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Properties of Eco- Friendly Natural Dyed Silk Fabric-A Comparison

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Abstract: The fastness properties of the flower of *Spathodea campanulata* and Cordia sebestena dyed silk fabric have been studied using different combination (1:3,1:1 and 3:1) of various mordants, such as myrobolan:nickel sulphate, myrobolan: aluminium sulphate, myrobolan: potassium dichromate, myrobolan: ferrous sulphate and myrobolan:stannous chloride. The wash, rub, light and perspiration fastness of the dyed samples have been evaluated. Comparing thefastness properties and colour strength of flower of *Spathodea campanulata* and Cordia sebestena dyed silk by using combination of mordants. In the comparative study of fastness properties and colour strength of the dyed silk samples *Spathodea campanulata* in simultaneous mordanting method with 1 : 3 mordant combination gives better results than using flower of Cordia sebestena.
Keywords: Cordia sebestena, Dyeing, Mordant, Natural dye, Silk, *Spathodea campanulata*.

Introduction

Up to the end of the 19th century natural dyes used to be the main colourants for textiles. But the introduction of synthetic dyes led to an almost complete replacement of natural dyes, due to favorable application properties of synthetic dyes. Besides, a wide range of available colours, higher reproducibility and improved quality of dyeing could be achieved at lower specific cost. However, recently the interest in the use of natural dyes has been growing rapidly due to the result of stringent environmental standards imposed by many countries in response to toxic and allergic reactions associated with synthetic dyes[1,2,3].Hence, due to the current eco-consciousness, the researcher's attention has been shifted to the use of natural dyes for dyeing textile materials.

Materials and Methods

The present investigation deals with the extraction of natural dye from the flower of *Spathodea campanulata*. Spathodea is a monotypic genus in the flowering plant family Bignoniaceae. *Spathodea campanulata* is commonly known as the Fountain tree, African tulip tree. It is native to tropical Africa. This tree is planted extensively as an ornamental tree throughout the tropics and is much appreciated for its very showy reddish-orange or crimson (rarely yellow), campanulata flowers. It is commonly planted as a street tree in India. The generic comes from the Ancient Greek words.

The flower of *Spathodea campanulata* dye was used to extract colourant for dyeing silk at optimized dyeing conditions[4,5,6], using combination of mordants and then the colour fastness of the dyed samples to washing, rubbing, perspiration and light evaluated. *Cordia sebestena* is a species of flowering plant in the Boraginaceae family. It is commonly known as Geiger tree. *Cordia sebestena* is widely planted throughout the tropics and subtropics as an ornamental plant in gardens because of its flowers. It is native to the American tropics, from southern Florida in the United States (http: //en. wikipedia. org/ wiki/ cordial _ sebestena). In this study the flower of *Cordia sebestena* was used.

Bleached silk fabric obtained from Gandhigram Rural University, Dindugal**,** was used for the study. Analytical reagents (AR) grade ferrous sulphate, aluminium sulphate, nickel sulphate, potassium dichromate, stannous chloride, commercial grade acetic acid, common salt, sodium carbonate were used. A natural mordant myrobolan (*Terminalia chebula*) powder[7,8] was used for the study. The ethanol extract of the flower of *Spathodea campanulata* was used to get brown colour component for dyeing of fabrics. Depending upon the mordant used, the colour obtained on textiles from the flower of *Spathodea campanulata* extract may give different shades.

A known quantity of flower of *Spathodea campanulata* was dried, powdered and soaked in warm water overnight. The colour extract was obtained by boiling it in the same water. This dye extract was allowed to cool, finally filtered and used for dyeing. The dyeing was carried out at optimized dyeing conditions: dye extraction time 60min, material-to-liquor ratio 1:20, temp. 60^0C, wave length 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. The total amount of two mordants used in each combination was 5% owf, i.e. 5 g of the mordant / 100 g of the fabric. Each of the five mordant combinations in three different ratios mentioned above was used with all the three mordanting methods, namely pre-mordanting, simultaneous mordanting and post-mordanting for dyeing[9,10].

