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Tea leaves: A herbal dye on ERI silk

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Abstract
Eco-friendly natural dyes are in demand now a days. Dyeing eri silk with different dyestuffs enhance the quality of fabric as well as its aesthetic value. Colouring of eri silk with tea leaves as a natural dye makes the natural grey or beige colour of eri silk more attractive. Various dyeing conditions were optimised with the use of different mordants and colour fastness properties of the fabrics were determined and it was found that all the mordants showed maximum absorption in simultaneous mordanting method. The colour fastness was observed very fair to good rating and colour yield was cyote, field drab, bistre and straw colour.

Keywords: Colourfastness, Eri silk, mordant, natural dye, optimization, tea leaves

Introduction
Colour is the first attribute that is observed and is the first factor governing fabric choice. The art of colouring fabrics probably began in antiquity by "coating" the textile rather than dyeing it. Colouring refers to applying a colour producing material onto a fabric physical means, such as by painting, rubbing or pressing it into the fibre.

Eri (*Samia ricini*), also known as endi or erndi, ranks next to tassar in commercial importance. It is described as a silk of incredible durability. The eri silk yarns are generally woven to fabric which is used as winter wrapper. The eri cloth can be an excellent material for shirting, suiting, bed spread, neck tie, curtain, dress materials and other furnishing items [11].

Natural dyes have the property of eco-friendliness and does not create any environmental problems at the stage of production or use and maintain ecological balance. The use of natural dyes on textiles has been one of the consequences of increased environmental awareness worldwide. Tea can be used as a dye source for colouring eri silk. Tea is a tree or bush, consumed as beverage made from the leaves. The plant is an evergreen and indigenous to Assam (India) and probably to parts of China and Japan. In its native state, it grows to a height of about 30 ft (9.1 m), but in cultivation it is pruned to 3–5 ft (91–152 cm). The lanceolate leaves are dark green, the blossom is cream-colored and they have fragrannce. The different classes of compound found in tea include: amino acids, caffeine, carbohydrates, chlorophyll, lipids, mineral, nucleotides, organic acids, polyphones, saponins, unsaponifiable compounds and volatile compounds of the polyphenols, catechins are the principle colorant species [6, 8]. Tea plant is classified as *Camellia sinensis*- variety sinensis and variety assamica. There are six types of tea: green, yellow, dark, white, oolong and black. This classification is based on the processing method employed, the degree of fermentation and the oxidation of the polyphenols present in tea [5]. Considering the increasing popularity of using natural dyes as well as the potentiality of eri silk in global market the present study was undertaken with the following objectives: to optimize the dyeing conditions of selected dye for eri silk fabric and to evaluate the colour fastness properties of dyed fabric.

Materials and Method
For conducting the study the Annatto seed (*Bixa orellana*) were collected from Chowldhuwa of Lakhimpur district of Assam. The collected seeds were, cleaned and dried and tea leaves (*Camellia assamica*) were collected from tea garden of Assam Agricultural University, Jorhat. The tender tea leaves from below the third leaves which were not required for manufacturing of tea were selected for the study. The collected leaves were cleaned, washed and dried as the colour obtained from dry leaves are brighter than fresh ones. Eri silk (*Samia ricini*) fabric with plain weave were collected from local market of Jorhat.

Chemicals used
Chemical used for the study were Hydrogen peroxide, Soda ash/ sodium bicarbonate, Aluminium potassium sulphate (metallic salt)/ alum, Sodium chloride and Lactic acid, USP 85% of LR grade.

Mordants used
Four mordants namely Aluminium potassium sulphate (metallic salt)/ alum [Alk $(SO_4)_2.16\ H_2O$], Copper sulphate ($CuSO_4$), Ferrous sulphate ($FeSO_4$) and Stannous cloride ($SnCl_2$) were used for the study. Mordants are the substance capable of binding a dye to textile fabrics [9]. Mordant helps to produce faster shades by forming an insoluble compound of mordant and dyestuffs within the fiber itself [2, 10].

Methods
Degumming
Before dyeing degumming is done for removing the sericin and uniform dyeing. For this the silk fabric were boiled in washing soda solution (5g/lit) at 60 ^{0}C for 30 min. Fabric were washed properly in running water and dried.

Bleaching
Bleaching improves the whiteness property and also imparts uniform absorbency and high degree of dyeability. For this the silk fabric were boiled in 1% H_2O_2 at 50 ^{0}C for 30 min. Fabric were washed properly in running water and dried.

