



Colourfastness Properties of Tesu Dyed Silk

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Abstract

Colour fastness of fabric is very important aspect as end use of fabrics depends on this property. A study was conducted to investigate the colour fastness properties of silk fabric dyed with Tesu flower dye. The dye was extracted with fermentation technique and silk fabric was dyed using optimized conditions. Different natural mordants were used to study the effect on colourfastness. The dyed fabric samples were evaluated for colour fastness to washing, rubbing, light and perspiration using the methods prescribed by the Bureau of Indian Standards. On the basis of different shades obtained four natural mordants viz., amla fruit, pomegranate rind, mango bark and mehendi leaves were selected. The results revealed that 10 and 25 percent concentration of each mordant was selected for light and dark shades. Simultaneous and post mordanting were found to be better than pre mordanting method. It may be due to the reason that simultaneous and post mordanting helped in better fixation of dye and superfluous dye material might have stripped out. The washing fastness grades for colour change ranged from 4-5, whereas from 4-4/5 for colour staining with all the four mordants. The light fastness grades for all the samples ranged from 4-4/5 grades for colour change as well as colour staining. The perspiration fastness grades for colour change as well as colour staining ranged between 3/4-4/5 for both acidic and alkaline perspiration for all the samples. The rubbing fastness grades for colour change ranged between 4-4/5 for both dry and wet rubbing. The grades for colour staining were also between 4 and 4/5 for dry and wet rubbing for all the conditions. On the basis of overall fastness rating it was concluded that the colour fastness of the dyed samples improved considerably after mordanting.

Keywords: Tesu, fermentation, colourfastness.

Introduction

Colourfastness is the ability of dye to retain its colour or resistance of a textile material after exposure to specific chemical agencies. The fastness of color has a direct bearing on the consumer choice for certain colors and fabrics. Good color fastness means that a dye or pigment will retain its original color with conditions of wear or use, cleaning, washing and storage¹. The fastness of a colour can vary with the type of dye, the particular shade used, the depth of shade and how well the dyeing process has been carried out. It is therefore important to test any dyed or printed product for the fastness of the colours that have been used in its decoration. The increased realization in the textiles industry as well as among the conscious consumers to develop and demand eco-friendly methods of dyeing textiles has led to revive the old traditions of natural dyes, as these are safer in use with minimum health hazards². These are easily disposable, biodegradable, and can be used to make compost for agricultural purposes after they had been extracted. Water used is stored after each step of the dyeing process which can be easily recycled for agricultural use. Our environment possesses potentially an abundance of natural sources of colours. The plant world furnishes the principal source of dyestuff by which color could be developed and gives the yarn and the fabric a natural sheen. Combinations from these give up to 300 hues of colours that are not only environment friendly but recent findings claim that naturally dyed textiles

have therapeutic properties and provides relief for arthritis, diabetes, headaches and over-excited nerves and is also good for blood circulation³. Hence an attempt has been made to assess the colour fastness properties of Tesu dyed silk fabric.

Methodology

Textile material: Pure mulberry silk fabric was used for the experimental work.

Preparation of the fabric: The fabric was degummed to remove the sericin/gum, natural and added impurities like waxes and natural colouring matter present in fabric to make it more absorbent.

Preparation of dye bath and dyeing: Dried tesu flowers were purchased from local market of Hisar. Petals were separated from the stalk and ground to the powder form. Three percent dye material was fermented for five days with 10% biogas slurry in aqueous medium and strained, the fabric samples were dyed for 30 minutes at 100°C and the pH of the dye solution was 5.

Mordants used and mordanting method: Amla fruit, mango bark, mehendi leaves and pomegranate rind were used as mordants using post and simultaneous mordanting methods.

Determination of colourfastness properties: All the dyed samples were evaluated for colour fastness to washing, rubbing, light and perspiration using the methods prescribed by the Bureau of Indian Standards. The colourfastness grading was given by experts/five judges having experience of working with natural dyes.

Properties	Test Method
Washing	IS:3361-1979
Sunlight	IS: 686-1985
Perspiration	IS: 971-1983
Rubbing	IS: 766-1988

Results and Discussion

The optimum proportions of different dyeing variables are presented in table 1. Fermentation technique was used for dye extraction using various substrates (wheat flour and jaggery, bajra and jaggery, biogas slurry and sewage treated water) and biogas slurry was selected on the basis of percent dye absorption and visual appearance. The fermentation was done for seven days and fifth day of fermentation was observed as optimum

day of fermentation on the basis of percent dye absorption and maximum bacterial count of the dye solution.

