

Effect of Mordanting Process on Cotton Dyeing with *Acacia Catechu*

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Abstract:

In this work, 100% cotton woven fabrics were dyed with natural dye *Acacia Catechu*. The aqueous extract of the dye was applied on the scoured and bleached cotton. Mordanting was done by three processes- namely pre-mordanting, post-mordanting and simultaneous mordanting at the time of dyeing. Alum and Copper Sulphate were used as mordants. Fabrics were also dyed without any mordant to compare with the mordanted samples. The obtained colour of the samples in pre-mordanted with copper sulphate and alum gave deeper shade than other samples. Colour fastness to wash was better for post-mordanting process, Colour Fastness to Rubbing was found better in simultaneous-mordanting. Reflectance percentage was found greater while mordanting was not done and K/S value was greater for pre-mordanting process. Finally, the study concluded with the result that post-mordanting is a better process for dyeing of cotton woven fabric with catechu while using alum and copper sulphate as mordants.

Keywords: Acacia Catechu, Mordant, Natural dyes

1. INTRODUCTION

During the last few decades, the use of synthetic dyes is gradually receding due to an increased environmental awareness and harmful effects of either toxic degraded products of these dyes or their non-biodegradable nature. In addition to it, some serious health hazards like allergy and carcinogenicity are associated with some of the synthetic dyes[1]. On the other hand, natural dyes are known for their use in colouration of foods, leather as well as natural fibres like wool, silk and cotton since long time. The use of non-allergic, non-toxic and eco-friendly natural dyes on textiles have become a matter of significant importance due to the increased environmental awareness regarding the use of some hazardous synthetic dyes[2].

Nowadays, many of the textile exporters and commercial dyers are re-looking into the possible usage of natural colourants for the dyeing and printing of textiles. The revival interest of these dyes has led to the scientific investigations and publications of new knowledge and research. The research findings related to various sources of natural dyes [3], chemistry of dyes [4], extraction and method of application [5], and fastness performance of these dyes [6] are now available.

However, Natural dyes have a wide range of shades that can be obtained from various parts of plants, including roots, barks, leaves, flowers and fruits[7]. Dyeing with natural dyes normally requires use of one or more mordants, which are

metallic salts of aluminum, iron, chromium, copper and others, for ensuring a reasonable fastness of the colour to sunlight and washing [8]. The use of natural dyes cuts down the amount of toxic effluent resulting from synthetic dye processes significantly. Natural dyes have also been used for printing [9].

In this work, an effort has been made to apply *Acacia catechu* on cotton fabrics. *Acacia catechu* is a brown material with bitter taste. It is produced in the cottage industries in good amount in the northern part of Bangladesh, especially in Rajshahi where *Acacia Catechu* grows in abundance. Unfortunately, only a portion of it is utilised as spice with betel leaves (locally known as paan) for chewing. It is reported that it has some medicinal values[10].

Works have been done on its application wool fibre[11], its anti-mycotic properties[12], printing of cotton with it [9], dyeing of cotton in padding method[13], process analysis and optimization of dyeing with it [14], dyeing in pad steam method[15], cotton and silk dyeing with catechu without mordant [16].

The aim of this paper is to describe the effect of different mordanting processes on cotton dyeing with *Acacia catechu* in open bath exhaust-dyeing method.

2. MATERIALS & METHODS

A. Materials:

Acacia Catechu, 100% cotton woven fabrics, wetting agent (Lissapol), sequestering agent[EDTA (Ethylene Di amine Tetra Acetic Acid)]and Alum and Copper sulphate as mordants.

B. Methods:

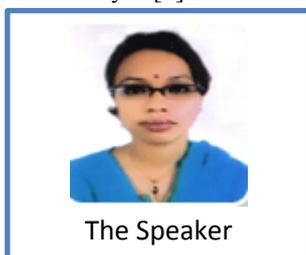
Open bath exhaust method has been used. The dye bath has been set according to the recipe described below.

- Dye extraction:

At first cubes of catechu was converted into powder form by using grinder, followed by boiling this powder. 1litre of water was used for 100 gm of catechu powder to make a solution. This dye solution was boiled for 2 hours and then filtered to get a clean dye solution.

- Mordanting Process:

For pre-mordanting, the fabric was rinsed with cold water first. Then mordant, water and fabric were taken in a vessel. In post-mordanting method, the fabric was treated with mordant in a separate bath after dyeing.



