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### Dyeing of silk with onion peel extract

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#### **Abstract**

The study was undertaken to explore the use of unconventional natural substance like onion peel as dyeing material. It was an effort to utilize the waste material in an efficient manner which could minimize the cost of dyeing. Dye was extracted from onion peel in neutral medium for dyeing of silk. Two types of mordants i.e, natural and chemical were used. Pre and post mordanting techniques were adopted at room temperature. Fabric samples were dyed in neutral and acidic medium. All the dyed samples were evaluated for their colour value and colour fastness properties. According to results obtained, it was found that, in general, dyeing in acidic medium gave the better results in terms of the effect of different mordants, dye absorption, brightness and colour variation as compared to the samples dyed in neutral medium. Samples showed good to excellent colour fastness properties against washing, perspiration, crocking and light fastness. Little bit of staining was visible on the adjacent undyed samples. In general, natural mordants had better colour fastness properties as compared to chemical mordants.

**Keywords:** Unconventional natural substance, Onion peel, mordants

#### **1. Introduction**

The concept of 'Eco-friendly' is fast spreading the world over. Various steps are being taken to preserve the environment and to reduce pollution. Industries are the major sources of causing pollution. They contribute various kinds of pollutants to the environment that can cause serious damage to the biosystem. Textile industry is one of them, which is characterized by the high consumption of resources like water, fuel and a variety of chemicals in a long process sequence that generates a significant amount of waste<sup>[1]</sup>. The use of non-toxic and eco-friendly natural dyes on textiles has become a matter of significant importance because of the increased environmental awareness in order to avoid some hazardous synthetic dyes<sup>[5]</sup>. However, worldwide use of natural dyes for the colouration of textiles has mainly been confined to craftsmen, small scale dyers and printers as well as small scale exporters and producers dealing with high valued eco-friendly textile production and sales. Recently, a number of commercial dyers and small textile export houses have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes<sup>[2]</sup>.

For successful commercial use of natural dyes, the appropriate and standardized dyeing techniques need to be adopted without sacrificing required quality of dyed textile materials<sup>[9]</sup>. Use of natural unconventional sources for dyeing of textiles can make the dyeing process cheaper and eco-friendly. Examples of unconventional sources of dyeing can be beetroot, beetle nut, marigold flower, mango seed, onion peel etc. These sources are easy to collect and their dyeing process does not harm the environment. In the present study, dry onion skins of onions were used for colouring natural textile materials. It was an effort to utilize the waste material in an efficient manner which could minimize the cost of dyeing. Mordanting was done at the room temperature which would result in energy savings. Extraction was done through an eco-friendly method i.e, in aqueous medium. The colour value of the dyed samples in terms of their K/S, L\*a\*b\* and L\*c\*h\* values were measured. Also, colour fastness with respect to wash, perspiration, crock and light was assessed. A comparison between the colour values and fastness properties of samples dyed in different mediums was carried out.

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## 2. Methods & Material

Fabrics:	Silk (GSM: 44, Thread Count: 102x99, 100% Mulberry Silk, Plain Weave)
Dye:	Dry Onion Peel was procured from the local vegetable market which was usually discarded as waste.
Chemical:	Acetic acid
Mordants:	Natural Mordants ( <i>Harad</i> , <i>Supari</i> , Eucalyptus) Chemical Mordants (Alum, CuSO <sub>4</sub> , FeSO <sub>4</sub> )
Instruments:	Spectrophotometer, Wash fastness tester, Light fastness tester, Crock meter and Perspirometer.

## 3. Methodology

In order to achieve the objectives of the study, the experimental work was carried out in a stepwise, sequential manner. The framework of the study has been given below:

### 3.1 Preparation of Fabric

Degumming of silk fabric was done in a liquor containing 2g/l of non-ionic soap solution. The process was carried out at 50°C for 1 hour, maintaining a material to liquor ratio (M.L.R.) of 1:50. It was worked regularly in this solution and later, rinsed and dried in the shade.