Optimization of different dyeing conditions
A series of experiments were conducted to optimize the different dyeing conditions namely dye extraction medium, dye extraction time, dye material concentration, combination ratio, dyeing time, concentration of mordants, mordanting time, mordanting methods etc. for dyeing of eri silk fabric with tea (*Camellia seninsis*) and annatto (*Bixa orellana*) dye.
In all the experiments, the values of some of the variables like material to liquor ratio for extraction (1:50), material to liquor ratio (1:30) for dyeing, extraction temperature (100 °C) and dyeing temperature (70 °C) for the study were kept constant based on some research findings [3, 4, 7].

Extraction of dye
For the selection of extraction medium 3 methods were selected i.e. aqueous, alkaline and acidic and tested, and it was found that aqueous medium was more suitable based on percent dye extraction. In this method 1gm dye material were mixed in 100ml of soft water at 100 ^{0}C for 1 hour.

Dyeing of eri silk fabric
The eri silk fabrics to be dyed were weighed. The extracted dye liquor was taken as per requirement at material to liquor ratio 1: 30. The optical density of the dye liquor was recorded. The eri silk fabrics were placed in the dye liquor and dyed for 45 minutes in the dye bath with occasional stirring. After completion, the fabrics were removed and the optical density of the liquor was recorded. The fabrics were then soaped, washed, rinsed and dried in shade. The percentage of dye absorption (%) of the fabric was estimated by using the following formulae:

$$\%\ \text{of dye absorption} = \frac{\text{OD of the liquor before dyeing - OD of the liquor after dyeing}}{\text{OD of the liquor before dyeing}} \times 100$$

Optimization of Mordanting Methods
Optimization of mordanting methods were carried out by adopting the pre, post and simultaneous mordanting methods. Absorption (%) of dye by the eri silk fabric was calculated from optical density values for different mordanting methods. The method showing the maximum dye absorption was selected as the optimum method for each mordants.

Pre-mordanting method
Pre-mordanting method was done by mordanting the fabric first and then dyed. For this method, an aqueous solution was prepared by dissolving required amount of mordant in water. The fabric were boiled in 70 ºC in this solution for 30 minutes and then entered in the prepared dye solution for dyeing.

Simultaneous mordanting
In this method, the mordants and dye were applied simultaneously in the same bath. The eri silk fabric were placed in the extracted dye bath and dyed for 15 minutes. The required amount of mordants were added to the dye solution by lifting fabric and mixed properly. The fabric were then dyed in the solution for 30 minutes.

Post mordanting
In this method the sample were first dyed with dye solution and then mordanted. A mordanting bath was prepared as per recipe for mordanting. After dyeing the samples were removed with the help of a glass rod and then entered in the mordanting bath and heated to a temperature of 60-70°C for 30 minutes. Then the samples were allowed to cool, rinsed and dried in shade.

Optimization of combination ratio of tea and annatto
The combination ratio was optimized by extracting tea: annatto dye at different ratios *viz.*, 10:90, 20:80, 30:70, 40:60, 50:50 and vice versa with both the dye, and optical densities of the extracted dye liquor for different ratios were recorded. Dye extraction ratio was optimized based on maximum optical density value obtained by the dye liquor for different ratios.

Evaluation of colourfastness
The dyed samples of eri silk yarn were evaluated for colour fastness to washing, colour fastness to sunlight, colour fastness to crocking (dry and wet), colour fastness to pressing (dry and wet) and colour fastness to perspiration (acidic and alkaline) by using ASTM (1) procedure.

Findings and Discussion
Optimization of dye extraction time
It was clear from Table 1, that the maximum optical density value (2.520) was obtained in 60 min of extraction time. Hence 60 min extraction time for tea dye might be considered as suitable time for extraction.

Optimization of dye material concentration
It was cleared from the Table 2, that dye absorption was found maximum (60.82%) in 3 percent concentration of dye. As the dye concentrations increased the absorption percentage were decreased gradually. Hence, 3 percent concentration might be considered as suitable for dyeing eri silk fabric.

Optimization of dyeing time

Data obtained from the Table 3, revealed that maximum absorption (71.04%) of dye by the fabric was found at 45 minutes of dyeing time. The absorption (%) by the fabric was decreased gradually by the increasing the dyeing time. Hence, 45 minutes duration of dyeing time was considered as optimum time, as it showed maximum absorption by the eri silk fabric.

