COLOUR GAMUT OF HOLARRHENA ANTIDYSENTRICA LINN. DYED SILK

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Abstract: *Holarrhena antidysentrica* Linn is a member of Apocynaceae, small to medium sized deciduous *Holarrhena* tree, attaining of forty feet. Tall shrub bearing fairly large, opposite short petioled membranous ovate oblong, prominently veined leaves. Present work deals with dyeing of silk with *Holarrhena antidysentrica* leaf extract as a source of natural dye.
The study was aimed to evaluate the colour values of dyed silk in terms of L*a*b*c*h* values which fall within the yellow red region. Alum as a sole mordant and alum in binary combination with metal and natural mordants significantly altered the colour shades to expand the palette. If results in good to excellent fastness against washing, perspiration, rubbing and sunlight fastness.

Keyword: Holarrhena antidysentrica Linn. Leaf Natural dye, Silk

1. Introduction

Today due to the global environmental awareness trend of using natural colours is growing. Production and application of synthetic dyes release large amount of waste and unfixed colourant causing health hazards, pollution and disturb eco-balance. The most alarming and injurious to health is the presence of toxic chemicals in the finished textiles, especially which are coming in contact with the skin has opened new challenges for the persons working in the field of textiles. Taking into consideration the need of ecofriendly textiles and green fashions *Halarrhena antidysentrica* Linn. has been trapped to explore as a source of natural dye for sustainable development. The range of yellow to brown obtained on silk will definitely find useful to the designers, manufactures and ultimately to the green minded consumers. *Holarrhena antidysentrica* Linn. belonging to family Apocynaceae is found throughout the deciduous forests of India . It often grows gregariously and can be grown in the most reclaimed wasteland with moderate rainfall. [1]. *Holarrhena antidysentrica* is a small to medium sized deciduous tree attaining a height of about forty feet, bearing fairly large, apposite, short petioled, membranous, ovate - ablong, prominently veined leaves; cymose clusters of large white fragrant flowers and pairs of narrow slender, a foot (20cm) long pendulous follicles. Artificial reproduction can be secured both by direct sowing and by cutting [2]. Chemotaxonomical study of *Holarrhena antidysentrica* detected 2.3% tannins in the leaves. [3]. The most important auxiliaries in case of natural dyes are mordants. Alum has been proposed for its low environmental toxicity.[4]. Metal salts or tannic acid improves the fastness properties and provides the wide range of shades. [5]. In the present study naturally occurring tannins were also used as mordants to make the process ecofriendly.

2. Materials and Methods

100% grey tussar silk was used, as it is biodegradable in nature prefer safe route of using natural dye on natural fibre. *Holarrhena antidysentrica* Linn leaves were collected from Melghat forest in the month of February. Natural mordants such as Harda fruits (*Terminalia chebula* Linn)

Pomegranate rind (*Punica granatum* Linn), Babool bark (*Acacia Arabica* Linn) and metal mordants such as Alum were used. Tin (Stannous chloride) Iron (Ferous sulphate), Lb. Gd of Qualigens, Nonionic detergent.

3. Methods

In order to make the fabric absorbent to obtain level dyeing and penetration of dyestuffs, degumming of silk was done.

Preparation and Optimization of dyeing Parameters of *Holarrhena antidysentrica* fresh leaves.

The leaves were washed thoroughly to remove dirt particles and fungus if any. The *Holarrhena antidysentrica* leaves were cut into fine pieces mixed with water and boiled. The material to liquor ratio was maintained to 1:50 throughout. Extraction was carried out to get optimum depth of colour by optimizing dye material concentration, extraction time and pH.

Tannin treatment

The test samples were divided into control and experimental group. Test samples of experimental group were treated with 10% harda power (owf) with 1:20 M:L ratio for 30 minutes. Samples were removed, padded and dried.