### 3.2 Extraction of Dye from Onion Peel

Dye extraction was carried out in neutral medium at pH 7. 10g of dry onion peel was added to 500ml of water. The liquor was kept at 100°C for 1 hour. Continuous stirring was required at the gap of 10 minutes. Extracted dye was sieved through nylon cloth and some amount of water was added to maintain the volume of the extracted dye solution to 500ml. The sieved dye was used for dyeing of silk.

### 3.3 Dyeing With Onion Peel Extract

The dye bath was prepared with MLR 1:60 with 1/2 volume of water and 1/2 volume of the extracted dye solution. The pH of dyeing bath was kept at 4 (using acetic acid), and 7. The silk fabric was entered into the dye bath at room temperature. The temperature was raised gradually and maintained at 80°C. Constant stirring was done. After 50 minutes the samples were removed, rinsed in cold water and then dried in shade.

### 3.4 Mordanting of Samples

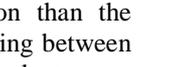
Mordanting was carried out by two different methods i.e. pre mordanting and post mordanting in neutral medium. Samples were entered into the solution of mordant (10% owf) at room temperature and were kept for 1 hour with MLR 1:60. Both natural (*supari*, *harad* and eucalyptus) and chemical (alum, CuSO<sub>4</sub>, and FeSO<sub>4</sub>) mordants were used. Samples were squeezed and then dried without washing. Dyeing was also carried out without using any mordant.

## 4. Results & Discussion

### Effect of mordants, mordanting methods and ph of dyeing on colour value of samples

Table 1 shows the colour values and shades obtained when pre mordanted silk samples were dyed in neutral and acidic medium. On comparing the samples dyed in neutral and acidic dye bath, it was observed that the shades obtained in acidic medium were much darker than in neutral medium as the K/S values of the samples dyed in acidic medium were more than in neutral medium. This indicates that the dye exhaustion was more in acidic medium. The L\* values of samples dyed in neutral medium were higher than in acidic medium as the colours obtained were slightly lighter. In general, the c\* values of samples dyed in acidic medium showed higher values which indicates high intensity of colour in acidic medium.

**Table 1:** effect of pre mordanting on silk samples dyed in neutral and acidic medium

Mordan-TS	Medium Of Dyeing	Shades Obtained	K/S	L*	a*	b*	c*	h*
<i>Supari</i>	Neutral		8.73	54.00	11.15	17.36	12.63	57.27
	Acidic		14.70	49.49	17.45	25.65	31.03	55.76
<i>Harad</i>	Neutral		10.23	49.00	17.19	25.02	30.35	55.49
	Acidic		14.5	51.54	17.41	23.96	29.62	53.98
Eucalyptus	Neutral		8.38	54.29	10.08	16.86	19.64	51.10
	Acidic		14.05	48.94	15.82	18.09	24.04	48.81
Alum	Neutral		6.06	63.86	10.98	27.94	30.02	68.51
	Acidic		12.14	54.71	6.29	43.42	43.87	81.73
CuSO <sub>4</sub>	Neutral		4.34	56.32	4.06	24.04	24.38	80.38
	Acidic		9.84	47.38	9.91	30.92	32.47	72.19
FeSO <sub>4</sub>	Neutral		7.6	49.28	1.84	14.53	14.65	82.76
	Acidic		13.8	34.42	4.19	14.40	15.00	73.75

The natural mordants had more dye exhaustion than the chemical mordants as their K/S values were ranging between 8 and 15 whereas; the K/S values of chemical mordants were

between 4 and 12. It may be seen from the h\* values that almost every sample was positioned in red-yellow zone because all the values were less than 90°. The natural

mordants gave natural colour of onion whereas  $\text{CuSO}_4$  and alum showed tints and shades of yellow colour and  $\text{FeSO}_4$  showed the property of an achromatic colour which means it

cannot be classified as a subset of the colors red, green, blue (RGB) or yellow.