Colour fastness to washing[11,12] of the dyed fabric 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 grey scale as per ISO-05-A02 (loss of shade depth) and ISO-105-AO3 (extent of staining) and the same was cross-checked by measuring the loss of depth of colour and staining using Macbeth 2020 plus computer-aided colour measurement system attached with relevant software. Colour fastness to rubbing (dry and wet) was assessed as per IS: 766-1984 method using a manually operated crock meter and grey scale 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 watt Philips mercury bulb tungsten filament lamp simulating day light) along with the eight blue wool standards (BS1006: BOI: 1978). The fading of each sample was observed against the fading of blue wool standards (1-8).

Colour fastness to perspiration[13,14,15] was assessed according to IS 971-1983, composite specimen was prepared by placing the test specimen between two adjacent pieces of silk 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 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.

The evaluation of colour fastness to light, washing, rubbing and perspiration using myrobolan: nickel sulphate combination in aqueous medium is presented in Table 1. All the treated samples subjected to light show fairly good (3-4) light fastness for all mordant combinations. The wash fastness grades range between 3 and 4 for all of the treated samples and there is no colour staining observed.

The colour change to dry and wet rubbing for all the treated samples is found to be excellent (5). There is a variation from no colour staining to negligible colour staining (5 to 4-5) in dry rubbing. Most of the treated samples show excellent fastness grade to colour change in both acidic and alkaline media. There is no colour staining (5) observed for all the treated samples in both acidic and alkaline media (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. The colour fastness and colour strength values of dyed silk fabrics by using various combinations of mordants obtained in the present study and the values obtained by the earlier researchers are presented in Table 1.1. In all the three methods of dyeing using three plant parts, the mordants ferrous sulphate and aluminium sulphate showed excellent results.

From the comparison of colour strength results, it is clear that among the three mordant combinations 1 : 3 mordant combination is found to be better for dyeing. Comparing the three dyeing methods, simultaneous method in all two natural dyes gave excellent results.

Similar results were obtained in the previous study reported by Surabhi mahajan et al (2005). Analysis of data from the Table 1 indicates that higher the concentration of mordants the higher will be the K/S value (Pan et al 2003).A better light fastness (GS : 4-5) was observed in the present study compared to Samanta et al (2007) study when stannous chloride (GS : 1) was used as a mordant in premordanting method.

In the comparative study of fastness properties and colour strength of the dyed silk samples *Spathodea campanulata* in simultaneous mordanting method with 1 : 3 mordant combination gives better results. From this results, the dyeing ability for Spathodea campanulata is better than Cordia sebestena.

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Table 1Comparison of fastness properties and colour strength of dyed silk in combination of mordants

Plant parts used for dyeing	Mordant used	Method	Properties							Reference
			WF	LF	RF		PF		CS (K/S)	
					Dry	Wet	Acidic	Alkaline		
Flower of *Spathodea campanulata*	MB : AS (1 : 3)	SM	4-5	4	5	5	4	4-5	3.41	Present study
		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	4-5	3-4	5	5	4	5	3.03	
Flower of *Cordia sebestena*	MB : AS (1 : 3)	SM	4-5	3-4	5	5	4	4-5	3.18	
		PM	5	3-4	4-5	5	5	5	2.91	
	MS :FS (1 : 3)	SM	5	3-4	4-5	5	4	5	3.26	
		PM	5	3-4	5	5	5	5	2.89	
Prunus persica	AS : $CuSO_4$ (1 : 3)	SM	4-5	4-6	4-5	4-5	5	5	-	Surabhi mahajan et al (2005)
	AS : FS (1 : 3)	SM	5	5-6	4-5	4-5	4-5	4-5	-	
	$CuSO_4$: FS (1 : 3)	SM	5	5-6	4-5	4-5	4-5	4-5	-	
Jackfruit wood (Jute)	MB : SC (20 : 20)	PM	5	1	4-5	4-5	-	-	3.13	Samanta et al (2007)
	MB : AS (20 : 20)	PM	4	3	5	5	-	-	3.35	
Jackfruit leaf(Jute)	Potash alum(12%)	PM	-	-	-	-	-	-	4.48	Pan et al (2003)
Marigold flower(Jute)	Potash alum(12%)	PM	-	-	-	-	-	-	5.06	