Mardanting

Two metal mordants Tin and Iron and two natural vegetable mordants, pomegranate rind and babool bark were used in combination with alum (Alum + Tin). (Alum + Iron), (Alum + Pomegranate rind) and (Alum + Babool bark) binary combinations. Taking alum as a single mordant and in binary combination with other mordants the ratio of mordant was varied from (10:0) (9:1) (7:3) and (5:5) for each combination. Mordanting was carried out separately for control and experimental group keeping M:L ratio as 1:50. The wetted samples were entered into the mordanting bath initially at 50^0C. and slowly it was raised up to $90^0C \pm 1^0$ and mordanting was carried out for 45 minutes. Samples were taken out squeezed gently and then put immediately in to the dye bath which was previously set at 50^0C.

Dyeing

Dyeing was carried out separately for control and experimental group of silk samples. Dyebath was prepared with optimum dye material concentration as 40% (owf) with 7 pH as optimum and dye extraction time as 90 minutes. With these optimized dyeing parameters dyeing was carried out for 45 minutes keeping M:L ratio as 1:50. The initial temp was 50^0 C, slowly it was raised up to $90^0 \pm 1^0$C. The dye bath was allowed to cool at room temperature for 15 minutes. The dyed samples were removed squeezed and rinsed thoroughly in cold water.

Evaluation of colour values and Assessment of Fastness properties.

Colour values of the dyed silk samples were analysed on the basis of L* a* b* c* h* values using reflectance spectra through data colour international spectrophotometer.

Dyed samples were assessed for fastness to washing (ISO2), fastness to perspiration (IS : 971 – 1983), fastness to rubbing (IS : 766 – 1988) and colour fastness to sunlight (IS:686-1985). The samples were evaluated for colour change and colour staining using grey scale. (ISO 105 – 102 : 1818, BS 1006 – 1021990 Std. method)

4. Results and Discussion

Precision in the description of colour is enhanced considerably by the organizing into three dimensional array using Lightness L, Chroma C and Hue H as the coordinates describing a colour soild [6].

Table 1- L * a* b* & c* h* Values of *Holarrhena antidysentrica* Dyed Silk

COLOUR COORDINATES											
HNT – SILK						HTT – SILK					
	L*	a*	b*	c*	H		L*	a*	b*	c*	H
HNTS0	57.52	10.42	35.37	36.87	73.58	HTTS0	65.83	7.60	2.32	27.39	73.90
HNTST1	60.41	11.75	32.99	35.02	70.39	HTTST1	67.45	7.60	29.48	30.44	75.55
HNTST2	68.09	8.85	37.93	38.95	76.39	HTTST2	68.99	7.89	28.42	29.49	74.48
HNTST3	68.54	9.92	33.25	34.70	73.39	HTTST3	69.44	7.72	33.18	34.07	76.91
HNTSI1	47.80	5.66	17.55	18.44	72.14	HTTSI1	44.86	3.63	17.98	18.32	78.88
HNTSI2	46.47	4.56	14.96	15.64	73.05	HTTSI2	38.57	2.00	10.95	11.13	79.66
HNTSI3	44.85	4.07	13.90	14.48	73.68	HTTSI3	39.04	1.79	8.18	3.38	77.65
HNTSP1	63.50	9.38	28.58	30.08	71.83	HTTSP1	60.98	8.39	27.79	29.03	73.20
HNTST2	63.55	9.22	29.02	30.45	72.37	HTTSP2	61.15	8.22	27.57	28.78	73.39
HNTSP3	62.90	9.56	23.71	25.57	68.04	HTTSP3	59.11	8.94	24.04	25.65	69.61
HNTSB1	59.86	10.33	25.62	27.62	68.03	HTTSB1	62.25	8.70	27.32	28.67	72.34
HNTSB2	59.61	10.10	23.12	25.23	66.40	HTTSB2	58.92	9.89	25.76	27.60	68.99
HNTSB3	61.57	9.82	20.43	22.67	64.33	HTTSB3	60.26	9.67	22.80	24.76	67.01