The Speaker

In addition, in the simultaneous mordanting method, both dyeing and mordanting processes were carried out in the same bath itself.

For this study, 3% mordant was used in 1:40 liquor ratio. Then mordanting at 80^oc temperature for 30mins in all processes of pre-mordanting, post-mordanting and simultaneous dyeing-mordanting.

Dyeing:

Dyeing of cotton fabric was done by extraction of catechu maintaining the liquor ratio 1:40 and temperature 100^oc for 30 minutes. After dyeing washing was done with cold water

Colour characteristics measurement:

Reflectance percentage and colour strength (K/S) of all dyed samples (without mordanting, pre-mordanting, post-mordanting and simultaneous mordanting) were measured by using a spectrophotometer “Spectro 600” (Spectro 600).

G. Colour fastness to wash and rubbing of dyed samples:

Washing fastness of dyed samples was tested according to ISO 105:CO3 method at 60^oc for 30 minutes. Colour-fastness to rubbing of dyed samples was tested according to ISO 105/12 method.

3. RESULTS & DISCUSSION

A. Colour Characteristics of Cotton Fabric Dyed with Catechu:

Table1 shows that the presence of mordant in the cotton samples 2, 3, 4, 5, 6 and 7 dyed with catechu influences the depth of shade significantly. Alum and copper sulphate as mordants help cotton fabrics to gain darker shades. It is apparent that when mordants are used before and after the dyeing process, depth of colour on cotton samples becomes more prominent than that on cotton when mordants are applied during the dyeing at simultaneous process. Alum imparts lighter shades than copper sulphate.

B. Reflectance Percentage of Dyed Samples:

Obtained reflectance percentage is plotted on graph for sample 1, 2, 3, 4, 5, 6, 7 (see Figure 1). Sample 1 shows highest reflectance (50.71%) while sample 2 and sample 5 show lower values (15.19% and 15.85% respectively). The reflectance (%) for sample 3,4,6,7 was almost same. The values were 31.68%, 31.7%, 30.42% and 31.3% respectively.

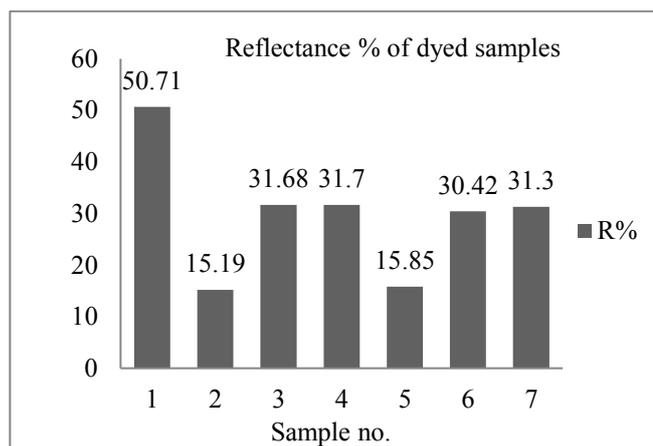


Figure 1: Graphical Representation of Reflectance %

C. K/S Value of Dyed Samples:

K/S value of dyed samples was calculated from reflectance percentage. Obtained K/S value was plotted on graph for sample 1,2,3,4,5,6,7 (see Figure 2). Sample 2 and sample 5 show the highest K/S value than other samples. As the reflectance value of the sample 2 and 5 were lower than the others inversely their colour strength which is indicated by K/S values were 2.367 and 2.233 respectively. For the samples 3, 4, 6, 7 the K/S values are 0.736, 0.735, 0.795 and 0.753 respectively. The sample 1 showed the lowest K/S value 0.239.