Four concentrations i.e. 5, 10, 15 and 20 percent of substrate were tried and 10 percent substrate was found to be optimum on the basis of percent dye absorption and visual appearance. Six concentrations viz. 1, 2, 3, 4, 5 and 6 percent of dye material were tried and 3 percent for *tesu* dye was selected. The optimum dyeing temperature for dyeing was 100°C. Four different dyeing times (15, 30, 45 and 60 minutes) were tried and 30 minutes was found optimum with maximum absorption. Dyeing was carried out at 4 different pH values i.e. 4, 5, 6 and 7. Maximum dye absorption was exhibited at 5 pH.

Mordant concentration: Mordants not only provide specific colours but also improve the colour fastness properties. On the basis of different shades obtained four natural mordants viz., *amla fruit*, *pomegranate* rind, mango bark and *mehandi* leaves were selected. Six concentrations i.e. 5, 10, 15, 20, 25 and 30 percent of the mordants were tried. On the basis of percent dye absorption and visual appearance, 10 and 25 percent concentration of each mordant was selected for light and dark shades.

Table-1
Optimum proportions of dyeing variables for dyeing of silk with *tesu* dye

Variables	Trial proportions	Selected proportions
Substrate for fermentation	wheat flour and jaggery, <i>bajra</i> and jaggery, biogas slurry, sewage treated water	Biogas slurry
Substrate concentration	5, 10, 15, 20	10%
Days of fermentation`	1, 2, 3, 4, 5, 6, 7	5
Dye material concentration	1, 2, 3, 4, 5, 6	3%
Dyeing time (minutes)	15, 30, 45, 60	30
Dyeing temperature (°C)	50, 60, 70, 80, 90, 100	100
Dyeing pH	4, 5, 6, 7	5

Mordants



Amla fruit



mango bark



mehandi leaves



pomegranate rind

Figure- 1

Mordanting method: Three mordanting methods namely, pre-mordanting, simultaneous mordanting and post-mordanting were used which gave different colour tones with different mordants. It is evident from figure-1 that post mordanting was found to be the best method for *amla* fruit mordant with maximum percent dye absorption i.e. 39.52 and 45.26 for light and dark shades, respectively. In case of pomegranate rind maximum dye absorption was observed in post mordanting for light (36.59%) and dark (41.32%) shades where as with mango bark the maximum dye absorption was given by simultaneous mordanting for light shade (40.98%) and post mordanting for dark (43.94%) shade. On the other hand simultaneous

mordanting with *mehandi* leaves gave maximum percent dye absorption i.e. 41.42 and 45.73 for light and dark shades, respectively.

Color pallette with Tesu dye: The color obtained without mordanting was brilliant greenish yellow, with *amla* fruit ranged from pale yellow to yellowish green, with pomegranate rind were different shades of lemon chiffon where as the colors obtained with *mango* bark ranged from faded greenish yellow to vivid yellow and with *mehandi* leaves ranged from faded grayish yellow to Pale grayish yellow.

Table 2
Mordant concentration for *tesu* dye

Mordant concentrations	Percent dye absorption (Mordants)			
	<i>Amla</i> fruit	Pomegranate rind	Mango bark	<i>Mehandi</i> leaves
5	30.49	29.66	32.14	30.81
10	32.04	30.98	33.58	33.16
15	34.10	32.39	35.05	35.11
20	35.86	34.26	36.72	36.73
25	37.27	35.10	37.95	38.11
30	37.59	34.72	37.20	38.58

