

Dyeing of Silk Fabric using Lemon Leaves Extract with the Effect of Different Mordants

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ABSTRACT: The study of clothing and textiles traces the availability and use of textiles for the making of clothing over human history. The wearing of clothing is exclusively a human characteristic and is a feature of most human societies. The social significance of the finished product reflects their culture. This study is a small step in utilizing the value of natural leaf extract dyeing towards the textile material. Mainly the study is been carried out to prevent chemical dyes and toxic effect by using the natural dyes. As most of the studies is done on cotton fabrics here the project has been concentrated to apply the natural dyes on silk fabric. The main objectives of the present study is to dye the silk fabric with the dyes extracted from lemon (*C. limetta*) leaves along with different mordants and mordanting techniques. The natural dyed silk fabric is visually evaluated and tested for their physical properties and colour fastness using standard testing methods.

KEYWORDS: Dyeing, silk fabric, *C. limetta*, mordants, mordanting techniques, colour fastness.

I. INTRODUCTION

The wearing of clothes is exclusively a human characteristics. It is not known exactly that when human began to wear clothes. Anthropologists believe that animal skins and plant leaves were adapted as outer coverings mainly for protection of humans from different climatic conditions. Later used for other purposes such as decoration, culture and prestige.

The finished product reflects the social significance of the humans. Today, dyeing is a complex, specialised science. Nearly all dyestuffs are now produced from synthetic compounds. This means that costs have been greatly reduced and certain application and wear characteristics have been greatly enhanced. Dyeing is done in a solution which uses synthetic dyes or natural dyes which form a chemical bond between the dye molecules and the fibre under the controlled factors of time and temperature by different methods of dyeing and also in different stages as fibre, yarn, fabric and garment.

Natural dyes contain natural colouring matter which is neither carcinogenic nor hazardous to environment. These colours are non-allergic and non-toxic to human body and perpetuate an ancient tradition. Some dyes even have some therapeutic values for which the raw materials find use in medicine fields, describe Gerald and Kanawa [1] and Ashis Kumar *et al* [2]. The dyeing with natural colourants was one of the oldest techniques practised by the ancient civilization people, denote by Mohd Ibrahimkhan *et al* [3].

But many practitioners of the craft of natural dyeing, dyes do not have affinity for fibres and can affinity for fibres using auxiliary agents. These auxiliary agents are called as mordants or mordant dyes. These mordants have affinity for both fibre and dye, denotes Hemalatha Jain [4]. Many natural dye colour fades bleed badly without mordanting. Most natural dyes are non-substantive dyes, which mean that they have a little colouring power within themselves and they

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required the mordants for fixation of dye into the fibre, pointed Ekta *et al.* With the help of mordants different colours and its tones can be obtained from a single dye source. Various studies have been carried out by different scientists on effect of mordants and mordanting techniques but very little work has been done on mordant combinations. It is reported that colour depth vary from mordant to mordant and mordanting technique to mordanting technique, describes Neelam *et al.*

Thus the study is a small step in utilizing the value of natural lemon leaf extract dyeing towards the silk material with different mordants and mordanting techniques. Mainly the study is been carried out to prevent chemical dyes and toxic effect by using the natural dyes. The dyed fabric are then analysed for the colour fastness and their physical properties towards dyeing.

II. MATERIALS AND METHODS

A. Selection of Fabric

Silk is a natural protein fibre with good absorbency makes comfortable to wear in warm weather. Silk fabrics are commercially dyed using acid dyes. The 100% silk fabrics were selected for the study and were purchased from Sarvodaya silk showroom, Padiyur at the cost of Rs.525/meter.

B. Selection and Preparation of Natural Dyes



Fig. 1: Natural dye sources (a) *C.Limetta* - Lemon leaves (b) Extraction of dyes from *C.Limetta*

For natural dyeing fresh leaves of *C. limetta* (lemon) were selected shown in Figure 1(a). The fresh leaves were collected from Erode, washed and ground into fine paste with water with 1:4 ratio of leaves and water respectively boiled, filtered and used for dyeing.

C. Selection and Preparation of Mordants



Fig. 2 Mordants (a) *Punica granatum* – Pomogranate rind (b) *Terminalia chebula* – Myrobalan (c) *Acacia nilotica* - Babul bark

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The natural mordants selected for the study were *Punica granatum* (Pomegranate rind), *Terminalia chebula* (Myrobalan) and *Acacia nilotica* (Babul bark) are shown in figure 2. The pomegranate rinds were collected and dried in shade for 20 days. Then it was powdered and used. Myrobalan powder and Babul bark powders were purchased from Karur chettiyar shop, Tirupur.

D. Dyeing of silk fabric with mordant

The mordanting techniques selected for dyeing the silk fabric are Pre mordanting, Meta mordanting and Post mordanting with two different concentrations.