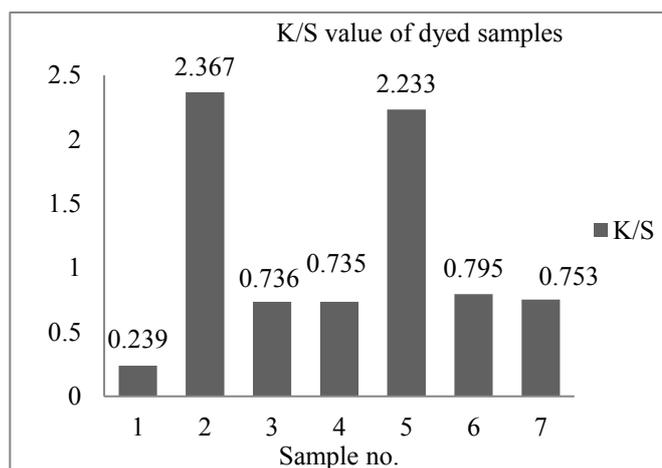


Figure 2: Graphical representation of K/S for dyed sample

D. Effect of Dyeing on Colour Fastness to Wash:

Without Mordanting	Mordanting with Alum			Mordanting with copper sulphate		
Sample-1	Sample-2 Pre-mordanting	Sample-3 Post-mordanting	Sample-4 Simultaneous mordanting	Sample-5 Pre-mordanting	Sample-6 Post-mordanting	Sample-7 Simultaneous mordanting

Table 2 shows that the cotton fabrics dyed in the presence of mordant (alum and copper sulphate) have less colour fastness to wash than the sample

dyed without mordant. Washing of cotton fabric samples in the method of ISO 105:C03 releases some amount of dyes that signifies poor colour fastness to wash, especially when mordant are used during dyeing at simultaneous process for sample 4 and 7. The grey scale rating of sample 4 shows that the change in colour and the staining are 1/2 and 3/4 respectively. The change in colour of the sample 7 is 1/2 and colour staining is 4. For pre-mordanted and post-mordanted with alum samples 2 and 3 shows the grey scale rating of change in colour and colour staining 3/4, 4 and 4/5, 4 respectively. Similarly, for pre-mordanted and post-mordanted with copper sulphate sample 5 and 6 shows the grey scale rating of change in colour and colour staining as 2/3, 3 and 2/3, 4/5 respectively.

Table2: Colour Fastness to Wash

Mordant	Method of mordanting	Change in Colour	Colour staining in cotton
No	Without Mordanting(Sample-1)	2/3	1/2
Alum	Pre-mordanting (Sample-2)	3/4	4/5
	Post-mordanting(Sample-3)	4	4
	Simultaneous mordanting (Sample-4)	1/2	3/4
Copper sulphate	Pre mordanting (Sample-5)	2/3	2/3
	Post mordanting (Sample-6)	3	4/5
	Simultaneous mordanting (Sample-7)	1/2	4

Table3: Colour Fastness to rubbing

Mordant	Method of mordanting	Dry rub	Wet rub
No	Without Mordanting(Sample-1)	4/5	2/3
Alum	Pre-mordanting (Sample-2)	4/5	1/2
	Post-mordanting (Sample-3)	4/5	4
	Simultaneous mordanting (Sample-4)	4/5	4/5
Copper sulphate	Pre mordanting (Sample-5)	4	2/3
	Post mordanting (Sample-6)	3/4	2/3
	Simultaneous mordanting (Sample-7)	4/5	4/5

E. Effect of Dyeing on Colour Fastness to Rubbing

Table3 shows better results for dry rubbing fastness of all samples in grey scale evaluation. Mordanting of cotton fabric samples with alum (samples 2, 3 and 4) imparts greater fastness to dry rubbing is 4/5 whereas the samples 5, 6 and 7 the rating of grey scale is 4, 3/4 and 4/5 respectively. In case of wet rubbing the samples are varied such as, for without mordanting the grey scale rating is 2/3, for alum mordanted samples 2, 3 and 4 the rating is 1/2, 4 and 4/5 respectively and for copper sulphatemordanted samples 5, 6 and 7 the rating is 2/3 and 4/5.

4. CONCLUSIONS

This work shows that Catechu creates a wide variety of brown shades on cotton, which can be highly appealing to many fashionable customers. It is found that the mordanting processes can affect the depth of shades of brown colour on cotton dyed with catechu. When deep shades are required, pre-mordanting process can be followed to dye cotton with *Acacia Catechu* in presence of alum and copper sulphate. However, post-mordanting process was found to give better colour fastness to wash and rubbing. Reflectance percentage was found greater while mordanting was not done at all and K/S value was found greater for pre-mordanting process. Both alum and copper sulphate perform more or less similar in dyeing with Catechu as the values of reflectance %, K/S, and colour fastness in relevant cases are very close to each other.

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