Dye material conc.- 3%, Dyeing temp.- 100°C, Dyeing time- 30min., Dyeing pH- 5

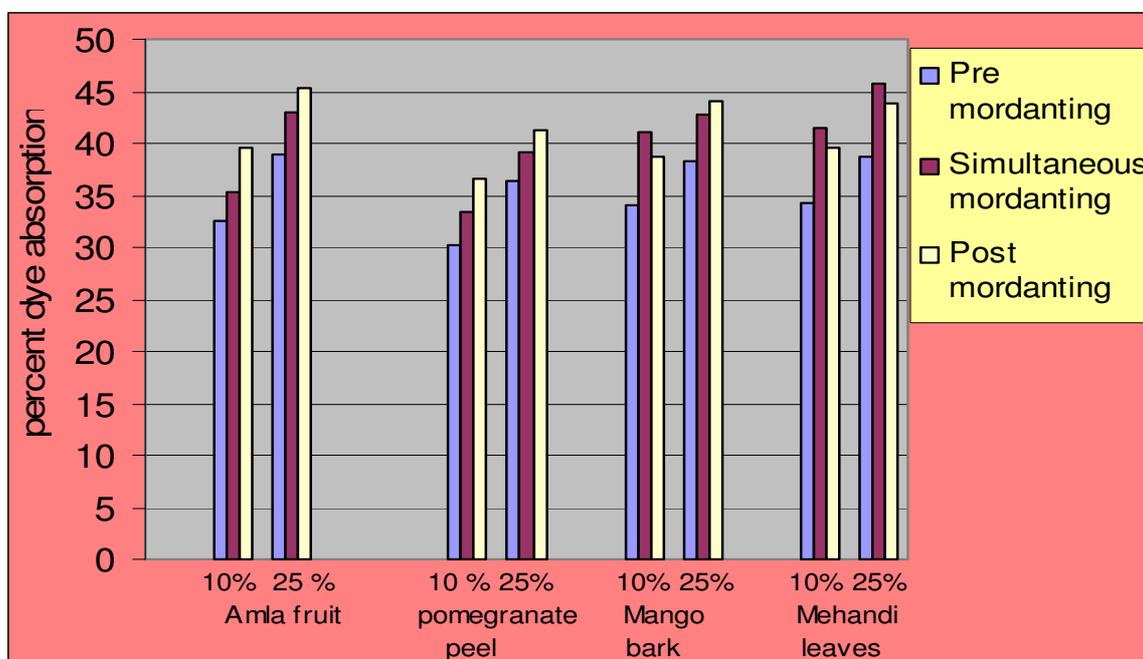


Figure-2
Mordanting methods for *tesu* dye

Table 3
Colours obtained with *tesu* dye

Mordant concentrations (%)	Pre mordanting	Simultaneous mordanting	Post mordanting
<i>Amla</i> fruit 10 25	Very pale yellow Pale yellow	Very light yellow Light yellow	Light yellowish green Yellowish green
Pomegranate rind 10 25	light lemon chiffon Pale lemon chiffon	Faded lemon chiffon Dull lemon chiffon	vivid lemon chiffon lemon chiffon
Mango bark 10 25	Faded greenish yellow Dull greenish yellow	Bright greenish yellow Pale yellow	Light greenish yellow Vivid yellow
<i>Mehandi</i> leaves 10 25	Faded grayish yellow Dull grayish yellow	Mod. grayish yellow Vivid grayish yellow	Light grayish yellow Pale grayish yellow
Control sample (unmordanted)	Brilliant greenish yellow		

