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Evaluation of natural dye paste on properties of natural textile

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Abstract
An investigation was carried out to find out the printing effect of turmeric (*Curcuma longa)* dye paste on colour fastness and physical properties of eri silk fabric. For the experiment two traditional designs were printed by using natural printing paste of turmeric (*Curcuma longa* L.) dye on eri silk fabric. The printed samples were evaluated visually and with the help of Grey Scale for determining the colour fastness properties, general appearance, texture, brilliancy of colour, clarity of design, sharpness of design outline and dye penetration in design. Colour fastness to washing and sunlight found excellent in mordant sample with ferrous sulphate for both designs, colour fastness to crocking was found better for stannous chloride and ferrous sulphate mordanted sample in dry conditions and ferrous sulphate mordanted sample in wet condition for both designs. In pressing colour fastness retained cent per cent in dry and wet condition for both design of all mordanted samples. All printed samples found to be fine to medium texture and good to fair in general appearance of both designs. Mordanted samples of ferrous sulphate of both designs found to be good in high brilliancy of colour, clarity of design, and sharpness of design outline and dye penetration in design. From the experiment it was found that all the printed samples exhibited an increasing trend in crease recovery angle, abrasion resistance, stiffness of fabric. The samples mordanted with alum exhibited the better result in respect of all the physical properties compared to the other printed samples.

Keywords: Eco-friendly, eri silk, properties, mordant, printing, turmeric dye

1. Introduction

The prime consideration in the choice of textile materials is the purpose, for which they are intending; but colour has been termed as the best salesman. It is possible to colour textile materials in varies way including staining and painting, but printing involves a penetration of the dyestuff into fibre and some degree of combination. The term textile printing is used to describe the production, by various mechanical and chemical means of coloured designs or patterns on textile substrates (Glover, 2005) [4]. The use of natural dyes for the colouration of textiles has mainly been confined to craft, dyers and printers. The prints obtained are brighter, intense possessing natural bloom (Corbman, 1976) [2].

However, recently the eco-friendly trend has been fueled by increases public awareness about environmental issue over the past decade. Business, both large and small, have started exploring the use of natural dyes as a means of producing an eco-logically sound product, fairly non-polluting, automatically harmonizing colour, rare colour idea and more challenging because of the element of chance, which would also appeal to the consumer (Ramesha,1998) [16]. Dyes used in printing are same as in regular dyeing but instead of the thin dye bath solution thickener combination are necessary for printing. Turmeric (*Curcuma longa* L.) which is the raw material of natural dye is widely available as a household curry powder and also be utilized as a printing paste. North-eastern region of India has been considered to be the homeland of all the commercially exploited silkworms i.e., eri, muga, tassar and mulberry.

Out of these, eri culture is the most ancient and is closely associated with tradition and culture of the people of their region. In India, eri was mostly used with oven design for the preparation of winter shawls, jacket for men and women. Dress materials and baby dresses are also made from Eri silk fabric, because of its soft texture and moisture absorbent quality. Eri silk durable and strong and has a typical texture; hence, it is widely used in home furnishing like curtains, bed covers, cushion covers, etc.

Therefore, the investigator felt the need and made an attempt to introduce the printed designs to enhance its aesthetic properties as well as demand in domestic and international market.

2. Materials and Methods: The study was carried out in the following headings.

2.1 Selection and preparation of fabric
Plain weave eri silk fabric having following specification was taken for the experiment.

Table 1: Construction particulars of test fabric

Fabric	Thread/cm		Weight (gm/m2)	Thickness (mm)
	End	Pick		
Eri silk	18	20	195	0.592

Degumming
Silk was treated with 2 g/l lux powder solution and 2 g/l Na_2CO_3 at material to liquor ration (M: L) was 1:20 and boiled for 60 minutes at 50°C with occasional stirring. After degumming the material was squeezed and washed thoroughly in hot water followed by cold water and then dried in air. After that fabric was iron to removed wrinkles.

2.2 Nomenclature of the sample
The samples names were assigned against different shades were obtained by the use of different mordants, which are given in the table below.