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

References

1. Anderson, B., Creative spinning, weaving and plant dyeing, Angus and Robinson, Singapore, 1971,24-28.
2. Samanta, A.K., Agarwal Priti, and Datta Siddhartha, Dyeing of jute and cotton fabrics using jack fruit extract: part –I: Effects of mordanting and dyeing process variables on colour yield and colour fastness properties, Indian Journal of Fibre and Textile Research, 2007, 32, 466-476.
3. Sandeep bains, Sumeet kang, and Koshal preet kaur, Dyeing of wool with Peach dye using combination of mordants, Journal of the Textile Association, 2005,127-131.
4. Sandeep Bains, Singh, O.P., Ganganpreet Goraya, and Manpreet Kang, Dyeing of cotton with Goldendrop (Onosma Echioides) dye, Journal of the Textile Association, 2003, 183-186,
5. Gulrajani, M.L. and Gupta Deepti, Natural dyes and their application to textiles, Department of Textile Technology, IIT, Delhi,1992,10-25.
6. Thomas Bechtold, Mussak, R., Mahamud -Ali, A., Ganglberger, E. and Geissler, Extraction of natural dyes for textile dyeing from coloured plant wastes released from food and beverage industry, J. Sci. Food Agric.,2006,.86,233-242.

7. Kumar, P. E., Kumaresan, M. and Boopathi, T.S, A study on the extraction of eco-friendly natural dyes from *Pongamia pinnato* for dyeing, Bharathiar University, Coimbatore,2004.
8. Kumaresan, M., Palanisamy, P.N. and Kumar, P.E, Application of eco-friendly natural dyes on Cotton obtained from the stem of *Achras sapota* using combination of mordants, Nature Environment and Pollution Technology,2010, 9(3),547-552.
9. Kumaresan, M., Palanisamy, P.N. and Kumar, P.E, Dyeing of cotton using flower of *Cordia sebestena*: Effects of mordanting and fastness properties, Journal of Asian Scientific Research,2011, 1(4), 137-142.
10. Kumaresan M., Palanisamy P.N. and Kumar P.E, Dyeing of cotton and silk fabrics using stem of *Achras sapota* extract: Effects of mordanting and dyeing process variables on colour yield and colour fastness properties, The Asian Journal of Experimental Chemistry, 2011, 6(1),1-7.
11. Kumaresan M., Palanisamy P.N. and Kumar P.E, Application of eco-friendly natural dye obtained from *Cordia sebestena* on cotton using combination of mordants, Journal of Natural Product and Plant Resources,2012, 2(1), 32-38.
12. Kumaresan M., Palanisamy P.N. and Kumar P.E, Application of eco-friendly natural dye on cotton using combination of mordants, Indian Journal of Fibre & Textile Research,2012,37,194-198.
13. Kumaresan M., Palanisamy P.N. and Kumar P.E, Dyeing of silk fabric with eco-friendly natural dyes using single mordants: Comparison of fastness properties and colour strength, International Journal of Research in Pharmaceutical and Biomedical Sciences, 2012,3(4),1614-1620.
14. Kumaresan M., Fastness properties of dyed silk fabric with eco-friendly natural dyes obtained from *Achras sapota and Cordia sebestena*- A Comparison,Journal of Environmental Nano Technology,2014,ISSN: 2279-0748,3(2),194-199.

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