Research Article

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Dyeing of Cotton Fabric with Natural Dye obtained from Flower of *Thespesia populnea* using Combination of Mordants

M. Kumaresan[1*], S. Ashwinbalaji[2], B. Karthikeyan[2]
[1]*Department of Chemistry, Erode Sengunthar Engineering College, Perundurai, TN, India.*
[2]*Department of Computer Science & Engineering, Erode Sengunthar Engineering College, Perundurai, TN, India.*
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*mkumsrenu@gmail.com

ABSTRACT

The fastness properties of Thespesia populnea flower dyed cotton fabric have been investigated with different combination (1:3,1:1 and 3:1) of different mordants, viz. myrobolan:nickel sulphate, myrobolan:aluminium sulphate, myrobolan:potassium dichromate, myrobolan:ferrous sulphate and myrobolan:stannous chloride. The coloured samples were tested for wash, rub, light, and sweat fastness. Using a mixture of mordants to compare the fastness and colour strength of flower of Thespesia populnea coloured cotton. Thespesia populnea in simultaneous mordanting process with 1:3 mordant combination produces best results in a comparative investigation of fastness qualities and colour strength of dyed cotton fabrics.

Keywords: Cotton; Dyeing; Mordant; Natural *dye; Thespesia populnea*.

1. INTRODUCTION

People used natural dyes for colouring in the past, and those natural dyes were also the primary colourants in textiles. A wider spectrum of colours, more repeatability, and better dyeing quality might also be accomplished at a lower particular cost. However, due to severe environmental requirements implemented by many nations in response to harmful and allergic responses associated with synthetic dyes, interest in the use of natural dyes has lately risen quickly (Samanta *et al.* 2007; Sandeep Bains *et al.* 2005). As a result of the present environmental consciousness, the focus of the researcher has switched to the use of natural dyes for colouring textile materials (Sandeep Bains *et al.* 2003; Gulrajani and Gupta Deepti, 1992; Thomas Bechtold *et al.* 2006).

2. MATERIALS AND METHODS

The aim of this research work is to extract natural dye from the flower of *Thespesia populnea*. *It* is an important tree for Pacific Island peoples. The bark is twisted into ropes. Wind, salt spray, and the blazing sun are all protected by the trees. Seeds, leaves, and bark are used to make medicine and food.

Trees were placed around temple locations in ancient times. Because to overharvesting in some regions and growing urbanisation in others, the tree is now rarer than it was previously. Where adequate locations are available in the Pacific, the tree is easy to grow and should be considered for reforestation and urban forestry initiatives.

Fig. 1: Flower of *Thespesia populnea*

Milo is a small evergreen tree with a short, often crooked stem and a broad, dense crown. It features heart-shaped glossy green leaves and yellow hibiscus-like blooms. It has taken root in tropical climes all throughout the planet, from the Caribbean to Africa.

The tree is useful as a coastal windbreak since it is wind and salt spray resistant and thrives in sandy, saline soils. It is easy to propagate and grows quickly. It quickly naturalises and has become a weed in certain locations, therefore it shouldn't be planted in regions where it isn't already established. The tree thrives in direct sunshine and can withstand drought. Dry wood termites are resistant to the heartwood. Milo may be used for a variety of things, such as coastline protection, animal food, windbreaks, and living fences. Despite its excellent timber, the most prevalent usage in the Pacific now is probably as a decorative tree.

The investigation was conducted on bleached cotton cloth procured from Gandhigram Rural University in Dindugal. Ferrous sulphate, aluminium sulphate, nickel sulphate, potassium dichromate, stannous chloride, commercial-grade acetic acid, common salt, and sodium carbonate were employed as analytical reagents (AR). A natural mordant myrobolan (*Terminalia chebula*) powder (Kumaresan *et al.* 2010) was used for the study. *Thespesia populnea* flower ethanol extract was utilised to create a brown colour component for fabric dyeing. The colour acquired on textiles from the flower of *Thespesia populnea* extract may vary depending on the mordant employed.

A known quantity of *Thespesia populnea* flower was dried, powdered, and steeped overnight in warm water. Boiling the colour extract in the same water yielded the colour extract. After cooling, the dye extract was filtered and utilised for dyeing. The dyeing was carried out at optimized dyeing conditions: dye extraction time 60 min, material-to-liquor ratio 1:20, temp. 60 ˚C, wavelength 420 nm and dyeing time 50 min. The mordant combinations, viz. myrobolan: nickel sulphate, myrobolan: aluminium sulphate, myrobolan: potassium dichromate, myrobolan: ferrous sulphate, myrobolan: stannous chloride were used each in the ratio of 1:3, 1:1 and 3:1. In each combination, the total amount of two mordants utilized was 5%, or 5 g of mordant per 100 g of fabric. All three mordanting procedures, namely pre-mordanting, simultaneous mordanting, and post-mordanting for dyeing, were utilized with each of the five mordant combinations in three distinct ratios described above.

