# APPLICATION OF TURMERIC DYE (CURCUMIN) ON COTTON FABRICS

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## Abstract

The Application of turmeric dye on cotton fabrics has been studied. Desizing and mercerization operation was carried out on the cotton fabrics prior to dyeing to remove the starch or size naturally present in the cotton and for easy absorption and retention of the dye in the fabric. The cotton fabrics were dyed at different time range (15, 30, 45 and 60 minutes) and at different temperature (60°C, 70°C, 80°C, 90°C and 100°C) respectively. It was observed that increase in time, at constant temperature just slightly increases the shade of the fabric which is attributable to the fact that the turmeric dyes dissolves almost instantly and therefore absorbed by the fabrics. Therefore, increase in time at constant temperature has no marked significance on the fabric since it has already absorbed all the dyes possible almost instantly. In contrast, increase in temperature at constant time shows favourable increase in the dye absorption by the fabrics as compared to increase in time at constant temperature. This can be attributed to the fact that increase in temperature causes the curcumin to be readily absorbed by the fabrics which increases as temperature increases. However at temperature range of 90°C and 100°C, there is no marked effect of the dye on the fabric, this can be attributable also to the fact that as such temperature the dye has already been exhausted and therefore its dyeing ability becomes ineffective. The cotton fabric was also subjected to different colour fastness test especially wash and light. The results show that temperature of dyeing from 80°C to 100°C at 15 minutes and above gave better fastness to light while temperature at 100°C for 15 minutes and above gave better fastness to washing compared to dyeing temperature of 60°C to 90°C respectively.

**Keywords**: Cotton, turmeric dye (curcumin), colour fastness, desizing, mercerization.

## 1. INTRODUCTION

Natural dyes are found in nature and are used to colour textiles and gives very soothing and soft shades as compared to synthetic dyes (Samanta, 2009). The awareness of the importance of natural dyes has made it more relevant worldwide in the context of increasing environment consciousness (Farell, 2012).

The non-toxic, biodegradable and eco-friendly properties make them exceedingly popular amongst scientist and industrialist. Production of synthetic dyes is dependent on petrochemical source and some of synthetic dyes contain toxic or carcinogenic amines which are not eco-friendly (Punrattanasin, et al., 2014).

The harmful effects of synthetic dye and chemicals used in dyeing have brought about the alternative preparation of dye using natural sources (Selvi, 2014). This is mainly attributed to strict environmental standards set by many countries to avoid the health hazards associated with synthetic dyes used in textiles (Fithriyah, 2013). Tumeric is derived from the rhizome of the plant (curcuma longan L), a member of the Zingiberaceae family (Hemanthraj, 2014).

India is the largest producer, consumer and exporter of turmeric in the world. It dominates the world production scenario contributing 78% followed by China (8%), Myanamr (4%) and Nigeria and Bangaladesh together contributing to 6% of the global production. It is an important spice used in cosmetic, colouring agent and also used for colouring textiles and for Medicinal purposes.

However, for the purpose of this research, the turmeric dye (curcumin) will be applied to cotton fabric using varying dyeing conditions.

Turmeric dye (curcumin) imparts the yellow colour on textile fibrics.

## 2.0 MATERIALS AND METHOD

- White cotton fabrics
- Tumeric dye (curcumin)
- Stirrer
- Nose mask
- Beakers
- Hand gloves
- Weighing balance.
- Basic laboratory glass wares, such as, conical flasks, measuring cylinders, thermometer, stirring rod, and volumetric flask.

## 2.1 METHOD

### 2.1.1 Fabric preparation:

The cotton fabrics were obtained in its grey state, desizing and mercerization operation was carried out on the fabrics. It was then weighed and wetted out before immersion into the dye liquor.

### 2.2 Desizing operation:

Desizing operation was carried out on the cotton fabric. The objective of desizing is to remove the size or starch naturally present in the cotton fabrics for easy absorption of dyes. If the size is not removed, the absorbency of the fabric towards water and dyes will be seriously impaired. The cloth was impregnated with water only and stored for 48 hours at room temperature. During this period, the starch becomes degraded by enzymes naturally present in the medium, it was then washed off.

### 2.3 Mercerization operation:

Mercerization process was carried out by treating the cotton fabrics in a concentrated solution of 25% caustic soda for 2 minutes at room temperature. The material was then thoroughly washed in water, rinsed to remove the alkali, and dried. This increases the colour yield on dyeing and significantly increases the dye affinity of the cloth relative to that of an untreated material.

### 2.4 Raw material preparation:

The turmeric root was gotten from a local market and was thoroughly washed to remove the dirt and other impurities. The back was then peeled off and was dried in an oven till it is free from any trace of moisture. It was then grinded into powder.

### 2.5 Dyeing process:

1g each of the cotton fabrics was first wetted out for 5 minutes to also improve the swelling of the pores for dye uptake and immersed in a dye bath containing 2% concentration of the turmeric dye at different time range of 15, 30, 45, and 60 minutes respectively and at different temperature of 60°C, 70°C, 80°C, 90°C and 100°C. It was then washed thoroughly in water and dried.

