AJHS.
Asian Journal of Home Science
Volume **9** | Issue 1 | June, 2014 | 215-218

e ISSN-0976-8351 | Open Access - *www.researchjournal.co.in*

Research Paper

Yarn dyeing with natural dyes extracted from plant sources

■ RAJASHREE PHUKON

Received: 23.05.2013; **Revised:** 04.05.2014; **Accepted:** 19.05.2014

Author for correspondence

RAJASHREE PHUKON
Department of Home Science,
Sibsagar Girls College, SIVASAGAR (ASSAM) INDIA
Email: rajashreephukan@yahoo.com

■ **ABSTRACT :** The study was undertaken with an aim to develop the dyeing conditions of four different natural dyes which are easily available in North East India, namely,*Myrica nagi* Thumb. (Bay berry), *Garcinia xanthochymus* Hook. f. (Cochin goroka), *Artocarpus integrifolia* Linn. f. (Jack fruit) and *Eugenia jambolana* Lam. (Black plum) on wool yarn. The natural mordant used in the research work is aluminium potassium sulphate ($AlK(SO_4)_2$) for better fixation of the dyes. The dyes are extracted by alkaline method and the extraction time is optimized from the optical density values. The pre-mordanting method is used for mordanting the yarn. Shades of different colours, ranging from yellow to brown are obtained from the dyes on wool yarn. Fastness grades rated for all the samples are found to be good irrespective of all the dyes. The dyes are found to be an ideal source which could be adopted at commercial level.

■ **KEY WORDS:** Natural dye, Dyeing, Mordant, Eco friendly

■ **HOW TO CITE THIS PAPER :** Phukon, Rajashree (2014). Yarn dyeing with natural dyes extracted from plant sources. *Asian J. Home Sci.,* **9** (1) : 215-218.

Natural dyes have been part of man's life, since time immemorial. The age-old art of dyeing with natural dyes was common in India. Natural dyes are obtained from natural sources such as vegetable matter, minerals and insects. Early efforts of colouring fabrics were hampered by the fact that some of the dyes are not very colourfast. Eventually scientist found that this defect could be partially overcome by the use of mordant. The natural colouring substances are now developing trends for their use all over the world because of health hazards and toxicity problems created by the synthetic dyes Phukon (2010).

Objective:

Considering the growing importance of natural colorants all over the world, the present work was undertaken with an aim to study the dyeing conditions of selected natural dyes on wool yarn.

■ RESEARCH METHODS

Selection and preparation of yarn for dyeing:

Wool yarn was selected for dyeing and collected from a private firm.

Selection of natural dyes:

Table A: Dye yielding plants selected for the study are

Sr. No.	Botanical name	Common name	Family	Parts used
1.	*Myrica nagi* Thumb	Bay berry	Myriaceae	Bark
2.	*Garcinia xanthochymus* Hook. f.	Cochin goroka	Guttiferae	Bark
3.	*Artocarpus integrifolia* Linn. f.	Jack fruit	Moraceae	Root
4.	*Eugenia jambolana* Lam.	Black plum	Myriaceae	Bark

Selection of mordant :

Mordant form the link between dyestuff and fibre, which allows the dye with no affinity for the fibre to be fixed Phukon (2006). Among the mordant used for fixing natural dyes, metallic mordents are most common. The mordant used in the research work is Aluminium potassium sulphate (alum) $AlK_2(SO_4)_2$ which is consider as eco friendly Vankar (2009).

Selection of mordant concentration:

The amount of mordents used in dyeing plays an important role as the mordents forms the link between the dyestuff and fibre. After much preliminary work, the mordant concentration was determined which was mainly based on the percentage of absorption of the dye and visual assessment of the shade. Three mordant percentages were used and the observations were made at three levels *i.e.* 5, 10 and 15 per cent concentrations.

Mordanting method:

Pre-mordanting method was used for this study. In this method, the yarns were mordanted in the first stage and then dyed. First optical density of the extracted dye liquor was recorded. 5, 10, and 15 per cent solution of alum were prepared by dissolving in water. Yarn samples were then treated in each of the mordant solutions and then dyed in the prepared dye bath for various time periods for each dye. Optical density of the dye liquor was recorded before and after dyeing. Samples were then washed, rinsed and dried in shade.

Extraction of dyes:

Selected natural dyes were extracted by alkaline method. In this method, 1 per cent of alkaline solution was prepared by adding 1 ml of Na_2CO_3 in 100 ml of soft water. The dye material was boiled at 80-90°C in the dye bath. Then the dye solution was filtered. The optical density of the solution was recorded.

Determination of dye absorption using spectrophotometer:

For determining the percentage of dye absorption by the yarn, the dye solution before and after dyeing was subjected to visual light of specific wavelength using spectrophotometer. The beam of light transmitted by the sample was detected and recorded as optical density. The hue given by the dye was noted. To arrive at the peak wavelength suitable for the dye liquor, scanning of the dye liquor was done and the peak at which optical density was high was noted.

Test for colour fastness:

All the dyed yarn samples were evaluated for colour fastness to washing sunlight, rubbing, and perspiration by the standard procedures lay down by Bureau of Indian Standards (Bureau of Indian Standards, 1956).

■ RESEARCH FINDINGS AND DISCUSSION

The findings of the present work are discussed below:

– Optimized dyeing conditions.

– Optimized dye material extraction time.