Table 2: Nomenclature of the sample

Sample	Mordant	Shade obtained
0	-	-
UT	-	Mastered yellow
AT1	Alum	Golden yellow
AT2	Stannous chloride	Orange
AT3	Ferrous sulphate	Brownish black

2.3 Selection of design for printing
Two traditional designs were selected and name accordingly to the local terms used for the motifs and designs *viz*., Joon-Dhol Biri Phul (D_a) and Pepa-Japi Phul (D_b).

2.4 Selection of technique for printing
Screen printing technique was selected for printing the fabric.

2.5 Selection of chemicals (mordants) for printing
The chemicals (mordant) used for the experiment were Alum (Al_2SO_4), Stannous chloride ($SnCl_2.2H_2O$), Ferrous sulphate ($Fe2SO_4.7H_2O$), synthetic thickener (Ethyl acrylate) and fixer (Acrafix) were used for the experimental work.

2.6 Preparation of dye powder and printing paste for printing
2.6.1 Preparation of dye powder: 1 kg of raw fresh turmeric (*Curcuma longa* L.) was taken and boiled in 3 liter of water for 15 minutes at a boiling temperature. After that the turmeric were dried in the sun light and powder were prepared.

2.6.2 Preparation of printing paste
Printing paste was prepared by using 6 per cent of turmeric dye powder, 1:2 thickener ratio, 1.5 per cent of fixer concentration, 3 per cent of mordant concentration.

2.7 Application of printing paste on fabric
Fabric was ironed and fixed on the printing table with pins. Screen was placed on top of it and the printing paste was pouring on one side of the screen and it was spread with the help of the squeeze and dried in air for 24 hrs.

2.8 Developing of printed design
Printed samples were wrapped in paper and then steamed at a cottage steamer for a period of 1½ hours at a boiling temperature and then dried in air.

3. Findings and Discussion
Table 3 exhibited that evaluation of the entire sample showed better result in the case of colour fastness properties. However, the samples of both designs of AT3 showed better fastness to colour changes and colour staining than UT, AT_1, and AT_2 samples. From the Table 4 it could be concluded that the general appearance of all the treated printed samples of both designs i.e., AT_1, AT_2 and AT_3 were better than untreated sample i.e. UT. It was observed from the Table 5 that samples UT was considered as fine (68 per cent) and medium (32 per cent). For samples AT_1, AT_2 and AT_3 of both design 76 per cent, 24 per cent of respondent rated samples as fine and medium respectively. From the result it was cleared that treated printed samples of both the designs had fine texture than untreated samples. It was revealed from the Table 6 that the high brilliancy of colour was obtained in sample AT_2 and AT_3 of both designs while the other samples viz., UT and AT_1 were found to be of moderate brilliancy of colour. It was evident from the Table 7 that in respect of clarity of design sample AT_2 and AT_3 were found best followed by UT and AT_1 for both designs.

It was noted from Table 8 that sample UT was considered as very good (90 per cent), good (6 per cent) and fair (4 per cent). For samples AT_1 and AT_2 of both design 94 per cent and 6 per cent of respondent rated samples as very good and good respectively. While 96 per cent and 4 per cent considered as very good and good for sample AT_3 of both design respectively. From the result it was found sharpness of design outline of treated printed samples of both the designs were very good result than the untreated sample.

It was observed from the Table 9, Dye penetration in designs was found maximum in sample AT_3 (96 per cent, 96 per cent) of both design followed by AT_1 (56 per cent, 56 per cent), AT_2 (52 per cent, 58 per cent) and UT (38 per cent, 42 per cent) of both designs. From the result it was cleared that treated printed samples had maximum penetration in design than the untreated sample for both designs.

