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Effects of Different Mordants Used in Turmeric Dyeing with Cotton Fabric

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ABSTRACT: Dyeing of cotton fabric with turmeric (Curcuma longa) extract solution is an experimental dyeing method here. In this paper, we are trying to give a comparative study about the color fastness properties of turmeric dyed knit fabrics specifically color fastness to wash, water, perspiration, rubbing and saliva. Dyeing processes were completed by a common method for cotton fabrics and being compared with and without mordant. All experiments were performed according to ISO standard. We found that mordant can enhance the color fastness properties of cotton fabrics dyed with turmeric extract, comparatively better than without mordant. We also seek possibility of applying natural dyes with other synthetic dyes by experimental results.

KEYWORDS: Natural dyes, Turmeric, Fastness, Vinegar, Glauber salt.

1 INTRODUCTION

Cotton fabric is generally dyed with various natural and synthetic dyes. Henna, Neem, Turmeric these kinds of natural dyes are becoming popular in dyeing process for research because of their availability and eco-friendly characteristics. Dyeing is one of the most vital parts in apparel production. Natural dyes are used since ancient ages despite of few limitations. On the other side, synthetic dyes gained their popularity because of their price, availability and publicity [1]. Natural dyes are biodegradable, non-toxic and non-allergic [2]. So, we are trying to increase the use of natural dyes in exchange of synthetic or non-disposable dyes to save our environment as well as the future. Natural dyes are less attractive to cellulosic fibers so that we need to use mordant to get better fastness [3]. Different types of dyes along with various mordant are used in dyeing. Mordant acts as an ingredient for fixation of any kind of dyeing even it was used to get different shades from the same dye [4]. Now-a-days Mordants are becoming popular because it is easy to fix any dye molecules into the fibers in order to acquire better shade with better fastness properties. It can be used either before or after dyeing or sometimes during dyeing process [5]. Turmeric is a flowering plant and the roots of which are mainly used as an ingredient in cooking. Previous studies of turmeric dyeing process have already been conducted in order to make it suitable and profitable in every way and till many researchers are working on this area. But many of them are already analyzed the differences of shades and other properties using turmeric dyes. Curcumin is the main coloring ingredient of turmeric rhizome which is also recognized because of its antimicrobial and antioxidant activities [6], [7]. This curcumin is a great source of natural dyes for dyeing and recently curcumin and bixin were used on cotton & reed carpet for implementing fast and substantive color to textile or other materials. Researchers have also found that light fastness of curcumin is better than bixin [8]. In this paper, we tried to give a disparity among the fastness properties of turmeric dyeing for cotton fabric. Color fastness refers to the resistance of color of a dyed or printed textile to various types of influences like washing, light, rubbing, perspiration, saliva etc. The stability of color of dyeing or its fastness is one of the most important properties. During its use, a dyed or printed material may loss its color for various causes such as decomposition of the molecules in the fibers (as in light fading), removal of dye molecule into the external medium (as in washing), friction on the outer surface of the dyed materials (as in rubbing), reaction with acid, alkali or perspiration (as in perspiration fastness) and many other like these. Many papers relating to anti-bacterial finishes have been analyzed for cotton and silk fabrics dyeing with turmeric extracts. Other reports are also available regarding color fastness to wash can be increased by modifying cotton fabric with enzyme and chitosan with turmeric dyeing [9]. S. Umbreen et.al has been done on the comparison between natural and synthetic dye according to the result getting from rubbing fastness, color fastness to wash and light fastness test of cotton

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fabric dyed with turmeric [10]. In this paper, we are trying to give a comparative study about the color fastness properties of turmeric dyeing with cotton knit fabrics, specially color fastness to wash, water, perspiration, rubbing and saliva with mordant and without mordant. Our purpose is also to find-out the effectiveness of mordant with turmeric dyes and the probability to use turmeric dye with other dyes.

2 EXPERIMENTAL

2.1 MATERIALS

i) Fabric: Pretreated Cotton fabric (Pique) was collected from Magpie composite limited which GSM is 210.
ii) Chemicals:

- Dyes: Turmeric rhizomes extract for dyeing the Ccotton fabric.
- Mordants: Vinegar and Glauber salt.

