International Journal of Trend in Scientific Research and Development, Volume 1(4), ISSN: 2456-6470
www.ijtsrd.com

Dyeing of Cotton with Natural Dye Obtained from Barks of Bombax Ceiba Linn locally known as Semal

Dr.Yogesh Vadwala

S.M.Patel College of Home Science,
Vallabh Vidyanagar-388120 Gujarat, India

Dr.Namrita Kola

Department of Home Science, Sardar Patel University,Vallabh Vidyanagar Gujarat, India

ABSTRACT

The present study was carried out to revive the old art of dyeing with natural dye obtained from barks of Bombax ceiba Linn. locally known as semal tree. The commercialization of the present process will be helpful for their viable application in handloom and textile industries. Further, this will also have great impact especially for the economic growth of the rural dyer communities. In the present study, Cotton fabric was pre-treated with eco-friendly and non eco-friendly mordants. The various shades were obtained. The name of the shade and shade code was obtained by matching the shade card presented by Asian paint India. Colour strength of dyed cotton fabric was measured in terms of L, a, b colour scale by using hunter lab instrument (Hunterlab EasyMatchQC) Colour flex EZ 45/0, Reflectance . mode. The dyed samples have shown good to excellent and poor to good fastness properties.

KEYWORDS

Mordant, Ecofriendly, *Bombax ceiba Linn*, Cotton, Dyeing

INTRODUCTION

The use of natural dyes for textile dyeing purposes, decreased to a large extent after the discovery of synthetic dyes in 1856. As a result, with a distinct lowering in synthetic dye stuff costs, the natural dyes were virtually unused at the beginning of twenties century [1] Until the latter half of the 19th century people were using natural dyes [2] for colouring the textile fibre after invention of synthetic dyes, natural dyes are not used because of the advantage of synthetic dye over natural dye in respect of application, colour range, fastness properties, and availability. Some synthetic dyes are hazardous, carcinogenic and also release vast amount of pollutant in the environment during their manufacturing.[3-10]

Synthetic dyes are not good due to their toxic effect; and it creates allergic reaction to skin and also creates pollution. Thus revival of natural dyeing technique as one of the alternative is being emphasized for this purpose. Many natural resources which are being wasted indiscriminately or thrown away as waste product contain useful dye and pigment. Earlier studies have revealed that the waste contain many flavones which can be effectively used as dyes.[11-12]

In many of the world's developing countries , natural dyes can offer not only rich and varied source of dye stuff, , but also the possibility of an income through sustainable harvest and sale of these plants [13]. Presently there is an excessive use of synthetic dyes, estimated at around 10,000,000 tons per annum, the production and application of which release vast amount of waste and unfixed colorants causing serious health hazards and disturbing the eco-balance of nature [14] .

Natural dyes serve duel purposes of catering to fashion trends as well as being environment friendly. In this context, India is at an advantageous position since the country holds a rich reservoir of natural resources with potential products. According to recent studies the present Indian flora is estimated to contain about 50,000 species.[15]

Nowadays, fortunately, there is increasing awareness among people towards natural dyes. Natural dyes have better biodegradability and generally have higher compatibility with the environment. They are non-toxic, non-allergic to skin, non-carcinogenic, easily available and renewable [16].

Bombax ceiba Linn :

Source of images: Google Images

Bombax ceiba Linn. (Family Bombacaceae), the large beautiful and deciduous tree is found throughout india and other parts of tropical and sub-tropical Asia, Australia and Africa ascending the hill up to 1500m [17]. It is known by different names such as Red Silk Cotton tree , Indian Kapok tree (English), Shalmali (Sanskrit), Semal (hindi),semlo(gujarati), Shimul (Bengali), Mullilavu (Malyalam) Kondaburuga (Telugu) in different languages[18]. The plant is even mentioned in mahabharata proving its presence since a long time[19].

The tree is a large sized tall, deciduous tree having straight, buttressed trunk with a clear bole and widespread branches. **The trunk and branch bark is gray in colour having hard, sharp and conical prickles**.

According to ayurveda, it has stimulant, astringent, haemostatic, aphrodisiac, diuretic, antidiarrhoeal, cardiotonic, emetic, demulcent, antidysenteric, alterative and antipyretic properties **[20,21]**. Besides having immence medicinal potential, it has also been used for other commercial and industrial purposes**[17]**. No adverse effect is reported on use of the plant as a drug.

