5	4/5
		Wet	4	4	4
7	$CuSO_4$ 0.5%	Dry	4/5	4/5	4/5
		Wet	4	4	4
8	$CuSO_4$ 1%	Dry	4/5	4/5	4/5
		Wet	4	4	4
9	$CuSO_4$ 2%	Dry	4/5	4/5	4/5
		Wet	4	4	4
10	$Fecl_3$ 0.5%	Dry	4/5	4/5	4/5
		Wet	4	4	4
11	$Fecl_3$ 0.5%	Dry	4/5	4/5	4/5
		Wet	4	4	4
12	$Fecl_3$ 0.5%	Dry	4/5	4/5	4/5
		Wet	4	4	4
13	No mordant	Dry	4/5	4/5	4/5
		Wet	4	4	4

Table 1 shows that we can get different shades by using different types of modants. Beside it was also found that cotton can be dyed without mordanting by using henna but we don't get excellent shades. If we want to get excellent shade we need to use mordants. In this experiment we have tried to show that how different techniques of mordanting change the shades despite of using same mordant with same concentration. Table- 4 shows color fastness with respect to rubbing was very good for all the samples but color fastness to wash was not good for all that was shown by Table- 2. It is found that assessment result for color change was very good in pre-mordanting technique for 1% Potassium dichromate, in meta-mordanting technique for 0.5% Potassium dichromate, 0.5% and 1% Alum and in post-mordanting technique for 1 % Potassium dichromate, 0.5 % Ferric chloride. And also good result was found in meta-mordanting technique for 2% Potassium dichromate and in post-mordanting technique for 0.5% Potassium dichromate. Besides it was also found that assessment result for color staining was very good for all samples which is very advantageous for dyeing of cotton fabric with natural dyes.

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