2.2 EQUIPMENT

i) Dyeing was carried out on Lab Dyer 212 machine which is from India and made by the company of MAG Solvics Private Limited.
ii) Color fastness to washing carried out in Rota-wash machine
iii) Color fastness to rubbing carried out in Crock-meter.
iv) Color fastness to perspiration carried out in Perspiration tester.
v) Color fastness to saliva carried out in Perspirometer.
vi) Color fastness to water carried out in Perspirometer.

2.3 METHODOLOGY

i) Dyeing Procedure:

At first, we prepared the turmeric extract solution from the heated rhizome. 5.0 gram of fabric was dyed for 40 minutes with 100 ml turmeric extract solution where the temperature was 90°C. The process was also performed with 1.5 ml vinegar and 2 gram glauber salt as mordant. After dyeing, the fabric was treated with soap wash and rinse with fresh water.

ii) Evaluation of Color Fastness:

- Color Fastness to Washing: Color fastness to washing test is done by EN ISO 105 C06 A2S/C2S method.
- Color Fastness to Water: Color fastness to water test is done by AATCC 107-1991 or EN ISO 105 E01method.
- Color Fastness to Perspiration: Color fastness to Perspiration test is done by ISO 105 E04 method.
- Color fastness to Saliva: Color fastness to saliva test is done by Chinese Standard GB/T-18886 method.
- Color Fastness to Rubbing: Color fastness to rubbing test is done by EN ISO 105 X12 method.

3 RESULTS AND DISCUSSIONS

Table 1. Assessment of color fastness to wash

S. L.	Turmeric extract solution	Mordant Name	Amount of Mordant Used	Grade					
				Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1	100 ml	Glauber Salt	2 gram	3	3	2-3	4-5	4-5	4-5
2	100 ml	Vinegar	1.5 ml	3	3	2-3	4-5	4-5	4-5
3	100 ml	Without mordant	-	2	2	1-2	3	3	3-4

From table 01 we can see the color fastness to wash for wool, acrylic and polyester are better than nylon, cotton and acetate without using any mordant. We also figured out that we can get better wash fastness for turmeric dyeing with different mordant for example vinegar and glauber salt and both give same results for every type of fabric.

Table 2. Assessment of color fastness to water

S. L.	Turmeric extract solution	Mordant Name	Amount of Mordant Used	Grade					
				Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1	100 ml	Glauber Salt	2 gram	2-3	2-3	2-3	3-4	3-4	3-4
2	100 ml	Vinegar	1.5 ml	2-3	2-3	2-3	3-4	3-4	3-4
3	100 ml	Without Mordant	-	2-3	1-2	2	4	2-3	3-4

From table 02 polyester & wool show better color fastness to water than the others without using any mordant. It also shows that we can get better water fastness for turmeric dyeing with using different mordant for example vinegar and glauber salt and both give same results for every type of fabric.

Table 3. Assessment of color fastness to rubbing

Sample No.	Amount of Mordant	Rating for Dry Rub	Decision	Rating for Wet Rub	Decision
Glauber Salt	2 gram	4-5	Excellent	4	Good
Vinegar	1.5 ml	4-5	Excellent	3-4	Very Good
Without Mordant	-	4-5	Excellent	2-3	Slightly Fair

From table 03 we can see that dry rubbing fastness of all fabrics show better result with or without mordant. But rubbing fastness rating for wet is not good without mordant and better for salt as mordant.

Table 4. Assessment of color fastness to perspiration

S. L.	Turmeric extract solution	Mordant Name	Amount of Mordant Used	Grade					
				Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1	100 ml	Glauber Salt	2 gram	2-3	2-3	2-3	3-4	3-4	3-4
2	100 ml	Vinegar	1.5 ml	2	2-3	2-3	3-4	3-4	3-4
3	100 ml	Without Mordant	-	2	2	2	2-3	3	2-3

From table 04 Acrylic, polyester & wool show better color fastness to perspiration than the others without mordant. It also shows that we can get better fastness to perspiration for turmeric dyeing with vinegar and glauber salt. Both mordants yielded same results for all types of fabric accept acetate.