**Table 2:** Effect of post mordanting on silk samples dyed in neutral and acidic medium

Mordan-TS	Medium of dyeing	Shades obtained	K/S	L*	a*	b*	c*	h*
<i>Supari</i>	Neutral		5.89	57.99	11.92	21.14	24.27	60.57
	Acidic		14.07	52.06	14.65	30.97	34.26	64.67
<i>Harad</i>	Neutral		2.02	61.94	12.74	19.23	23.07	56.46
	Acidic		2.5	61.37	10.10	16.48	19.32	58.47
Eucalyptus	Neutral		10.78	52.18	13.39	22.47	26.15	59.19
	Acidic		13.64	53.51	17.64	25.50	31.01	55.31
Alum	Neutral		10.32	58.12	13.41	17.03	21.67	59.75
	Acidic		15.62	50.96	12.88	38.37	40.48	71.42
$\text{CuSO}_4$	Neutral		8.33	56.10	9.77	22.15	24.21	66.17
	Acidic		15.19	40.12	12.81	31.43	33.94	67.80
$\text{FeSO}_4$	Neutral		12.14	49.12	12.12	21.23	25.41	70.21
	Acidic		14.59	26.08	3.00	8.39	8.91	70.31

On evaluating the post mordanted silk samples dyed in neutral and acidic medium, it was observed that results obtained by post mordanting of samples were similar to the pre mordanting. The shades obtained in acidic medium were much darker than in neutral medium as the K/S values of the samples dyed in acidic medium were more than in neutral medium. This indicates more dye uptake in acidic medium. The  $L^*$  values of the samples dyed in acidic medium were lesser than in neutral medium as the colours obtained were darker. In general, the  $c^*$  values of samples dyed in acidic medium showed higher values which indicates high intensity

of colour in acidic medium. The  $c^*$  values of the samples dyed in neutral medium were ranging between 21 and 26 only.

The  $h^*$  values of all the samples treated with different mordants were in red-yellow zone as all the values were less than  $90^\circ$ . In spite of having high K/S value, the  $a^*$  and  $b^*$  values of  $\text{FeSO}_4$  in acidic medium was less because it is an achromatic colour. Among all the mordants, alum had highest  $h^*$  value which means it had more yellow content. Eucalyptus had the lowest  $h^*$  value exhibiting more red content.

**Table 3:** Unmordanted silk samples dyed in neutral and acidic medium

Mordan-TS	Medium of dyeing	Shades obtained	K/S	L*	a*	b*	c*	h*
No mordant used	Neutral		3.70	62.08	8.08	12.70	15.23	57.04
	Acidic		5.11	60.49	12.26	32.08	24.78	65.61

Table 3 shows the shades and colour values obtained when silk samples were dyed in neutral and acidic medium without using any mordant. On evaluating the unmordanted silk samples, it was observed that result obtained was similar to the pre and post mordanting. The shade obtained in acidic medium was much darker than in neutral medium as the K/S value of the sample dyed in acidic medium was more than in neutral medium. This indicates more dye uptake in acidic medium. The  $L^*$  value of the sample dyed in acidic medium was lesser than in neutral medium as the colour obtained was darker. The  $c^*$  value of the sample dyed in acidic medium was more which indicates high intensity of the colour in acidic medium. Sample dyed in neutral medium was redder than the sample dyed in acidic medium as the  $h^*$  value of the sample dyed in neutral medium was less.

### Comparison between Pre, Post and Unmordanted Silk Samples

On comparing pre and post mordanted silk samples, it was observed that, on an average, pre mordanting method exhibited more dye exhaustion with natural mordants. While, post mordanting method exhibited more dye uptake with chemical mordants which is clearly evident from table 1 and 2. Unmordanted samples had comparatively less dye uptake as compared to pre and post mordanted samples. This is evident in table 3 as the K/S values were comparatively less. The samples treated with natural mordants by pre mordanting method exhibited more red content, as the  $h^*$  values of the samples were less as compared to the samples treated with natural mordants by the post mordanting method. Unmordanted samples yielded shades which were more in yellow region.