It was evident from the Table 10 both the warp and weft direction of all the samples showed a significant increased in crease recovery angle. The crease recovery angle in warp direction was greater than that of weft direction. The result of the data also indicated the untreated sample (UT) exhibited maximum increased in crease recovery angle (10.83 per cent) followed by treated samples as AT_1, AT_2 and AT_3 (7.31 per cent, 4.96 per cent and 3.87 per cent) in warp direction respectively. In weft direction, the sample mordanted with alum (AT1) showed the highest crease recovery angle (12.67 per cent) and sample mordanted with ferrous sulphate (AT_3) showed the lowest crease recovery angle (8.48 per cent). The increase and decreased in crease recovery may be due to different chemicals used in preparing the paste.

The Table 11 revealed that all the samples had increased in abrasion resistance. The increase abrasion resistance of untreated sample (UT) was found 10.76 per cent. However, among all the treated samples with different mordants were found to be higher abrasion resistance (4.16 per cent) in sample mordanted with alum (AT_1) than AT_2 (1.38 per cent) and AT_3, (1.38 per cent).The decrease in abrasion resistance may be due to effect of different chemicals used in preparing paste and increase may be due to absorption of paste.

Both warp and weft direction of treated and untreated samples indicated an increased in bending length reported in Table 12. The maximum increased was found in sample AT_3 mordanted with ferrous sulphate (37.83 per cent) followed by AT_2 (32.11 per cent), AT_1 (17.96 per cent) and UT (1.43 per cent) in weft direction. Whereas the sample in warp direction, as for AT_1 mordanted with alum showed increased by 34.09 per cent, AT_2 mordanted with stannous chloride by 30.30 per cent, AT_3 mordanted with ferrous sulphate by 28.21 per cent and untreated sample (UT) by 25.37 per cent respectively. Increased in breaking strength in both warp and weft due to higher crimp percentage and also due to the increase in size of the dye molecule after using the chemical as a metal salt.

From the Table 13 it was evident that all the samples found an increased trend in flexural rigidity in warp and weft direction. Highest increased was observed in sample mordanted with ferrous sulphate (AT_3) by174.12 per cent followed by AT_2 (137.78 per cent), AT_1 (70.11 per cent) and UT (8.133 per cent) in weft direction. The sample mordanted with alum (AT_1) showed maximum increased in flexural rigidity in warp direction by 149.87 per cent and the untreated sample (UT) showed lowest flexural rigidity by 104.27 per cent, respectively. The decreased in flexural rigidity may be use of chemicals in preparing the printing paste and increase may be due to absorption of dye paste.

Table 3: Colour fastness grades for printed samples

Sample	Design	Washing fastness		Light fastness	Crocking fastness				Pressing fastness			
					Dry		Wet		Dry		Wet	
		CC	CS	CC	CC	CS	CC	CS	CC	CS	CC	CS
UT	D_a	3-4	4-5	3	4	4	3-4	3-4	4-5	4-5	4-5	4-5
	D_b	3-4	4-5	3	4	4	3-4	3-4	4-5	4-5	4-5	4-5
AT_1	D_a	4-5	4-5	4-5	4-5	4-5	4	4	5	5	5	5
	D_b	4-5	4-5	4-5	4-5	4-5	4	4	5	5	5	5
AT_2	D_a	4-5	5	4-5	4-5	4-5	4	4	5	5	5	5
	D_b	4-5	5	4-5	4-5	4-5	4	4	5	5	5	5
AT_3	D_a	5	5	4-5	4-5	4-5	4-5	4-5	5	5	5	5
	D_b	5	5	4-5	4-5	4-5	4-5	4-5	5	5	5	5

Colour fastness

CC = Colour changes; CS = Colour staining

Table 4: Rating effect of general appearance of printed samples (in percentage)

Sample Factor	UT		AT_1		AT_2		AT_3	
	D_a	D_b	D_a	D_b	D_a	D_b	D_a	D_b
Very good	90	90	94	94	98	94	98	94
Good	6	8	-	6	-	6	-	6
Fair	4	2	6	-	2	-	2	-
Poor	-	-	-	-	-	-	-	-

Table 5: Rating effect of texture of printed samples (in percentage)