Table 5. Assessment of color fastness to saliva

S. L.	Turmeric extract solution	Mordant Name	Amount of Mordant Used	Grade					
				Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1	100 ml	Glauber Salt	2 gram	2-3	2-3	2-3	3-4	3-4	3-4
2	100 ml	Vinegar	1.5 ml	2-3	2-3	2-3	3-4	3-4	3-4
3	100 ml	Without Mordant	-	2	2	2	2-3	3	3

From table 05 Wool and acrylic show better color fastness to saliva than the others without mordant. It also shows that we can get better color fastness to saliva for turmeric dyeing using vinegar and glauber salt and both showed same results for all types of fabric.

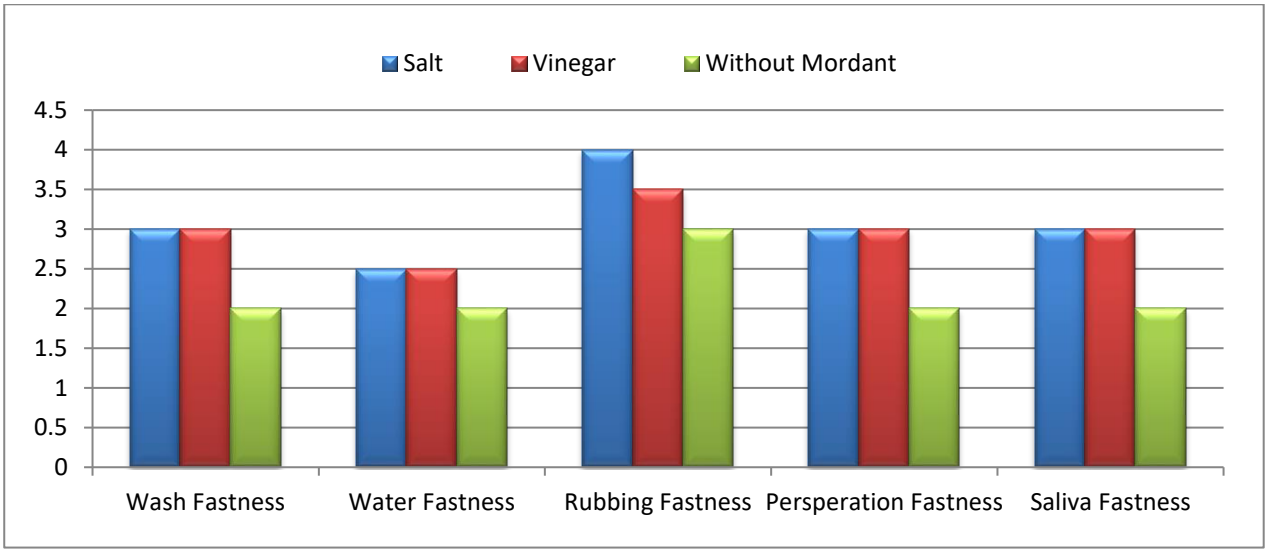

Fig. 1. Comparison of the fastness properties with different mordant

Fig 01 is an overall property described here at a glance. In every dyeing process we got well shade of cotton fabric but when we tested all of dyed fabric for color fastness to wash, water, perspiration, rubbing and saliva, we found out that the results were different. When we applied glauber salt as a mordant with turmeric extract solution for dyeing of cotton fabric the test result for color fastness to wash, water, rubbing, perspiration and saliva was good. When we applied vinegar, we found similar result as glauber salt except rubbing fastness. It is clearly observed that dyed cotton fabric without mordant was not as good as dyeing with the mordant like vinegar & salt for colorfastness test. Our result is also analogous to report of S. Umbreen et.al. They reported that the turmeric extract solely cannot produce excellent color fastness properties without mordant.

4 CONCLUSION

Many attempts were taken to dye cotton fabric with turmeric extract solution. Cotton fabric dyed with turmeric solution provides brilliant shade but the problem of these shades is lower fastness properties especially for color fastness to wash, water, rubbing, perspiration and saliva test. But if we use glauber salt and vinegar as mordant then we can get better fastness result which may be considerable for choosing turmeric dye commercially with other dyes. Analyzing the above results, it is concluded that the problem which arises due to dyeing with turmeric extract solution can't be overcome without mordant. Besides, glauber salt is a bit preferable than vinegar as the fastness test results are better for glauber salt than vinegar. Finally, it is suggested for turmeric extract solution will be a good alternative to provide better shade and fastness properties as well as increase the probability to use turmeric dye with other dyes.

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