Being a multipurpose uses of tree reflect intelligent approaches for its sustainable use and preservation while some are seriously causing harm to this beneficial tree species. Thousands of of *bombax ceiba* trees or branches are cut and burn in holi festival. Therefore, there is an urgent need to develop some sustainable conservation strategies and create awareness among rural and urban communities in order to preserve such a tree of immense medicinal value.

Majority of natural dyes have the hydroxyl groups in its structure and they are soluble or sparingly soluble in water. Some time solubility is increased by adding alkali or acid. Some of natural dyes do not have a solubilising group in which case a

temporary solubility group is generated at time of application.

MATERIALS AND METHOD:

Bark with conical prickle collected were collected and dried at room temperature. Then ground and sieved.

Extraction of dye: 100 gram dry powder was taken in 1 litre water and allowed to stand for overnight. Next day the mixture was boiled for 30 minute and then filter with cotton cloth and with simple filter paper to get a clear solution. The weight of dry powder after dye extraction was taken to know the concentration of dye. pH of dye solution was measured. (Weight of the dry powder after extraction was 80 grams and pH of the dye solution was 7 to 8)

Photograph-1 Dry bark with trunk, powder of bark with trunk and dye extract of Semal bark

Bark with trunk of Semal

Bark with trunk powder of Semal

Dye extract of Semal bark

Dyeing procedure: Cotton Fabric sample was scoured in mild detergent solution and dried in shade then weight accurately and further soaked in water and treated with 10% mordant solution for 30 minutes at room temperature. Mordants were used eco-friendly and non eco-friendly shown in **table-1**

Dye solution was taken according to M:L ratio 1:30 for 10% shade and 10 % common salt solution with respect to weight of material was added. The dye bath was warm to which mordanted fabric sample was entered and the temperature was increased up to boiling (85 to 90º C) for cotton for 25-30 minute. The pH of dye bath was measured. The sample was allowed to cool in the dye bath then washed in cold water, squeeze and dried in shade.

Preparation of a shade cards of dyed fabric:

Fabric dyed with the four natural dyes using different mordants various colour shades were obtained. Using the dyed samples a shade card was prepared. The name of the shade and shade code was obtained by matching the shade card presented by Asian paint India.

Colour fastness properties:

Colour fastness properties mainly sunlight, washing, perspiration (acid & alkali), rubbing (dry & wet) was carried out using standard methods. **[22]**

Colour strength:

Colour strength of dyed cotton fabric was measured in terms of L, a, b colour scale by using **hunter lab instrument (Hunterlab EasyMatchQC) Colour flex EZ 45/0, Reflectance mode**

RESULT AND DISCUSSION:

Colour shade, colour strength and colour fastness of cotton fabric dyed with extract of Semal bark:

Various colours were obtained which varied from light pink to grey and black, these colour mainly depended on the mordant used. Dyeing of unmordanted cotton fabric, resulted in light pink shade. Dyeing with mordanted fabric resulted different light shades of pink, brown and grey. The colour shades obtained with ecofriendly mordants was compared with those shades obtained by non eco-friendly mordants, Nearly similar shades were obtained by using terminalia chibula extract and alum. The shade card is presented in **plate 4.6**

The presence of mordanted sample in the dye bath influenced the pH of the dyebath. pH of the dye bath was 8-9 without mordant. By using different mordant (10%), pH of the dye bath varied from acidic (2.0) to basic(8.5).

Plate-4.6 Shade card of cotton fabric sample dyed with Semal bark extract with and without mordants, Colour shade and code number

Sr. No.	Mordants	Dyed cotton fabric, colour shade and shade code	Sr. No.	Mordants	Dyed cotton fabric, colour shade and shade code
1	Undyed		2	Without mordant	Essence 8099
3	Curcuma longa	Lilac dash 8210	4	Terminalia chibula	Camel 8650
5	Tannic acid	Apricot-n 0501	6	Punica granatum	Strawberry 0481
7	Na_2CO_3	Lilac dash 8210	8	CH_3COOH	Morning light