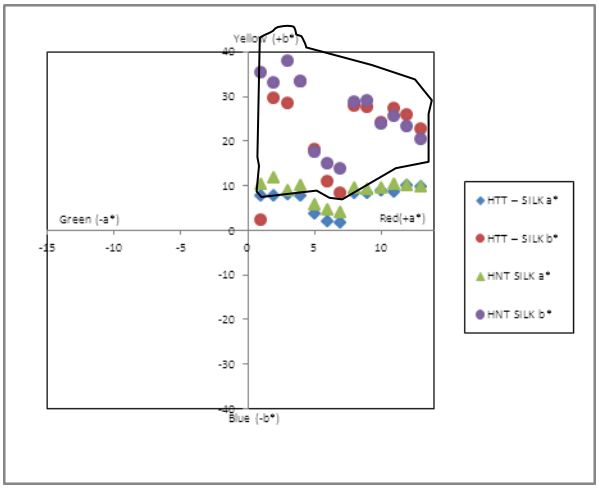

Figure 1: Colour Gamut of of *Holarrhena antidysentrica* dyed silk

Decoding H- *Holarrhena antidysentrica*
S – Silk

Mordants	Mordant Conc/Proportions
A - Alum	0 (10 : 0)
T – Tin (A + T)	1 (9 : 1)
I - Iron (A + I)	2 (7 : 3)
P – Pomegranate (A + P)	3 (5 : 5)

Grading Scale CC – Colour change,

CS – Colour staining,

HNTS0 – *H antidysentrica* HTTS0

NT – No pretreatment ,TT–Tannin treatment

The plot of the a* b* values of these samples are reproduced in Fig 1 : The colour gamut was obtained by joining the extreme points of this plot. It can be seen from the fig. 1 that the basic colours namely yellow, Red, Blue and Green decide the contours of the gamut.

The colour gamut in figure shows that the colour values of *Holarrhena antidysentrica* predominantly fall within the yellow red region. The flavanols present in the leaves of *Holarrhena antidysentrica* are Quercetin, Kaempferol. Leucoanthocyanins (flavonoids) [3]. Total alkaloid content in leaves of *Holarrhena antidysentrica* is 0.97, which occurring as tannates [2].

It can be seen from the table - 1 that dyed silk samples of control and experimental group showed the maximum L* values for (Alum + Tin) combination which were found higher as compared to other mordant combinations. Maximum value was observed for the sample HNTSTI with maximum redness. The highest b* value was noted for sample HTTST3 where as lowest b* value was noticed for HTTSI3. C* values (Chromatic) were found to be decreased in the pre-treated silk samples which decreases the intensity of the colour. Slight increase in h* values of tannin treated samples shifted them towards the yellow region.

From the colour catalogue it can be seen that silk imparted Golden brown, golden yellow to range of oranges brown colour using alum as a single mordant and alum with two natural and two metal mordants as binary mordant combinations with varying ratios. Pretreatment with tannin plays an important role in imparting shade variations.

Table 2- Washing Fastness of *Holarrhena antidysentrica* Dyed Silk

Mordants	Mordants Conc (owf)%	SILK			
		NT		TT	
		CC	CS	CC	CS
A	(10:0)	4	5	5	5
A + T	(9:1)	4	5	5	5
A + T	(7:3)	4	5	5	5
A + T	(5:5)	4	5	5	5
A + I	(9:1)	4	5	4	5
A + I	(7:3)	4	5	4	5
A + I	(5:5)	4	5	4	5
A + P	(9:1)	4	5	4	5
A + P	(7:3)	4	5	4	5
A + P	(5:5)	4	5	4	5
A + B	(9:1)	4	5	5	5
A + B	(7:3)	4	5	5	5
A + B	(5:5)	4	5	5	5

Grading for colour change1-Extremely poor, 1/2- very poor, 2 - poor, 2/3 - fair, 3 - Moderate,3/4 - fairly good, 4 - good, 4/5 - very good, 5 - excellent,
Grading for colour staining 1- Much staining, 2 - considerable staining, 3- Noticeable staining, 4- Slight staining, 5- Negligible staining.

It is apparent from the table that (Alum + pomegranate rind) as binary mordant combination is found best suitable showing excellent wash fastness. Pomegranate rind can be used as a mordant and as a substitute for harda, even deeper shades with equal fastness properties can be achieved. In some cases the rind can be used to produce new shades [9]. Tannin treatment was found suitable to improve wash fastness in case of Alum with Tin and Iron as metal mordants in binary combination.