E. Recipe

Mordant Powder	:	5% & 10%
Dye	:	10%
Material: Liquor Ratio	:	1: 20
Time (Mordanting)	:	30 min
Time (Dyeing)	:	60 min
Temperature	:	60 – 90 ⁰ C

F. Mordanting Procedure

According to the weight of the fabric the amount of water and mordant powder is determined. Boil the mordant powder by adding required amount of water and allow the residue to settle down. The solution is strained with fine muslin cloth to remove the residues. The fabric is wetted and immersed in the filtrate and boiled for 30 minutes at 90⁰ C with periodic stirring to avoid uneven mordanting. The fabric is then squeezed and dried. The mordanting can be done prior to dyeing in case of pre-mordanting and after dyeing for post mordanting. Meta-mordanting is the process of dyeing and mordanting in the same bath simultaneously.

G. Nomenclature of dyed samples

The nomenclatures of the dyed silk samples are as follows.

Table 1: Nomenclature of dyed samples

Dye 10%	Mordanting Techniques	Mordant					
		<i>Punica granatum</i>		<i>Terminalia chebula</i>		<i>Acacia nilotica</i>	
		5%	10%	5%	10%	5%	10%
<i>C. limetta</i>	Pre	PrP ₁	PrP ₂	PrT ₁	PrT ₂	PrA ₁	PrA ₂
	Meta	MP ₁	MP ₂	MT ₁	MT ₂	MA ₁	MA ₂
	Post	PoP ₁	PoP ₂	PoT ₁	PoT ₂	PoA ₁	PoA ₂

H. Evaluation of Finished Fabric

a. Visual Evaluation

The dyed samples were displayed and the feedback was collected from 50 students for visual evaluation of their depth of colour, texture and overall appearance. The samples were ranked for their above qualities and analyzed. In each dyeing technique (pre, meta and post) one sample with highest score was selected for further study. The preforms used for the visual evaluation is given in appendix-I. The dyed samples are given in appendix-II.

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b. Laboratory test

The samples are evaluated for the physical properties such as EPI, PPI, GSM (ASTM D3776), thickness (ASTM F2251), stiffness (ASTM D1388), crease recovery (AATCC 66), tensile strength (ASTM D5035), colour fastness for washing, crocking (AATCC 8), pressing and sunlight according to the standards.

III. RESULT AND DISCUSSION

A. Visual evaluation

Table 2: Visual evaluation dyed samples

Dye (10%)	Mordant		
	<i>Punica granatum</i>	<i>Terminalia chebula</i>	<i>Acacia nilotica</i>
<i>C. limetta</i>	MP ₁	PoT ₂	MA ₁

From the table, it is clear that the sample MP₁, PoT₂, MA₁ shows the better colour, texture and overall appearance. Meta mordanting techniques of punica granatum and acacia nilotica at 5% conc. of mordant and post mordant of Terminalia chebula at 10% conc. shows the better results when compared to all other types.

B. Laboratory test result

Table 3: Fabric particulars

S. No	Particulars		Value				
			Control fabric	Dyed Sample			
				MP ₁	PoT ₂	MA ₁	
1	Count	EPI	40	43	44	43	
		PPI	30	31	31	31	
2	Weight (GSM)		0.99	0.97	0.96	0.98	
3	Thickness (mm)		30	28	26	28	
4	Stiffness	Warp	2.4	2.1	1.5	2.1	
		Weft	2	2	1.9	1.9	
5	Crease Recovery (°)	Warp	42	42	44	42	
		Weft	50	51	48.8	51	
6	Tensile Strength	Warp	19.8	19.6	18	19.6	
		Weft	11	12.2	12	12.5	
7	Colour fastness to Washing	Stain	-	5	4/5	5	
		Color change	-	5	4	5	
8	Colour fastness to Crocking	Dry	Stain	-	5	5	
			Color change	-	5	5	
		Wet	Stain	-	5	4/5	4/5
			Color change	-	5	4	5
9	Colour fastness to Pressing	Dry	Stain	-	5	4/5	
			Color change	-	5	5	
		Wet	Stain	-	5	4/5	4/5
			Color change	-	5	4	5
10	Colour fastness to Sunlight		-	4/5	4	4/5	

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Note: 5 – Excellent fastness, 4 – Very good Fastness, 3 – Good fastness, 2 – Poor fastness, 1 – Very poor fastness.

From the table it is concluded that the properties such as fabric weight, thickness, stiffness and tensile strength (weft) are decreased. The properties such as crease recovery and tensile strength (warp) are increased. The fabric count remains the same before and after dyeing. The fastness properties of the dyed sample is found to be very good on most of the conditions.