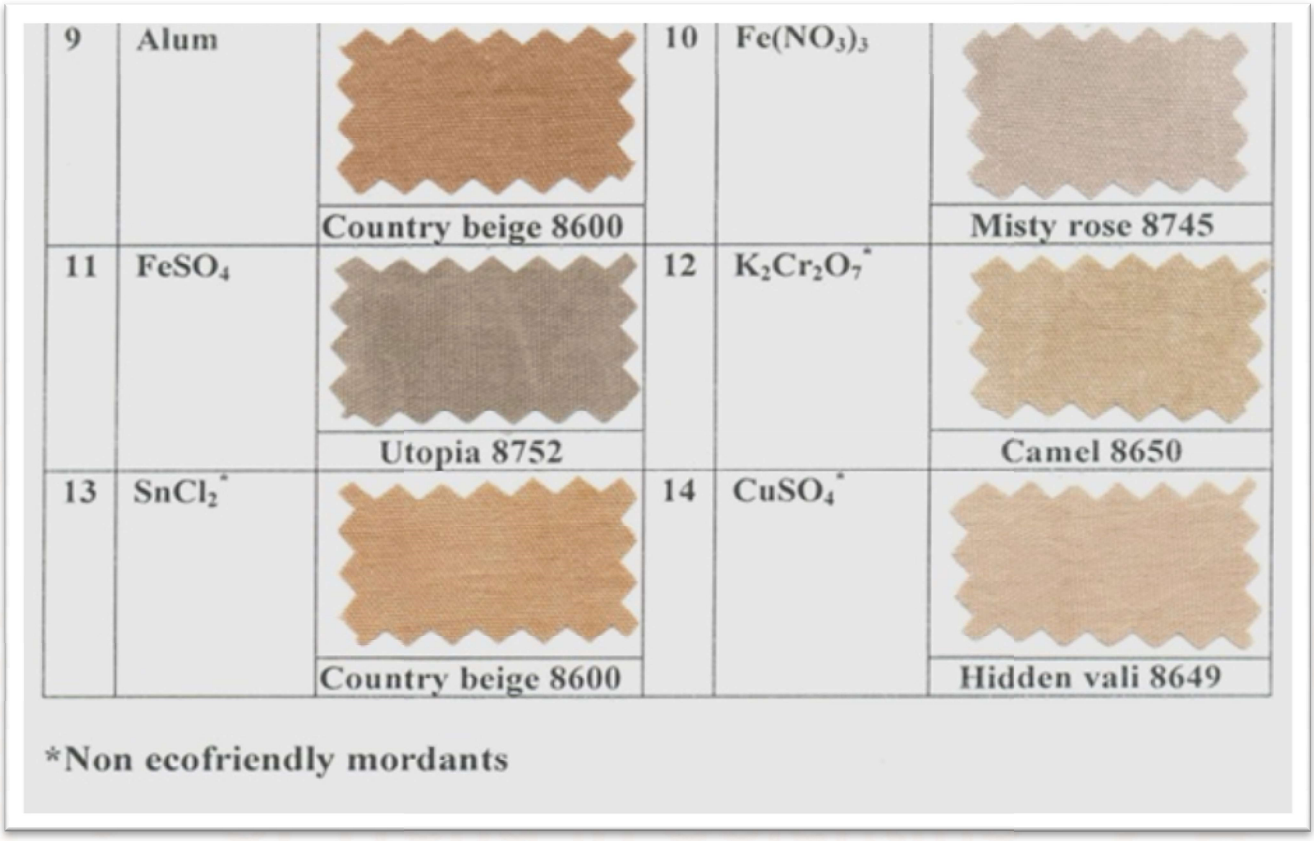


Table -1 pH of the dye bath, colour strength and fastness properties of dyed cotton fabric with Semal bark extract

Sr.No.	Name of the mordant	pH of dye bath	Colour strength			Fastness properties of dyed fabrics					
			L	a	b	Li	Wa	PA	PB	DR	WR
1	Undyed		72.70	6.58	-15.89						
2	Without mordant	7.8	59.57	5.71	11.24	5	5	4-5	4-5	5	3-4
3	Curcuma longa	8	64.52	5.12	3.84	5	5	5	4-5	5	4
4	Terminalia chibula	4	60.30	4.85	9.97	4	4-5	4-5	4	5	4
5	Tannic acid	4	58.65	4.77	11.88	4-5	4-5	4	5	5	3-4
6	Punica Granatum	5.5	65.23	4.66	2.67	5	5	5	4-5	5	4-5
7	Na_2CO_3	8.5	66.21	5.92	-3.76	5	4	4-5	3-4	5	4-5
8	CH_3COOH	4.5	63.21	5.36	5.12	4-5	5	4	4	5	4-5
9	Alum	3	48.47	9.20	12.45	4	5	4	4	5	3-4

