

# A STUDY ON THE FASTNESS PROPERTIES OF COTTON FABRIC DYED WITH TURMERIC DYESTUFF

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**Abstract:** *The main objectives of this study are to produce the turmeric dyed cotton fabric which protect the material from microbial attack, to determine the colour fastness to light, washing and rubbing of turmeric dyed cotton fabrics with different dyeing methods and to evaluate the turmeric dye on bleached cotton fabric. In this research, an attempt is carried out to dye the bleached cotton fabric using cheap and eco-friendly turmeric dye powder. Firstly, the beached cotton fabric and the turmeric roots are collected. Secondly, the beached cotton fabrics are dyed with turmeric dye powder by using four different dyeing methods. Alum is used as a mordant to fix the dye on cotton fabric. And then, the dyed cotton fabrics are tested for their colour fastness properties such as light fastness, washing fastness and rubbing fastness. Finally, the test results are compared and discussed. From the overall results it is seen that turmeric dyed cotton fabrics give better result both in light fastness and rubbing fastness.*

**Key Words:** *Turmeric dyestuff, Fastness properties, Dyeing methods, Mordant.*

## 1. INTRODUCTION:

Plant source means any part of plant; wood, root, leaf, bark, twig, flower, fruit and seed. Our surrounding have various types of tree; shrub, small tree and large tree. Every tree is also planted or cultivated in our surroundings not only for shade and ornamental purpose but also for other uses, such as buildings, paper, medicines, fuel, adhesives, plants, inks, textiles, etc.

Natural dyes have been used as a means to colour textiles for centuries. All the dyes until the latter half of nineteenth century were made of different parts of plants and animals. Natural dyes are deep and soft in colour shades when compared with synthetic dyes. And they are useful for human health because they have antimicrobial, insecticidal and healthy properties which are due to the origin of them extracted from plants. Most natural dyes are non-substantive dyes, which mean that they have very little colouring power within themselves and require the aid of mordants, to penetrate the yarn or fibre. Nowadays, most natural dyes use chemical mordants such as alum, copper sulphate, iron or chrome.

Natural turmeric dye has no side effect on skin and it has no harmful effect on environment also. In this study, turmeric powder is chosen as a raw material to extract the natural dye for dyeing the cotton fabric by using four different dyeing methods.

## 2. MATERIALS AND METHODS:

### 2.1 Collection of Sample

The roots of turmeric are collected from the, Yangon Division in Myanmar. The collected turmeric roots are washed with water to remove the dust and impurities. And then, they are dried in sunlight. Then, the roots of turmeric are powdered y means of grinder. The powder of turmeric roots are used as dyestuffs in this study.

### 2.2 Fabric Analysis of Dyed and Undyed Cotton Fabrics

The fabric analysis tests and the physical properties of fabrics are determined according to the respective ASTM Standards and AATCC Test Methods. All tests are carried out at standard atmospheric condition (20°C ± 2°C, 65 ± 2% RH)

### 2.3 Dyeing the Cotton Fabrics with Turmeric Dyestuffs

The four methods of dyeing are used to dye the bleached cotton fabric with powder of turmeric root. They are: (1) Dyeing without mordanting method, (2) Dyeing by pre-mordanting method, (3) Dyeing by post-mordanting method, and (4) Dyeing by simultaneous-mordanting method.

#### 2.3.1 Dyeing the Fabric without Mordanting Method

Thirty percent of powder of turmeric roots based on the weight of the fabric is dissolved in a small amount of water. Then the cold water is added to get the material to liquor ratio of 1:30. The sample fabric to be dyed is added to

the dye bath and dyeing is carried out at 90°C for about 45 minutes. During dyeing, the fabric is frequently stirred in order to obtain the good penetration of dye molecules into the fabric and even result on the cotton fabric. After dyeing, the dyed sample fabric is thoroughly washed with cold water to remove the unfixed dye particles and squeezed by hand. Then, the dyed fabric is dried at room temperature.

### **2.3.2 Dyeing the Fabric by Pre-mordanting Method**

Fifteen percent of alum based on the weight of the fabric is dissolved in a small amount of water. Then the cold water is added to get the material to liquor ratio of 1:30. Then the fabric to be mordanted is added to the solution. Mordanting is carried out at 60°C for about 30 minutes. After mordanting, the sample fabric is taken out and squeezed by hand and then immersed in the dye bath. The preparation of the dye solution and the dyeing process are done as described in article 1).