Sample Factor	UT		AT_1		AT_2		AT_3	
	D_a	D_b	D_a	D_b	D_a	D_b	D_a	D_b
Fine	68	68	76	76	76	76	76	76
Medium	32	32	24	24	24	24	24	24
Rough	-	-	-	-	-	-	-	-

Table 6: Rating effect of brilliancy of colour of printed samples (in percentage)

Sample Factor	UT		AT_1		AT_2		AT_3	
	D_a	D_b	D_a	D_b	D_a	D_b	D_a	D_b
High	88	88	90	90	98	98	98	98
Moderate	10	10	8	8	2	2	2	2
Low	2	2	2	2	-	-	-	-

Table 7: Rating effect of clarity of design of printed samples (in percentage)

Sample Factor	UT		AT_1		AT_2		AT_3	
	D_a	D_b	D_a	D_b	D_a	D_b	D_a	D_b
Very good	90	90	96	90	98	98	98	98
Good	8	10	2	10	2	2	2	2
Fair	2	-	2	-	-	-	-	-
Poor	-	-	-	-	-	-	-	-

Table 8: Rating effect of sharpness of design outline of printed samples (in percentage)

Sample Factor	UT		AT_1		AT_2		AT_3	
	D_a	D_b	D_a	D_b	D_a	D_b	D_a	D_b
Very good	90	90	94	94	94	94	96	96
Good	6	6	6	6	6	6	4	4
Fair	4	4	-	-	-	-	-	-
Poor	-	-	-	-	-	-	-	-

Table 9. Rating effect of dye penetration in design of printed samples (in percentage)

Sample Factor	UT		AT_1		AT_2		AT_3	
	D_a	D_b	D_a	D_b	D_a	D_b	D_a	D_b
Maximum	38	42	56	56	52	58	96	96
Mediocre	58	56	42	44	46	42	4	4
Minimum	4	2	2	-	2	-	-	-

Table 10: Effect of printing paste on fabric crease recovery angle (degree)

Direction of fabric	O	UT	AT1	AT2	AT3
WARP	120.36	133.40	143.15	140.02	138.56
% change in warp		+10.83	+7.31	+4.96	+3.87
WEFT	107.87	121.50	136.89	133.08	131.81
% change in weft		+12.63	+12.67	+9.50	+8.48

Note: '+'ve sign indicates increase in crease recovery angle

Per cent change of untreated sample (UT) is calculated from O sample

Per cent change of treated samples were calculated from UT sample

Table 11: Effect of printing paste on abrasion resistance of fabric (cycle to rupture)

Aspect	O	UT	AT_1	AT_2	AT_3
Abrasion resistance	65	72	75	73	73
% change in abrasion resistance		+10.76	+4.16	+1.38	+1.38

Note: '+'ve sign indicates increase in abrasion resistance
Per cent change of untreated sample (UT) is calculated from O sample
Per cent change of treated samples were calculated from UT sample

Table 12: Effect of printing paste on bending length (cm) of fabric

Direction of fabric	O	UT	AT_1	AT_2	AT_3
WARP	2.64	3.31	3.54	3.44	3.385
% change in warp		+25.37	+34.09	+30.30	+28.21
WEFT	3.145	3.19	3.71	4.155	4.335
% change in weft		+1.43	+17.96	32.11	+37.83

Note: '+'ve sign indicates increase in bending length
Per cent change of untreated sample (UT) is calculated from O sample
Per cent change of treated samples were calculated from UT sample

Table 13: Effect of printing paste on flexural rigidity (mNmm) of fabric

Direction of fabric	O	UT	AT_1	AT_2	AT_3
WARP	34.83	71.15	87.03	79.46	76.85
% change in warp		+104.27	+149.87	+128.13	+120.04
WEFT	58.89	63.68	100.18	140.03	161.43
% change in weft		+8.183	+70.11	+137.78	+174.12

Note: '+'ve sign indicates increase in flexual rigidity
Per cent change of untreated sample (UT) is calculated from O sample
Per cent change of treated samples were calculated from UT sample