**Effect of mordants, mordanting methods and ph of dyeing on colour fastness of samples**

**Wash fastness**

The wash fastness results obtained from the pre and post mordanted silk samples dyed in neutral and acidic medium gave good to excellent colour fastness properties. Samples dyed in neutral medium exhibited excellent wash fastness with grey scale rating of 5, with a few exceptions, as is evident from tables 4(a) – 4(d). It was observed that the dye exhaustion was better in acidic medium. However, the fixation was not complete. In both pre and post mordanting methods, samples treated with natural mordants were rated between 4 and 5. This indicates good to excellent fastness to colour change. Samples treated with chemical mordants were rated between 3/4 and 5. On an average, post mordanting method showed better wash fastness as compared to pre mordanting method. Unmordanted samples had excellent colour fastness to washing.

**Perspiration fastness**

All the samples showed excellent perspiration fastness in both acidic and alkaline perspiration conditions. The tested samples showed a grey scale rating of 5 for the change in colour and the staining on the adjacent fabric, with just a few exceptions. This showed that that the silk fabric dyed with the onion peel will not bleed and stain the other fabrics on wear.

**Crock fastness**

It is clear from the tables 4(a) – 4(d) that the rub fastness of the silk samples was better for dry rubbing than for wet. With dry rubbing, the tested samples showed a gray scale rating of 5 for the change in colour, with just a few exceptions. On the other hand, with wet rubbing, the gray scale rating was between 4 and 5. This indicates excellent fastness to crocking. Natural mordants showed better rub fastness properties as compared to chemical mordants. Staining on the crocking cloth was observed in both dry and wet rubbing and it was more in wet.

**Light fastness**

Light fastness results of the silk samples exhibited good fastness properties under all application conditions. The light fastness or the blue wool rating of dyed silk samples ranged from 5 – 7. In general, on mordanting with natural mordants and CuSO<sub>4</sub>, for both pre and post mordanting, the light fastness increased to 7. This is probably because of a more stable complex formation between the mordants and dye stuff. The fastness of a mordanted sample depends on the mordant and mordanting methods because different metal dye complexes are formed which may differ in their stability to light and also because the metal may have a positive or negative catalytic effect on the photochemical degradation of the dye<sup>ss</sup>. Unmordanted samples dyed in both the mediums were rated as 6.

**Table 4(a):** Fastness ratings of pre and unmordanted silk samples dyed in neutral medium

Mordants	Wash Fastness			Alkaline Perspiration			Acidic Perspiration			Dry Crocking		Wet Crocking		Light Fast-ness
	CC	CS		CC	CS		CC	CS		CC	CS	CC	CS	
		C	W		C	W		C	W					
Supari	5	4/5	4/5	5	5	5	4/5	5	5	5	4	5	3/4	7
Harad	5	5	4/5	5	5	5	5	5	5	5	4	5	3/4	6
Eucalyptus	5	5	4/5	5	5	5	4/5	5	5	5	4	5	3/4	6
Alum	5	4/5	4/5	4	5	4/5	4/5	5	5	5	4	4/5	4	6
CuSO <sub>4</sub>	4/5	4/5	4/5	4	4/5	4/5	5	5	5	5	4	5	4/5	6
FeSO <sub>4</sub>	4	4/5	4/5	5	5	5	5	5	5	4/5	3/4	4/5	3/4	5
Without Mordant	4/5	4/5	4/5	5	5	5	4/5	5	5	4/5	4	4/5	4	6

CC = Colour Change, CS = Colour Staining, C = Staining of Cotton, S = Staining of Silk