Optimization of mordant concentration

It was evident from the Table 4, that, the maximum absorption (94.52%) was found in 6 per cent concentration of alum. In the case of $CuSO_4$ 3% concentration showed maximum absorption (88.01%). In $FeSo_4$ absorption of dye was found maximum (68.00%) in 2 per cent concentration. The concentration of stannous chloride showed maximum absorption (67.57%) in 2 per cent concentration. Hence 6%, 3%, 2% and 2% concentration of mordant was selected as optimized for alum copper sulphate, ferrous sulphate and stannous chloride, respectively.

Optimization of mordanting time

From Table 5, it was evident that the highest absorption percentage of dye were obtained in 30 min of mordanting time of each mordant. Therefore, 30 min mordanting time was considered as the optimum time for mordanting for eri silk fabric.

Optimization of mordanting method

From the Table 6, it was clear that all the mordants shows maximum absorption in simultaneous mordanting method. Hence simultaneous mordanting method was considered as suitable mordanting method.

Colourfastness properties of dyed eri silk fabric

From the Table 7, it was interesting to know:-

Colour fastness to sunlight

Tea dyed samples without mordant and mordanted with alum and stanneous chloride, showed good colour fastness to sunlight. While ferrous sulphate and copper sulphate mordanted samples showed very fair fastness to sunlight.

Colour fastness to crocking

The dyed eri samples were tested for colourfastness to dry and wet crocking and observed that all samples dyed without mordant, alum, copper sulphate, ferrous sulphate, stannous chloride showed good fastness to dry crocking and no staining was observed. On the other hand colour fastness to wet crocking showed good fastness by samples dyed without mordant, copper sulphate, ferrous sulphate and stannous chloride mordanted while samples with alum mordant showed very fair fastness to wet crocking. No staining was observed by samples mordanted with alum, copper sulphate and stannous chloride and slightly stained by ferrous sulphate mordanted and without mordanted sample dyed with tea leaves.

Colour fastness to washing

The samples mordanted with alum, ferrous sulphate, stannous chloride and without mordant showed very fair fastness to washing while copper sulphate showed good fastness and no colour staining were observed for all the sample.

Colourfastness to perspiration

The dyed eri samples were tested for colour fastnesss to perspiration (acidic and alkali). In alkaline perspiration copper sulphate, stanneous chloride and without mordanted sample showed very fair fastness and slightly stained. While other samples mordanted with alum and ferrous sulphate showed good colour fastness to alkaline perspiration and no colour stain observed.

In acidic perspiration, samples without mordant and mordanted with copper sulphate, ferrous sulphate and stanneous chloride showed good colourfastness to acidic perspiration and no colour stained observed. While samples mordanted with alum showed very fair colour fastness to acidic perspiration and slightly stained.

Colourfastness to pressing

All samples without mordant, mordanted with alum, copper sulphate, ferrous sulphate and stannous chloride showed good fastness to dry pressing and no colour stain observed. While in wet pressing all the samples showed good fastness to wet pressing and no colour stain observed while copper sulphate sample showed slightly colour stain.

Table 1: Optimization of dye extraction time

Sl. No.	Dye extraction time (min)	Temperature (°C)	Optical density value
1	30	100	2.321
2	45	100	2.440
3	60	100	2.520
4	75	100	2.490
5	90	100	2.471
6	105	100	2.450

Table 2: Optimization of dye material concentration

Sl. No.	Extraction time (in min.)	Concentration of (dye/ 100g of fabric)	Dye absorption (%)
1	60	1	35.55
2	60	2	49.36
3	60	3	60.82
4	60	4	50.60
5	60	5	41.71
6	60	6	34.21

Table 3: Optimization of dyeing time

Sl. No.	Temperature (°c)	Wavelength (nm)	Dyeing time (min)	Dye absorption (%)
1	70	470	15	33.10
2	70	470	30	64.71
3	70	470	45	71.04
4	70	470	60	60.82
5	70	470	75	58.25
6	70	470	90	45.34

Table 4: Optimization of mordant concentration

Name of the mordant	Mordant concentration (g/100g of fabric)	Dye absorption (%)
Alum	2	62.10
	4	68.57
	6	94.52
	8	80.48
	10	76.03
	12	60.73
Copper sulphate	1	82.51
	2	83.21
	3	88.01
	4	85.08
	5	82.72
	6	76.82
Ferrous sulphate	1	55.14
	2	68.00
	3	54.78
	4	37.09
	5	33.28
	6	28.26
Stannous chloride	1	58.49
	2	67.57
	3	56.53
	4	32.01
	5	22.53
	6	18.62