10	$Fe(NO_3)_3$	2	57.66	3.87	3.74	4	5	4-5	5	5	4
11	$FeSO_4$	2.5	46.69	3.31	5.21	4-5	5	4-5	4-5	5	4
12	$K_2Cr_2O_7$	2	59.68	4.05	6.28	5	4	4-5	4-5	5	4
13	$SnCl_2$	2	51.38	10.47	14.22	5	5	4-5	4-5	4	3-4
14	$CuSO_4$	3.5	59.65	4.82	8.62	5	4	4-5	4	5	4

Li=Light, Wa=Washing, PA=Acid Perspiration, PB=Alkali Perspiration, DR=Dry Rubbing (Dry crocking), WR=Wet Rubbing(Wet crocking), c= Colour Change, cd= Colour Change to Dark

Term for fastness properties except crocking: 5=Excellent, 4=Good, 3=Fair, 2=Poor, 1= Very Poor
Degree of Crocking or staining of fabric:5= No Staining, 4= Slightly Stain, 3= Noticeably Stain, 2=Considerably Stain, 1=Heavily Stain

L,a,b Colour Scale:

The L,a,b colour scale is more visually uniform than the XYZ colour scale. in a uniform colour scale, the differences between point plotted in the colour space correspond to visual difference between the colour plotted. the L,a,b colour space is organized in cube form. the L axis runs from top to bottom. the maximum for L is 100, which would be a perfect reflecting diffuser. the minimum for L would be zero which would be black. the a and b axis have no specific numerical limits. positive a is red. negative a is green. positive b is yellow. negative b is blue. below is a diagram of the hunter L,a,b colour space. which are also shown in Figure-1.

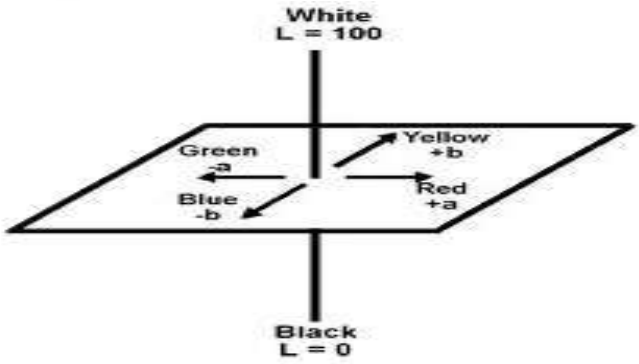


Figure-1.(L,a,b Colour Scale)