Fig 1: UT (Da): Without mordanting Joon-Dhul Biri (Phul) design sample

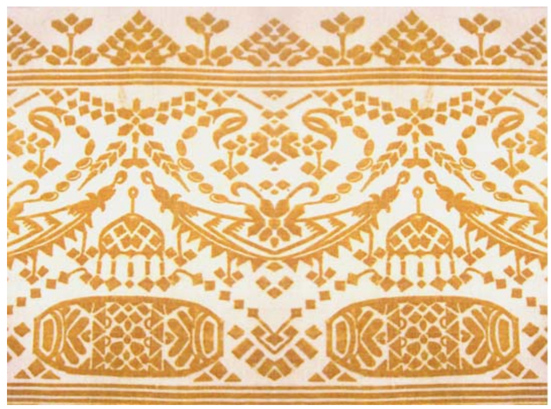

Fig 3: AT1 (Da): Mordanted Joon-Dhul Biri (Phul) design sample with alum

Fig 2: UT (Db): Without mordanting Pepa-Japi (Phul) design sample

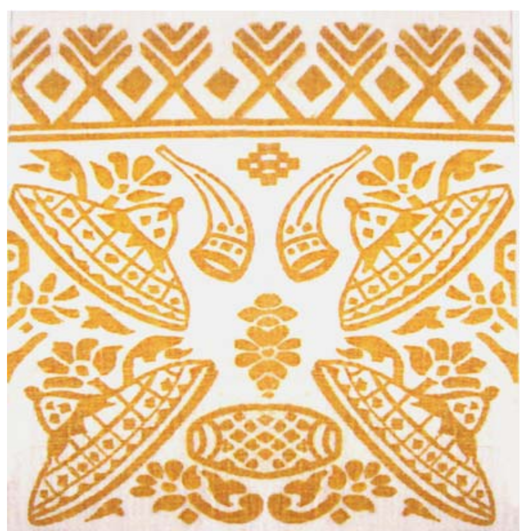

Fig 4: AT1 (Db): Mordanted Pepa-Japi (Phul) design sample with alum

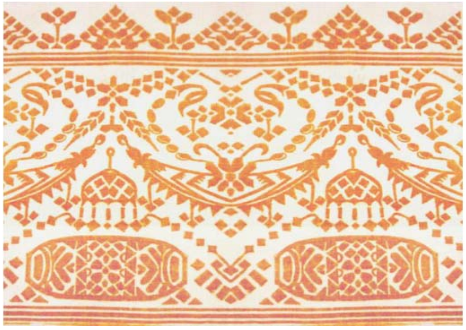

Fig 5: AT2 (Da): Mordanted Joon-Dhul Biri (Phul) design sample with stannous chloride

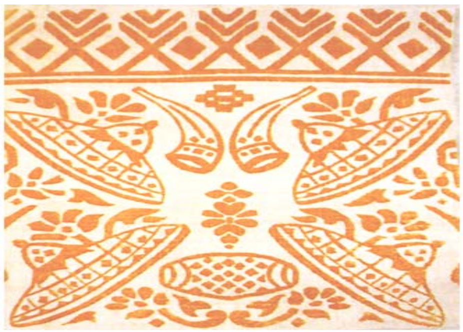

Fig 6: AT2 (Db): Mordanted Pepa-Japi (Phul) design sample with stannous chloride

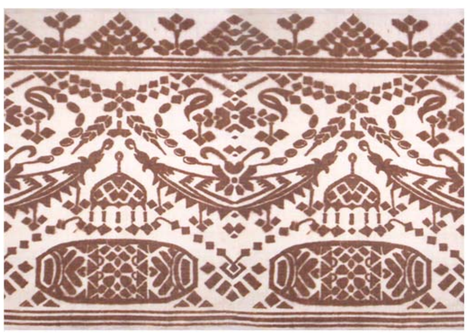

Fig 7: AT3 (Da): Mordanted Joon-Dhul Biri (Phul) design sample with ferrous sulphate