Table 1 revealed the optimized dye extraction time

Table 1 : Optimized dye material extraction time by determining optical density

Dye yielding plants	Extraction time, min.	Wave length (nm)	Optical density
M. nagi	45	470	0.470
G. xanthochymus	45	450	0.440
A. integrifolia	30	430	0.411
E. jambolana	60	500	0.324

Table 2 : Optimized concentration of various parameters for dyeing

Dye yielding plants	Concentration of dye material in g/100g of yam	Concentration of alkali g/100g of dye material	Concentration of the mordant g/100g of yarn	Mordanting time(min)	Dyeing time(min)
M. nagi	200	10	10	30	30
G. xanthochymus	200	10	10	30	30
A. integrifolia	300	15	15	30	30
E. jambolana	300	15	15	30	45

Table 3 : Fastness grades of the dyes on wool at optimum dyeing conditions

Dye yielding plants	Washing fastness grade		Rubbing fastness grade				Light fastness grade	Perspiration fastness grade			
			Dry		Wet			Acidic		Alkaline	
	CC*	CS#	CC	CS	CC	CS		CC	CS	CC	CS
M. nagi	4-5	4	5	5	4-5	4	5	4-5	4	4	4
G.xanthochymus	4-5	4	5	5	4-5	4	5	4	4	4	4
A. integrifolia	4-5	4	5	5	4-5	4	5	4-5	4	4-5	4
E. jambolana	4-5	4	5	5	4-5	4	5	4	4	4	4

* CC = Colour change # CS = Colour staining

Table4 : Physical properties of wool yarn before and after dyeing

Sr. No.	Yarn properties (before dyeing	Yarn properties (after dyeing) Sources							
		M. nagi		*G.xanthochymus*		*A. integrifolia*		*E. jambolana*	
		Dyed sample	% change	Dyed sample	% change	Dyed sample	% change	Dyed sample	% change
1.	Weight (0.016 g)	0.019	+18.75	0.019	+18.75	0.017	+6.25	0.017	+6.25
2.	Denier (68.57)	68.57	0.00	68.57	0.00	68.57	0.00	68.57	0.00
3.	Breaking load (2.199kg)	2.232	+1.50	2.203	+0.18	2.212	+0.59	2.212	+0.59
4.	Breaking strength (32.07g/denier)	32.55	+1.50	32.16	+0.28	32.21	+0.44	32.21	+0.44
5.	Elorgation (18.50 mm)	18.66	+0.86	18.60	+0.54	18.62	+0.65	18.62	+0.65
6.	Stress (10.42%)	10.61	+1.73	10.47	+0.38	10.30	+0.67	10.50	+0.67

Note : '+' indicate increase, '-' indicate decrease

which are 45 min for *M. nagi and G. xanthochymus,, likewise* one hr. for *E. jambolana* and 30 min for *A. integrifolia* based on optical density. The suitable wave length are 470. 450, 430 and 500 for *M. nagi, G. xanthochymus, A. integrifolia* and *E. Jambolana*, respectively.

Optimized concentration for dyeing:

The data presented on Table 2 showed that 200g of M. *Nagi* and *G. Xanthochymus* each are required for dyeing of 100g of wool where as 300g of *A. Integrifolia* and *E. Jambolana* each are required for dyeing of 100g of wool. Similarly the concentration of alkali required 10g of each for 100g of dye material *i.c. M. Nagi, G. Xanthochymus* and also 15g for *A. Integrifolia* for *E. Jambolana*. *Optimized mordanting* and dyeing time are 30 mins for all the dyes *except E. Jambolana* where optimized dyeing time is 45mins.

Colour produced:

The selected natural dyes produced different shades of beige, yellow, golden yellow, brick and brown colours on wool yarn.

Fastness grades of the dyes:

Fastness grades of the dyed wool yarns are given in Table 3. It can be seen from the table that the fastness grade rated for all the samples were good. Absolutely no colour change was found in dry rubbing samples. However, very little staining was found in few samples. Light fastness was also found to be good in all the dyed samples. As regards to washing and perspiration fastness, all the samples showed a negligible change.

Table 4 revealed the data on physical properties of wool yarn before and after dyeing with *four different sources of* dye. From the data it was observed that the physical properties of the yarn remained same after dyeing. It also found that, in some properties, dyed yarn showed better result than the undyed yarn.

Conclsuoin:

From the present study, it could be concluded that the selected dyes were found to be an ideal source of natural dyes. At the 21st century, maintaining a safe environmental balance becomes even more important as synthetic dyes are based on toxic raw materials and intermediates. The effluents from the industry are some of the major causes of environmental pollution. Natural dyes are not only free from this handicap but could also assist the regeneration of the environment if plans were developed to cultivate these plant varieties on a commercial scale. Petrochemicals, the base of synthetic dyes is limited and irreplaceable while the vegetarian

based resources of dyes are replaceable besides being bio-degradable. All over the world, environmental regulations are becoming more and more stringent and are forcing a shift of technology towards less polluting or practically non - polluting areas of technological development. Keeping in view the environmental aspects, there is a need to realize the importance of exploring the technology of non-toxic natural dyes. From the present work it could be summarized that the selected natural dyes are a suitable choice for colouration of wool yarn.

■ REFERENCES

Bureau of Indian Standards No's – IS: 3361-1979, IS: 686-1957, IS: 766-1956 and IS: 971-1956.

Phukon, R. (2006).Yarn dyeing with natural dyes extracted from plant sources. Ph.D. Thesis, Gauhati University, Guwahati, ASSAM (INDIA).

Phukon, R. (2010). Use of indigenous dyes for economic upliftment and sustainable livelihood. *Asian J. Home Sci.,* **4** (2) : 395-397.

Vankar, S.P. (2009). Current trends in natural dyes for eco friendly textiles. *Textile Indus. Trade J.,* **39** (9-10):19.