### **2.3.3 Dyeing the Fabric by Post-mordanting Method**

Thirty percent of dye powder based on the weight of the fabric is dissolved in a small amount of water. Then the cold water is added to get the material to liquor ratio of 1:30. Then the fabric is added to the dye bath. And the dye bath is heated at 90°C for about 45 minutes. During dyeing, the fabric is frequently stirred to obtain good penetration of dye molecules into the fabric and even result on the cotton fabric. After dyeing, the dyed fabric is thoroughly washed with cold water to remove the unfixed dye particles and squeezed by hand. Then, the dyed fabric is dried at room temperature. And then, 15% of alum based on the weight of the fabric is dissolved with cold water. The material to liquor ratio for mordanting is 1:30. Then the dyed fabric to be mordanted is added to the solution. When the fabric is wetted, the solution is heated and maintained at 60°C for about 30 minutes. After mordanting, the fabric is squeezed by hand and dried at room temperature.

### **2.3.4 Dyeing the Fabric by Simultaneous-mordanting Method**

Thirty percent of dye powder based on the weight of the fabric and 15% of alum based on the weight of the fabric are dissolved in a small amount of water. Then the cold water is added to get the material to liquor ratio of 1:30. Then the fabric is added to the dye bath. And dyeing is carried out at 90°C for about 45 minutes. During dyeing, the fabric is frequently stirred in order to obtain the good penetration of dye molecules into the fabric and even result on the cotton fabric. After dyeing, the fabric is thoroughly washed with cold water to remove the unfixed dye particles and squeezed by hand. Then, the dyed fabric is dried at room temperature.

## **2.4 Fastness Testing**

The dyed fabrics are tested for light fastness, washing fastness and rubbing fastness. The colour fastness is usually rated either by loss of depth of colour in original sample or is expressed by staining scale.

### **2.4.1 Fastness to Light**

In determining the light fastness of dyed fabrics, Acmetype fading tester is used. The principle is mainly based on AATCC test method. The operation is carried out at the Department of Testing and quality Control in Thatmadaw Textile Mill (Thamaing). The results of grading fastness to light of the material are described in Table II. Rating of colour fastness to light is expressed using signification shown in Table III.

### **2.4.2 Fastness to Washing**

In determining the washing fastness of dyed fabrics, Launder-ometer washing machine Rota Wash Colour Fastness tester is used. The operation is carried out in accordance with Test No. 4 of ISO 105. This test is carried out at the Department of Testing and quality Control in Thatmadaw Textile Mill (Thamaing). Test results of washing fastness are shown in Table II and signification of colour fastness to washing is shown in Table III.

### **2.4.3 Fastness to Rubbing**

In determining the rubbing fastness of dyed fabric, Gotech testing machine is used. There are two types of rubbing: dry rubbing and wet rubbing. This test is carried out at the Department of Testing and quality Control in Thatmadaw Textile Mill (Thamaing). Test results of rubbing fastness are shown in Table II and signification of colour fastness to rubbing is shown in Table III.

## **3. RESULTS AND DISCUSSIONS:**

The cotton fabric is used as a material to be dyed in this study due to its eco-friendly nature. The turmeric dyestuff is used in this study because not only it is cheap but also it gives a bright yellow colour. Alum can be used for protein and cellulose fabric. It improves light and washing fastness of all natural dyes and keeps colours clear. It is inexpensive and safe to use. So alum is used as a mordant in this study.

### **3.1 Comparison of the Properties of Dyed and Undyed Cotton Fabrics**

The physical properties of dyed and undyed fabrics are shown in Table I. In this study, it is observed that the properties of sample fabric are significantly changed due to dyeing processes.

TABLE I

COMPARISON OF THE PROPERTIES BETWEEN DYED AND UNDYED COTTON FABRICS

Sr. No.	Properties	Undyed Fabric	Dyed Fabric				Remark
			Without Mordant	Pre-mordant	Post-mordant	Simul-mordant	
1	Fabric Width (in)	36.181	34.075	34.175	34.225	34.163	Significant
2	Fabric Count						
	Ends/in	43	46	46	46	47	Significant
	Picks/in	33	35	37	36	35	Significant
3	Fabric Thickness (mm)	0.27	0.42	0.42	0.41	0.42	Significant
4	Fabric Weight (oz/yd <sup>2</sup> )	2.48	2.76	2.86	2.86	2.83	Significant
5	Yarn No. (Ne)						
	Warp	33	33	33	33	33	Not Significant
	Filling	37	37	37	37	37	Significant

### 3.1.1 Fabric Width

The results in Table I show that the sample width of the undyed fabric is significantly greater than that of the dyed fabric. So, it can be assumed that shrinkage is occurred after dyeing the fabric with turmeric powder. It can be due to the open construction of the sample fabric.

### 3.1.2 Fabric Count

From the test results, it is seen that the ends per inch and picks per inch of the fabrics dyed with different methods are significantly increased as compared to that of undyed fabric. It is observed that the number of ends per inch and picks per inch are increased due to the shrinkage of the width-wise and length-wise of the sample fabric.