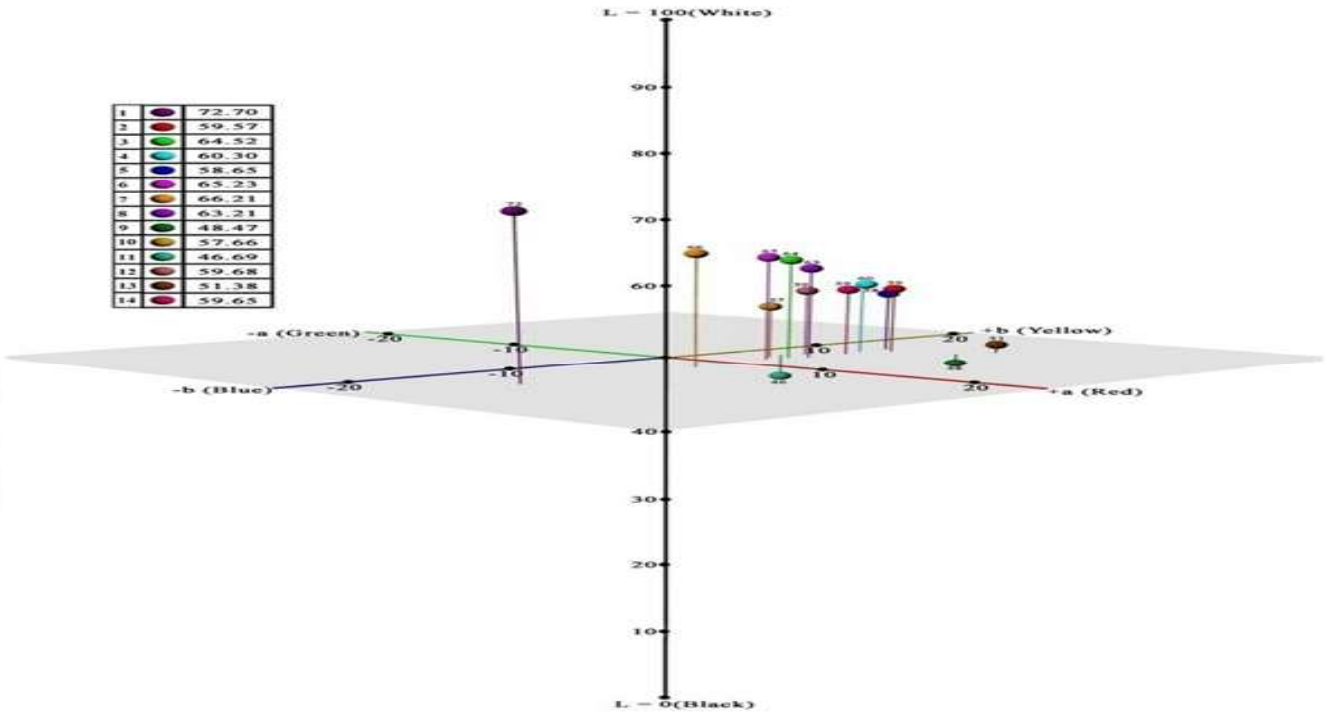
Colour strength of cotton:

Colour strength of undyed and dyed cotton fabric was measured in terms of L, a, b colour scale. The tabulated values are given in table-1 and graphically presented in graph- 1.The result was obtained in the range of 46.69 to 66.21 for 'L' value, alum and ferrous sulphate mordanted fabric shows lower value (< 50) because of dark colour and for 'a' value it was in the positive range of 3.31 to 10.47. While in 'b' the value obtain in the range of 2.67 to 14.22 except sodium carbonate mordanted fabric.

From the overall data value of L,a,b colour scale shows that colour obtained was yellow(+b), red (+a) (except sodium carbonate).Most of the samples could be classed as light reddish and light yellow, because of the higher value of +b ,+a and white (+L) i.e. L>50 except in ferrous sulphate and alum mordanted fabric lower value of 'L' was because of dark colour.

L,a,b value of ecofriendly mordanted fabric was compared with L,a,b value of shades obtained by non eco-friendly mordents, Nearly similar L,a,b were obtained by using alum and terminalia chibula extract.

Graph-1 Colour strength of cotton fabric dyed with Semal bark extract



Colour fastness of cotton

Sunlight fastness and washing fastness property of unmordanted and premordanted fabric sample was studied. Good to excellent result was obtained for all dyed fabrics.

Acid and alkali perspiration fastness properties of unmordanted and mordanted dyed fabric samples was carried out and result obtained for acidic perspiration was good to excellent For alkaline perspiration the result obtained was good to excellent, except for sample dyed with sodium carbonate, result was fair to good.

The results obtained for dry crocking fastness was good to excellent for all dyed fabric samples while for wet crocking fastness results varied from poor to good.

CONCLUSION:

The present study shows that natural dye obtained from barks of Bombax ceiba Linn. can be used as dye for colouring textiles. Non eco-friendly mordants was used only for comparison of shade with eco-friendly mordants. The commercialization of the present process will be helpful for their viable application in handloom and textile industries. Further, this will also have great impact especially for the economic growth of the rural dyer communities. The various shades were obtained. The dyed samples have shown good to excellent and poor to good fastness properties.

Natural dyes are safe and eco-friendly and textiles dyed with natural dyes are almost free from hazardous chemicals. Red listed mordants may be either avoided or may be optimized as per eco-standard, without impairing the desirable properties (e.g. fastness) of the textiles

REFERENCES:

[1] A Purrohit, S. Mallick. A.Nayak, N.B.Das,B.Nanda and S.Sahoo, 2007, *Current science*,Vol. 92, No.12.