Table 5: Optimization of mordanting time

Name of the mordant	Mordanting time (min)	Dye absorption (%)
Alum	15	59.28
	30	76.36
	45	61.06
	60	54.29
	75	48.26
Copper sulphate	15	70.28
	30	81.58
	45	78.21
	60	64.90
	75	59.20
Ferrous sulphate	15	64.23
	30	72.48
	45	68.64
	60	61.90
	75	56.26
Stannous chloride	15	47.79
	30	56.48
	45	49.14
	60	43.89
	75	35.43

Table 6: Optimization of mordanting method for all the mordants

Mordant	Mordanting method	Dye absorption (%)
Alum	Pre	54.79
	Simultaneous	63.43
	Post	49.14
Copper sulphate	Pre	53.82
	Simultaneous	69.58
	Post	57.21
Ferrous sulphate	Pre	43.26
	Simultaneous	56.94
	Post	48.83
Stannous chloride	Pre	41.85
	Simultaneous	48.38
	Post	39.63

Table 7: Ratings for colourfastness properties of dyed samples

Sl. No.	Mordant used	Sunlight	Washing		Crocking				Perspiration				Pressing			
					Dry		Wet		Acidic		Alkaline		Dry			Wet
			CC	CS	CC	CS	CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
1.	Without mordant	5	4	5	5	5	5	4	5	5	4	4	5	5	5	5
2.	Alum	5	4	5	5	5	4	5	4	4	5	5	5	5	5	5
3.	Copper sulphate	4	5	5	5	5	5	5	5	5	4	4	5	5	5	4
4.	Ferrous sulphate	4	4	5	5	5	5	4	5	5	5	5	5	5	5	5
5.	Stannous chloride	5	4	5	5	5	5	5	5	5	4	4	5	5	5	5

CC: Colour change; CS: Colour staining;
CC Ratings: 1 = very poor, 2 = poor, 3 = fair, 4 = very fair, 5 = good,
CS Ratings: 1= heavily stained, 2= considerably stained, 3= noticeable stained, 4=slightly stained,5= negligible or no staining

Conclusion
From the above study it has been found that tea dye can enhance the colour of eri silk fabric, which will be a boost in preparing diversified products. Such efforts are required to improve the qualities and aesthetic value of this poor man's silk to match with new trends in national and international market. On the basis of the findings of this study improvement in dyeing processes of eri silk with natural dyes may be incorporated in order to obtain wide consumer acceptance.

Reference

1. AATCC. AATCC Technical Manual 1967, American Association of Textile Chemicals and Colourist, New York. 1968; 25:619-639.
2. Bains S, Kaur K, Kang S. Comparative study of colour fastness properties of dyed cotton with Arjun (*Arjuna terminela*) dye using mordant and their combination. Tex. Trends. 2006; XLVIX (2):41-43.
3. Bansal A, Rani S, Sharma A, Sood A. Dyeing of silken yarns yarns with beribery dye. Textile Trends. 2006; XLVIII (12):39-40.
4. Gogoi N. on Studies on bleaching and dyeing behaviour of eri (*Philosomia ricini*) silk and evaluation of its physio-chemical properties. Ph.D. (H.Sc.) Thesis, Assam Agricultural University, Jorhat, 2004.
5. Gulrajani ML. Introduction to Natural Dyes. Indian Institute of Technology, New Delhi, 1992.
6. Gulrajani ML. Present status of natural dyes. Indian J. Fibre Text. Res., 2001, 26.
7. Hussain on Dyeing of eri silk yarn with coral jasmine flower (*Nystanthus arborthisis*). M.Sc. (H.Sc.) Thesis submitted to Assam Agricultural University, Jorhat, 2002.
8. Iriyana K, Ogura N, Takamiya AJ. Biochem. 1974; 76:901.
9. Nalankilli G. Natural dyes and the challenges. Paper presented in the seminar on new vistas for jute diversified products at SITRA, June 16, Coimbatore. UNDP and Ministry of Textile, India, 1997, pp. 229-230.
10. Sengupta S. Application of the liquor for colouration of cotton fabric. Tex. Trends. 1997; XLIV (3):21.
11. Thangavelu K. With a push ericulture can prosper. Indian Silk. 1989; XXVII(2):17.