### 3.1.3 Fabric Thickness

The results indicate that the fabrics dyed with different methods are thicker than the undyed cotton fabric. It is due to the shrinkage of fabric caused by dyeing and fixing of dye particles in the fibrous material.

### 3.1.4 Fabric Weight

The results show a significant difference between the weight of the undyed fabric and that of dyed fabrics. The reason is that it is due to the shrinkage of fabrics caused by dyeing processes and open construction of sample fabric. And the heavier fabrics are obtained by fixation of dye particles into the fibres and swelling of yarns in the fabric.

### 3.1.5 Yarn Number

In warp yarn number, there is no difference between undyed and dyed cotton fabrics. In the filling yarn, the yarn number of the dyed cotton fabric is less than that of undyed cotton fabric. It is obvious that there is significantly difference between undyed and dyed cotton fabrics. It can be seen that the filling yarn of dyed fabrics are coarser than that of undyed fabric due to dyeing processes and thus the thicker and more compact fabrics are achieved.

## 3.2 Comparison of the Fastness Properties of Dyed Cotton Fabrics

Table II indicates that the light fastness properties of all dyed samples are fair. In washing fastness test, the washing fastness ratings of the dyed fabrics with mordant are 3 (fair), except for the dyed fabric without mordant, whose rating is only 2 (poor). From these results, it can be found that mordant is required in order to fix the dye on the fibres and also to increase the washing fastness of turmeric dye.

After washing, it is observed that colour is slightly stained on the white cloths. According to the standard grey scale, the result shows that the fabrics dyed with turmeric are slightly changed in shade. This means that it would affect the colours of the fabrics when the fabric dyed with turmeric cannot be washed together with other fabrics.



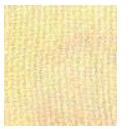


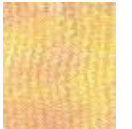







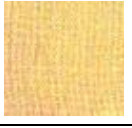
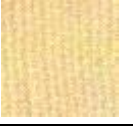


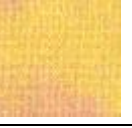


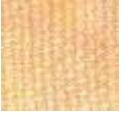
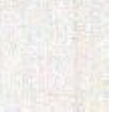

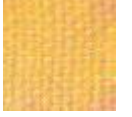
The colour fastness to rubbing of the dyed fabrics is shown good in dry and fair in wet but the fabric dyed with pre-mordanting method is fair when subjected to dry rubbing.

TABLE II  
COMPARISON OF THE FASTNESS PROPERTIES OF DYED COTTON FABRIC

Sr. No.	Dyeing Methods	Light Fastness	Washing Fastness		Rubbing Fastness	
			Fastness	Staining	Dry	Wet
1	Without mordanting Method	3	2	4	4	3
2	Pre-mordanting Method	3	3	4	3	3
3	Post-mordanting Method	3	3	4	4	3
4	Simultaneous-mordanting Method	3	3	4	4	3

TABLE III  
OBSERVATION OF LIGHT, WASHING AND RUBING FASTNESS TEST

Sr. No.	Dyeing Methods	Original Sample	Light Fastness	Washing Fastness		Rubbing Fastness	
				Fastness	Staining	Dry	Wet

1	Without mordanting Method						
2	Pre-mordanting Method						
3	Post-mordanting Method						
4	Simultaneous-mordanting Method						

#### 4. CONCLUSIONS

The present research shows that turmeric can be used to obtain a brilliant shade of yellow colour on bleached cotton fabric. Different shade of colour can be obtained by using four different dyeing methods. It is observed that the properties of bleached cotton fabric are significantly changed by dyeing with turmeric dye. After the dyeing process, the shrinkage of the bleached cotton fabric is occurred, heavier and thicker fabrics are achieved and then more compact structure of fabric is obtained.

By observing the fastness test results, the turmeric dyed fabrics have fair fastness to light. The washing fastness properties of all dyed fabrics with alum mordant are fair. After washing, slightly changed in shade of dyed fabric and the colour slightly stained on the white cloths are observed. The rubbing fastness properties of the turmeric dyed fabrics range from fair to good in dry and fair in wet. From the overall results, it is seen that turmeric dyed cotton fabrics give better result both in light fastness and rubbing fastness.

#### 5. RECOMMENDATIONS

According to the washing fastness test results, it is recommended that the turmeric dyed cotton fabric should not be washed together with other fabrics since the colour of turmeric dye can stain on the other fabrics.

As for future works, an attempt should be carried out in order to develop the optimum condition for turmeric dye on cotton fabric and to improve the fastness properties of dyed fabric by varying the concentration of dye and mordant, material to liquor ratio, temperature and treatment time and also by using different mordants.

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