**Table 4(b):** Fastness ratings of pre and unmordanted silk samples dyed in acidic medium

Mordants	Wash Fastness			Alkaline Perspiration			Acidic Perspiration			Dry Crocking		Wet Crocking		Light Fast-ness
	CC	CS		CC	CS		CC	CS		CC	CS	CC	CS	
		C	W		C	W		C	W					
Supari	4	4/5	4/5	5	5	5	5	5	5	5	4/5	5	4/5	7
Harad	4	5	4/5	5	5	5	5	5	5	5	4/5	5	4/5	6
Eucalyptus	4	4/5	4/5	5	5	5	5	5	5	5	4/5	4/5	4/5	6
Alum	4	5	4/5	4	4/5	4/5	4	4/5	5	5	3/4	4/5	3	6
CuSO <sub>4</sub>	5	4/5	4/5	4	4/5	4/5	4/5	5	5	4/5	3/4	4/5	3	7
FeSO <sub>4</sub>	3/4	4/5	4/5	5	5	5	5	5	5	4/5	4	4/5	3/4	6
Without Mordant	5	5	5	4	5	5	5	5	4	5	4/5	4/5	4	7

CC = Colour Change, CS = Colour Staining, C = Staining of Cotton, S = Staining of Silk

**Table 4(c):** Fastness ratings of post mordanted silk samples dyed in neutral medium

Mordants	Wash Fastness			Alkaline Perspiration			Acidic Perspiration			Dry Crocking		Wet Crocking		Light Fast-ness
	CC	CS		CC	CS		CC	CS		CC	CS	CC	CS	
		C	W		C	W		C	W					
Supari	5	4/5	5	5	5	4/5	4/5	5	5	5	4/5	5	4	7
Harad	5	5	4/5	5	5	5	5	5	5	5	4	5	4	7
Eucalyptus	5	5	4/5	5	5	5	5	5	5	5	4/5	5	4/5	6
Alum	5	5	5	4/5	5	5	4	5	4/5	5	4/5	5	4/5	6
CuSO <sub>4</sub>	5	4/5	4/5	5	5	4/5	5	5	5	5	4/5	5	4	6
FeSO <sub>4</sub>	4	4/5	4/5	5	5	5	5	5	5	4/5	4	4/5	3/4	6

CC = Colour Change, CS = Colour Staining, C = Staining of Cotton, S = Staining of Silk

**Table 4(d):** Fastness ratings of post mordanted silk samples dyed in acidic medium

Mordants	Wash Fastness			Alkaline Perspiration			Acidic Perspiration			Dry Crocking		Wet Crocking		Light Fast-ness
	CC	CS		CC	CS		CC	CS		CC	CS	CC	CS	
		C	W		C	W		C	W					
<i>Supari</i>	4	4/5	4/5	4/5	5	5	4/5	5	5	5	4/5	5	4	7
<i>Harad</i>	4	5	4/5	4/5	5	5	5	5	5	5	4/5	5	4	7
Eucalyptus	4	5	4/5	5	5	5	5	5	4/5	5	4/5	5	4	6
Alum	4	4/5	4/5	4	5	4/5	4/5	5	4/5	5	4	5	4	6
CuSO <sub>4</sub>	4/5	4/5	5	4	5	5	5	5	5	4/5	3/4	4/5	3	6
FeSO <sub>4</sub>	3/4	4/5	4/5	5	5	5	5	5	5	4/5	3/4	4	3/4	6

CC = Colour Change, CS = Colour Staining, C = Staining of Cotton, S = Staining of Silk

## 5. Conclusion

In the study, dry onion skins of onions were used for colouring natural textile materials. It was an effort to utilize the waste material in an efficient manner which could minimize the cost of dyeing. The source is easy to collect and its dyeing process does not harm the environment. Samples dyed in acidic medium showed better results in terms of shades obtained with different mordants, dye absorption, brightness and colour variation. Results of colour fastness to washing, perspiration, crocking as well as light obtained from the pre and post mordanted silk samples dyed in neutral and acidic medium gave good to excellent colour fastness properties. So, at the end, it can be concluded that onion peel can be used as a good source of natural dye on a large scale.

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