[2] Parkes, C. H. (2002). Creating colour in yarn: an introduction to natural dyes. *Knitter's*

Review (2002–2003).

[3] Nagia, F. A., & El-Mohamedy, R. S. R. (2007). Dyeing of wool with natural anthraquinone dyes from Fusarium oxysporum. *Dyes and pigments*, *75*(3), 550-555.

[4] Gulrajani M.L. & Gupta, D. (2001) NCUTE Workshop on dyeing and printing with natural dyes. *Indian Institute of Technology*, pg, 3-5.

[5] Gulrajani M.L. and Gupta, D., (1999) Conventoin on Natural Dyes, *Indian Institute of Technology, Delhi*, pp.3-22,

[6] Shanker, R., & Vankar, P. S. (2007). Dyeing cotton, wool and silk with Hibiscus mutabilis (Gulzuba). *Dyes and pigments*, *74*(2), 464-469.

[7] Jungalwala F.B., Cama H.R., (1962) *Journal of Biochem* 85 (1), 1-8.

[8] Patra, S. K., Nanda, B. N., Nayak, A., & Das, N. B. (2000). Yellow dye from debarked jackfruit wood. *COLOURAGE*, *47*(8), 17-18.

[9] Purohit, A., Das, R., Nayak, A., Nanda, B., & Das, N. B. (2009). Natural dyes from the waste leaves of Artocarpus heterophyllus. *Colourage*, *56*(5), 89-90.

[10] Chen, P. S., & Li, J. H. (2006). Chemopreventive effect of punicalagin, a novel tannin component isolated from Terminalia catappa, on H-ras-transformed NIH3T3 cells. *Toxicology letters*, *163*(1), 44-53.

[11] Lin, C. N., Lu, C. M., & Huang, P. L. (1995). Flavonoids from Artocarpus heterophyllus. *Phytochemistry*, *39*(6), 1447-1451.

[12] Chai-Ming, L., & Chun-Nan, L. (1994). Flavonoids and 9-hydroxy tridecyl docosanoate from Artocarpus heterophyllus. *Phytochemistry*, *35*(3), 781-783

[13] D.Jothi, 2008, *AUTEX Research Journal*,Vol.8,No.12.'

[14] H.Goodarzian and E.Ekrami, 2010, *WorldApplied Sciences Journal,* 9(4), 434-436.

[15] Dayal, R., & Dobhal, P. C. (1999). Some useful dye plants—prospects and possibilities. In *Proceedings of Convention on Natural Dyes* (pp. 83-94).

[16] Kulkarni. S.S, Gokhale. A.V, Bodake.U.M and Pathade.G.R, 2011, Cotton dyeing with Natural Dye Extracted from Pomegranate Peel, *Universal Journal of Environmental Research and Technology*, Vol. 1(2): 135-139.

[17] Jain, V., Verma, S. K., & Katewa, S. S. (2009). Myths, traditions and fate of multipurpose Bombax ceiba L.-An appraisal.

[18] Vaidyaratnam PS.(1997), *Indian Medicinal Plants* - A compendium of 500 species, Vol 3, (Orient Longman Publishing, Kottakkal), 222.

[19] Dixit, I. (1991). *An ethnobotanical survey of ingredients of domestic remedies in use in Ajmer district (Rajasthan)* (Doctoral dissertation, PhD Thesis,(Department of Botany, University of Rajasthan, Jaipur

[20] Williamson, E. M. (2002). *Major herbs of Ayurveda*. Churchill Livingstone.

[21] Singh, M. P., & Panda, Daya Books.H. (2005). *Medicinal herbs with their formulations*.

[22] AATCC Technical manual (2010). 85, American Association of Textile Chemists and Colourists,pg.19,22,25,40,86,91,108,366,368 & 374.

[23] Dr.Yogesh Vadwala "Natural dyes extracted from bark of Bombax ceiba Linn. locally known as semal and its application on various fabrics pretreated with eco-friendly and

noneco-friendly mordant" (ijtsrd), ISSN: 2456-
6470, Volume-1 | Issue-3 , April 2017