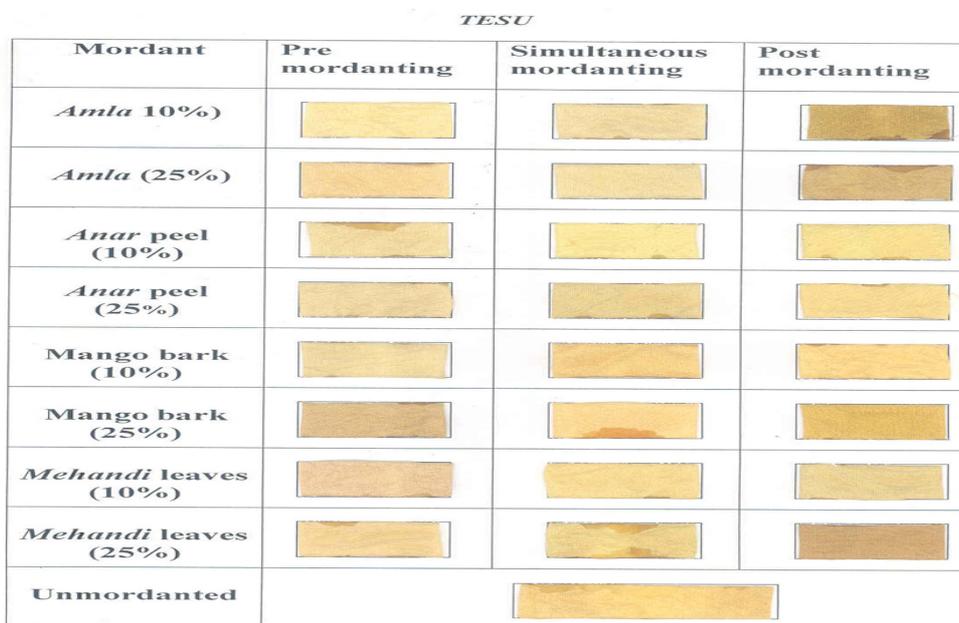


Figure-3
Shade card

Table-4
Colour fastness grades of *tesu* dye on silk with natural mordants

Treatment	Washing		Light	Perspiration				Rubbing			
	CC	CS		Acid		Alkali		Dry		Wet	
			CC	CS	CC	CS	CC	CS	CC	CS	
Control sample	4/5	3/4	3/4	3/4	3	3/4	3	4	4	3/4	3/4
Mordant concentration (%)											
<i>Amla</i> fruit 10	4/5	4	4/5	4	3/4	3/4	3/4	4	4/5	4	4
25	4/5	4	4/5	4	3/4	3/4	3/4	4	4/5	4	4
Pomegranate rind 10	4/5	4	4/5	4	3/4	4	3/4	4/5	4/5	4/5	4/5
25	4/5	4	4/5	4	3/4	4	4	4/5	4/5	4/5	4/5
Mango bark 10	4/5	4/5	4/5	4	4/5	4/5	4/5	4/5	4/5	4/5	4/5
25	4/5	4/5	4/5	4	4/5	4/5	4/5	4/5	4/5	4/5	4/5
<i>Mehandi</i> leaves 10	4/5	4/5	4/5	4	4	4	4	4/5	4/5	4	4/5
25	4/5	4/5	4/5	4	4	4	4	4/5	4/5	4	4/5

CC: Colour Change CS: Colour Staining

Colour fastness grades of tesu dye: Colour fastness values of the silk dyed with *tesu* dye using *amla* fruit, pomegranate rind, mango bark and *mehandi* leaves as mordants are given in table 4. The results being expressed in terms of change in colour and staining of adjacent cotton and silk fabric.

Wash fastness: The data in table 4 reveals that the wash fastness grade for colour change was 4/5 with all the mordants indicating very good wash fastness. The wash fastness grade for colour staining were 4 for *amla fruit* and *pomegranate rind* indicating good fastness and 4/5 with mango bark and *mehandi* leaves indicating very good wash fastness.

Light fastness: From table 4, it is evident that the light fastness grade of all the mordanted samples was 4/5 indicating very good light fastness.

Perspiration fastness: It is evident from the table 4 that perspiration fastness grade for colour change under acidic condition with all the mordants was 4 which shows good perspiration fastness to colour change. In case of alkaline condition, perspiration fastness grade for colour change with mango bark was maximum i.e. 4/5 indicating very good fastness, followed by pomegranate rind and *mehandi* leaves i.e. 4 indicating good fastness and for *amla* fruit it was 3/4 indicating very fair fastness.

Fastness rating for colour staining under acidic condition with mango bark was 4/5 indicating very good perspiration fastness, followed by *mehandi* leaves i.e. 4 indicating good fastness and 3/4 with *amla* fruit as well as pomegranate rind indicating very fair perspiration fastness to colour staining.

Rubbing fastness: It is clear from table 4 that dry rubbing fastness grade for colour change was 4/5 with pomegranate rind, mango bark and *mehandi* leaves indicating very good fastness where as 4 with *amla* fruit indicating good fastness. The dry rubbing fastness grade for colour staining was 4/5 in all the different conditions indicating very good dry rubbing fastness grade for colour staining.

The table 4 depicts that the wet rubbing fastness grade for colour change was 4/5 in case of pomegranate rind and mango

bark mordanted samples indicating very good fastness and 4 for *amla* fruit and *mehandi* leaves mordanted samples indicating good fastness. The colour staining grade for wet rubbing with pomegranate rind, mango bark and *mehandi* leaves was 4/5 indicating very good fastness and with *amla* fruit it was 4 indicating good fastness.

Conclusion

i. A wide range of yellow colour can be obtained using *amla* fruit, pomegranate rind, mango bark and *mehandi* leaves as mordants with *tesu* dye. ii. Simultaneous and post mordanting were found to be better than pre mordanting method. iii. Colour fastness of the dyed samples improved considerably after mordanting.

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