IV. SUMMARY AND CONCLUSION

In today’s world artificial dyes predominates than natural dyes because of their easy synthesis and cost of production. But besides that it causes serious effect on environment natural dyes are preferred as it is eco-friendly synthesis from natural materials. In this study, *C. limetta* (lemon leaves) were used for dyeing silk fabric. The colors obtained by the natural source is excellent. *Punica granatum* (Pomegranate rind) and *Terminalia chebula* (Myrobalan) mordant gave yellow tints were as *Acacia nilotica* (Babul bark) mordant gave slight maroon shade in dyeing process. The dyeing of silk can be achieved by the natural extract *C. limetta* (lemon leaves) with natural mordants and comparisons is made by evaluating characteristics like colour, texture and overall appearance. The dyed sample is tested for the fabric properties and color fastness.

There was a slight change in some of the physical properties after dyeing with natural dyes. Statistical report also says that dyeing doesn’t change the PPI, warp crease recovery and tensile strength. Whereas PPI, GSM, thickness, stiffness crease recovery in weft and weight loss during abrasion have changed after dyeing. This may due to the absorption of dye by the fabrics. The fastness property in this case showed very good results.

Recommendations:

Medicinal properties of dyed fabric with *C. limetta* (lemon leaves) natural dye can be studied and can be mixed with commercially available natural dyes to evaluated other properties.

Appendix – I: Preforma for visual evaluation

Please tick (√) the sample in each mordant type having good texture, colour and appearance.



















Dye 10%	Mordanting Techniques	Mordant					
		<i>Punica granatum</i>		<i>Terminalia chebula</i>		<i>Acacia nilotica</i>	
		5%	10%	5%	10%	5%	10%
<i>C. limetta</i>	Pre						
	Meta						
	Post						

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Appendix - II: Dyed silk fabric

Dye 10%		<i>C. limetta</i>	
Mordants ↓	Dyeing Techniques Conc % →	5	10
<i>Punica granatum</i>	Pre		
	Meta		
	Post		
<i>Terminalia chebula</i>	Pre		
	Meta		
	Post		
<i>Acacia nilotica</i>	Pre		
	Meta		
	Post		

REFERENCES

- [1] Gerald Smith and Rangit Te Kanawab, "Some Traditional Colourants of Maori and other Cultures", Chemistry in New Zealand, pp. 127- 131, October 2008.
- [2] Ashis Kumar Samanta , Priti Agarwal & Siddhartha Datta, "Dyeing of jute and cotton fabrics using Jackfruit wood extract: Part I — Effects of mordanting and dyeing process variables on colour yield and colour fastness properties", Indian Journal of Fibre & Textile Research, Vol. 32, pp. 466-476, December 2007.
- [3] Mohn Ibrahim Khan, Mohd Yusuf, Mohammad Shahid, Shafat Ahmad Khan, Mohd Ali Khan and Faqeer Mohammad, "Dyeing studies with henna and madder: A research on effect of tin (II) chloride mordant", Journal of Saudi chemical society, Vol. 19, Issue 1, pp. 64-72, Jan 2015.
- [4] Hemalatha Jain, "Techniques of Dyeing and Printing", Published by Ane Books Pvt. Ltd., 2010.
- [5] Adeel, S., Ali, S., Bhatti, I. A. and Zsila, F., "Dyeing Of Cotton Fabric Using Pomegranate (*Punica Granatum*) Aqueous Extract", Asian J. Chem, 21(5), pp.3493-3499, 2009.
- [6] Harish C Tiwari, Pratibha Singh, Pradeep Kumar Mishra, "Evaluation of various techniques for extraction of natural colorants from pomegranate rind", Indian Journal of Fibre and Textile Research, vol.35, pp.2722-276, sep 2010.
- [7] Katewa SS and Galav PK., "Traditional herbal medicines from Shekhawati region of Rajasthan", Indian Journal of Traditional Knowledge, Vol. 4 (3), pp. 237- 245, 2005.
- [8] Mahangade RR, Varadarajan PV, Verma JK and Bosco H., "New Dyeing Techniques for Enhancing Color Strength and Fastness Properties of Cotton Fabric Dyed with Natural Dyes", Indian Journal of Fibre and Textile Research, Vol. 34, pp.279-282, Sep 2009.
- [9] S. Voravuthikunchai, A. Lortheeranuwat, W. Jeeju, T. Sririrak, S. Phongpaichit, and T. Supawita, "Effective medicinal plants against enterohaemorrhagic *Escherichia coli* O157:H7", Journal of Ethnopharmacology, vol. 94, no. 1, pp. 49-54, 2004.
- [10] Kulkarni S.S., Gokhale A.V., Bodake U.M, Pathade G.R., "Cotton Dyeing with Natural Dye Extracted from Pomegranate (*Punica granatum*) Peel", Universal Journal of Environmental Research and Technology, Volume1, Issue 2, pp.135-139, 2011.