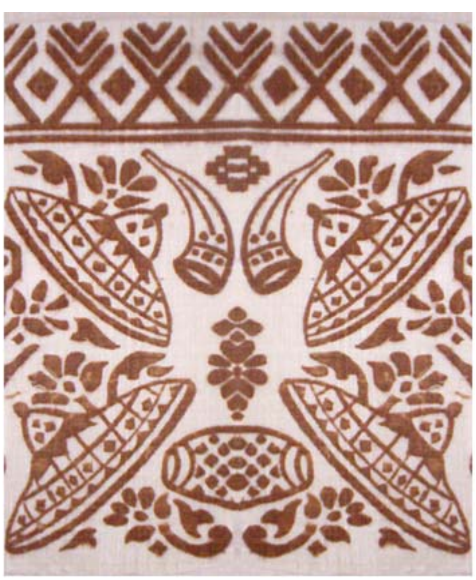

Fig 8: AT3 (Db): Mordanted Pepa-Japi (Phul) design sample with ferrous sulphate

4. Conclusion

The present experiment unveiled that the printing paste of turmeric can be successfully utilized to print the eri silk fabric which is eco-friendly, non-carcinogenic and biodegradable. The printing of eri silk fabric with turmeric dye produced various soft and stable natural print. From the experiment it can be concluded that, all printed samples with mordant improve the colour fastness properties of turmeric (*Curcuma longa* L.) dye on eri fabric. Sample mordent with alum showed the better result in respect of all the physical properties compared to the other printed sample.

On the other hand turmeric has various medicinal properties. It is used to cure pain, boils, pimples, piles etc. So eri fabrics printing with turmeric dye paste may relive body pains. Thus printing eri silk fabric with turmeric dye paste give a new look to this poor man's friend, will boost in preparing diversified products. Such efforts are required to improve the quality and aesthetic value of eri silk to match with new trends in national and international market.

5. References

1. Bhuyan R, Saikia DC. Natural dyes: Present scenario in North East India. Clearage. 2004, 5-27.
2. Corbman BP. Textiles Fibre to Fabric. 4th Edition, McGraw Hill Book. Inc., New York, 1976, 223-227.
3. Das S. Application of natural dyes on silk. Colourage, 1992; 39(9):52-54.
4. Glover B. Reactive dyes for textile printing. Colourage Annual, 2005, 67.
5. Gogoi A. Vegetable dyes and eri silk. Indian Textile Journal CVIII, 1998; (10):74-78.
6. Hess KP. Textile Fibers and their Use. 5th Edition, Oxford and IBM Publishing Co., New Delhi, 1959, 108-110.
7. Joseph ML. Essentials of Textiles. 3rd Edition, Holt. Rinehart and Winston, Inc., USA. 1975, 265-268.
8. Kalita B, Gogoi N. Effect of ultraviolet light on eri silk fabric. Tex. Index, 1998; 37(9):12-16.
9. Mara T. The Thames and Hudson manual of screen printing. Thames and Hujdson Ltd. London, 1983, 7-10.
10. Mullick P. Text Book of Home Science. Kalyani Publishers, Ludhiana, Madras, New Delhi, 2002.
11. Paul R, Malankes JR, Naik SR. Natural dyes classification, extension and fastness properties. Textile Dyer Printer. 1996; 29(22):16-24.
12. Sarkar AN. Sericulture in North East. Indian Silk, 1995; 33(9):4-41.
13. Sekar N. Turmeric colorants. *Colourage,* 2004, **6**:59.
14. Shenal VA. Technology of textile processing, Chemistry of dyes and principles of dyeing. Sevak Publication, Bombay, 1983. 2:261-265.
15. Srilakshmi B. Food Science. 2nd Edition, New Age International (P). Limited. Publishers New Delhi, 1999, 317-328.
16. Ramesha MN. Wild Silk: The future holds promises. Indian Silk, 1998; 37(8):3.
17. Vidyasagar PV. Hand Book of Textiles. 1st Edition, Mittal Publications, New Delhi. 1998, 65-67.
18. Wingate IB. Textile Fabrics and Their Selection. 1st Edition, Prentice Hall, Inc., Englewood Cliffs, 1935, 243.