Optimization process was carried out on the fabrics in which the time was kept constant at 15mins, 30mins, 45mins, and 60mins, while the temperature was varied at 60°C, 70°C, 80°C, 90°C and 100°C. The temperature was also kept constant at 60°C, 70°C, 80°C, 90°C and 100°C while the time was varied at 15mins, 30mins, 45mins, and 60mins respectively. It was then rinsed thoroughly and dried.

### 2.6 Colour fastness Test

An aspect of fabrics which is always of interest to consumer is how fast the colour is. This is because the beauty of a fabric is of no value unless the dye is fast under the conditions in which the fabric is to be used. The colour fastness test used for this analysis is the colour fastness to light and washing.

**2.7 Colour fastness to light:** The colour fastness to light was assessed by prolonged exposure of the samples to daylight. The exposure to light causes deterioration of all textile fibres and dyes to some extent, the high energy ultraviolet light in daylight being responsible. The most common effect of light on dye stuff is change in colour which is usually recognized as fading or loss of colour strength. The various samples were assessed for the degree of fading by exposing them to daylight for 72 hours, the result of the fastness test as related to the degree of fading is shown in table 1 in the discussion of result.

### 2.8 Colour fastness to washing:

The resistance of a dye to heat, water, soap, detergent and mechanical action, as employed during domestic laundering, is an important feature in the use of coloured textiles.

The samples were assessed to wash fastness by a series of five washing tests in severity from No.1 which is equivalent to hand washing to No. 5 which is equivalent to machine washing at near boiling temperature. The degree of staining was assessed by stitching the appropriate undyed piece of fabric to the dyed ones. The fabrics were then dried and the degree of staining of the undyed fabrics was assessed. The dyed fabrics that stains the undyed fabric more has less fastness to washing and vice versa. The results are displayed in table 2.

## 3.0 RESULTS AND DISCUSSIONS

### 3.1 Results from the optimization of dyeing process parameters:

it was observed that the time of dyeing had slight effect on the cotton fabric at constant temperatures of 60°C, 70°C, 80°C, 90°C and 100°C. Increase in time, therefore, slightly increases the shade of the fabric which is attributable to the fact the fabric was almost instantly dyed and therefore increase in time has little or no effect. On the other hand, increase in temperature at constant time of 15 minutes, 30 minutes, 45 minutes and 60 minutes during dyeing, has significant effect on the fabric and thus increasing the dye shades. This can be attributable to the fact that curcumin responds swiftly to hot water extraction and therefore penetrates the fabrics more easily.

However at constant dyeing temperatures above 80°C i.e 90°C and 100°C have no marked effect on the fabric, this can be attributable to the fact that at such temperature the dye has been completely dissolved in the fabric and therefore no significant increase in the dye shades of the fabrics.

### 3.2 Results of colour fastness test:

The two major colour fastness tests carried out are: colour fastness to light and washing

**TABLE 1. COLOUR FASTNESS TO LIGHT**

| | **TIME** | | | |
|---|---|---|---|---|
| **TEMPERATURE** | 15 MINUTES | 30 MINUTES | 45 MINUTES | 60 MINUTES |
| 60°C | LOW | LOW | LOW | LOW |
| 70°C | MODERATE | MODERATE | MODERATE | MODERATE |
| 80°C | HIGH | HIGH | HIGH | HIGH |
| 90°C | HIGH | HIGH | HIGH | HIGH |
| 100°C | HIGH | HIGH | HIGH | HIGH |

The above shows the result of the colour fastness to light. It was observed that at 60°C temperature, the fabric fastness to light at the different time range was low, while at 70°C the fastness to light was moderate. This can be attributed to the fact that at such temperature and time the dyed fabric is still susceptible to fading on exposure to daylight as shown in the result. However, at temperatures of 80°C, 90°C and 100°C, the colour fastness to light becomes high and therefore can resist fading. This can also be attributable to the fact that increase in temperature causes the dye to be highly absorbed in the fabric and as such has higher resistance to light. It is also noted that above 80°C, increase in temperature becomes irrelevant as far as fastness to light is concerned.

**TABLE 2. COLOUR FASTNESSES TO WASHING**

| | TIME | | | |
|---|---|---|---|---|
| **TEMPERATURE** | 15 MINUTES | 30 MINUTES | 45 MINUTES | 60 MINUTES |
| 60°C | LOW | LOW | LOW | LOW |
| 70°C | LOW | LOW | LOW | LOW |
| 80°C | MODERATE | MODERATE | MODERATE | MODERATE |
| 90°C | MODERATE | MODERATE | MODERATE | MODERATE |
| 100°C | HIGH | HIGH | HIGH | HIGH |

The above table shows similar results as fastness to light, however, only temperature at 100°C gave better resistance to washing.

## CONCLUSION

This research borders around application of turmeric dye to cotton fabrics by varying the temperature and time of dyeing to know the actual parameters required to obtain a standard dyed turmeric cotton fabrics. The results show that increase in time of dyeing has little or no effect on the fabric while increase in temperature has severe effect on the fabric which actually improves the quality of the resultant dyed cotton fabrics as seen in the colour fastness test.

However, it can be said that temperature of 80°C and above from 15 minutes gave sufficient resistance to light and as such reduces fading while temperature of 100°C from 15 minutes and above gave better wash fastness.

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