Table 3 - Acidic & Alkaline Perspiration Fastness of *Holarrhena antidysentrica* Dyed Silk

Mordants	Mordants Conc (owf)%	SILK (Acidic)				SILK (Alkaine)			
		NT		TT		NT		TT	
		CC	CS	CC	CS	CC	CS	CC	CS
A	10:0%	5	5	5	5	5	5	5	4
A + T	9:1%	5	5	5	5	5	5	5	4
A + T	7:3%	5	5	5	5	5	5	5	4
A + T	5:5%	5	5	5	5	5	5	5	4
A + I	9:1%	5	5	5	5	4	5	1	3
A + I	7:3%	5	5	5	5	4	5	1	3
A + I	5:5%	5	5	5	5	5	5	1	3
A + P	9:1%	5	5	5	5	5	5	5	5
A + P	7:3%	5	5	5	5	4	5	5	4
A + P	5:5%	5	5	5	4	5	5	5	4
A + B	9:1%	5	5	5	5	5	5	5	4
A + B	7:3%	5	5	5	5	5	5	5	4
A + B	5:5%	5	5	5	5	5	5	5	4

Acidic perspiration of almost all the silk samples exhibited excellent performance, where no treatment of tannin is required. No change in hue was noticed after the testing but more pronounced effect was seen in bringing luster.

Almost all silk samples of control group showed excellent performance during alkaline perspiration test with negligible staining on undyed piece. It is important to note that (Alum + Iron) binary combination of mordant showed sharp decrease in alkaline perspiration fastness which is seen very poor with regard to colour change and noticeable staining on undyed test specimen.

Table 4 - Rubbing Fastness (Dry and Wet) of *Holarrhena antidysentrica* Dyed Silk

Mordants	Mordants Conc (owf)%	SILK			
		NT		TT	
		Dry	Wet	Dry	Wet
A	(10:0)	5	3	5	5
A + T	(9:1)	4	3	5	4
A + T	(7:3)	5	4	5	4
A + T	(5:5)	5	4	5	4
A + I	(9:1)	4	4	4	3
A + I	(7:3)	4	4	4	3
A + I	(5:5)	4	3	5	4/5
A + P	(9:1)	5	4	5	3
A + P	(7:3)	4	3	5	3
A + P	(5:5)	4	3	4/5	3

A + B	(9:1)	5	4	5	3
A + B	(7:3)	5	3	5	3
A + B	(5:5)	4	4	4	3

Good to excellent dry rubbing fastness of almost all dyed silk samples of control and experimental group can be noticed from the table; whereas moderate to good wet rubbing fastness was rated for all the samples of control and experimental group. Similar results of control and experimental group no tannin treatment required except to achieve shade variation in colour.

Table 5- Sunlight Fastness of *Holarrhena antidysentrica* Dyed Silk

Mordants	Mordants	SILK	
		NT	TT
		CC	CC
A	(10:0)	3	4/5
A + T	(9:1)	4/5	4/5
A + T	(7:3)	4/5	4/5
A + T	(5:5)	4/5	4/5
A + I	(9:1)	4/5	4/5
A + I	(7:3)	4/5	4/5
A + I	(5:5)	4/5	4/5
A + P	(9:1)	4/5	4/5
A + P	(7:3)	4/5	4/5
A + P	(5:5)	4/5	4/5
A + B	(9:1)	4/5	4/5
A + B	(7:3)	4/5	4/5
A + B	(5:5)	4/5	4/5

From the results it would be fair to state that silk samples of control and experimental group dyed with *Holarrhena antidysentrica* are proved to be very fast when exposed to sunlight. It is therefore said that change in mordant and mordant combinations does not affect sunlight fastness in case of *Holarrhena antidysentrica* dyed silk.

5. Conclusion

Aqueous extraction of *Holarrhena antidysentrica* leaves and use of natural mordants such as Harda, Pomegranate rind and Babool bark provides a scope for ecofriendly dyeing process. *Holarrhena antidysentrica* leaves in fresh form shows good to excellent fastness properties on silk with alum as a sole mordant and alum in binary combination with other mordants. Variations in mordant proportions and tannin treatment helps in producing shade variation in colour, which ultimately expands the colour palette. Tannin treatment does not play any role to improve fastness but a fascinating range of brown and yellow can be imparted.

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