Colour fastness to washing of the dyed samples was determined as per IS: 764-1984 method using a Sasmira launder-O-meter following IS-3 wash fastness method. The wash fastness rating was assessed using greyscale as per ISO-05-A02 (loss of shade depth) and ISO-105-AO3 (extent of staining), and the same was checked by measuring the loss of depth of colour and staining using Macbeth 2020 plus computer-aided colour measurement system. Colour fastness to rubbing was assessed as per IS: 766-1984 method using crock meter and greyscale as per ISO-105-AO3 (extent of staining).

Colour fastness to exposure to light was determined as per IS: 2454-1984 method. The sample was exposed to UV light in a Shirley MBTF Microsal fade-O-meter (having 500 watts Philips mercury bulb tungsten filament lamp simulating daylight) along with the eight blue wool standards (BS1006: BOI: 1978). The fading of each sample was observed against the fading of blue wool standards.

Colour fastness to perspiration was assessed according to IS 971-1983, and composite specimen was prepared by placing the test specimen between two adjacent pieces of cotton and stitched all among four sides. The sample was soaked in the test solution (acidic /alkaline) separately with MLR 1:50 for 30 min at room temperature. The sample was then placed between two glass plates of perspirometer under the load of 4.5kg (10 lbs). The apparatus was kept in the oven for 4 h at 37±2˚C. At the end of this period, the specimen was removed and dried in air at a temperature not exceeding 60 ˚C. The test samples were graded for change in colour and staining using grey scales.

Table 1 shows the results of testing colour fastness to light, washing, rubbing, and sweating using a myrobolan: nickel sulphate combination in an aqueous media. For all mordant combinations, all treated samples exposed to light show pretty strong light fastness. All of the treated samples have wash fastness grades of 3 to 4, and no colour discoloration has been detected.

All of the treated samples show excellent colour change after dry and wet rubbing (5). Dry rubbing results vary from no colour staining to moderate colour discoloration (5 to 4-5). In both acidic and alkaline conditions, the majority of the treated samples show outstanding colour fastness grades. In both acidic and alkaline medium, there is no colour staining (5) for all of the treated samples (Table 1).

For the present study, three different combinations of mordants, such as 1 : 3, 1 : 1 and 3 : 1 were prepared by mixing the natural mordant myrobolan with five inorganic mordants and dyed on silk fabrics. Table 1. shows the colour fastness and colour strength values of dyed silk materials acquired in this study using various combinations of mordants, as well as the values acquired by previous studies. The mordants ferrous sulphate and aluminium sulphate produced good results in all three techniques of dyeing employing three plant sections (Gulrajani and Gupta Deepti, 1992).

The findings of the colour strength comparison show that among the three mordant combinations, the 1 : 3 mordant combination is determined to be the best for dyeing. When comparing the three dyeing procedures, the simultaneous technique produced great results in both natural dyes.

According to the data in Table 1, the higher the concentration of mordants, the higher the K/S value will be (Pan *et al*. 2003). In comparison to Kumaresan (2015), who employed stannous chloride (GS : 2) as a mordant in the premordanting procedure, the current study had improved lightfastness (GS : 4-5).

Thespesia populnea in simultaneous mordanting procedure with 1:3 mordant combination produces better results in a comparative examination of fastness qualities and colour strength of dyed silk samples. From these results, the dyeing ability for *Thespesia populnea* is better than the other natural dyes obtained from Flower of *Cordia sebestena and Spathodea campanulata.*

Table 1. Fastness properties and colour strength of dyed cotton in a combination of mordants

Plant parts used for dyeing	**Mordant used**	**Method**	**Properties**						
			WF		**RF**		**PF**		**CS (K/S)**
					Dry	**Wet**	**Acidic**	**Alkaline**	
Flower of *Thespesia populnea*	MB : AS (1 : 3)	SM	5	4	5	5	4	4-5	3.41
		PM	5	3-4	5	5	5	5	3.01
	MS :FS (1 : 3)	SM	5	3-4	5	5	5	5	3.52
		PM	5	3-4	5	5	4	5	3.03

WF-Wash fastness; LF-Light fastness; PF-Perspiration fastness; RF-Rub fastness; CS-Colour strength; PM-Pre mordanting; SM-Simultaneous mordanting; MB – Myrobolan; FS –Ferrous sulphate; AS- Aluminium sulphate; SC-Stannous chloride; $CuSO_4$-Copper sulphate.

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