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Dyeing of wool and cotton fibres with fruit rind of *Juglans regia* as natural dyes, and standardization of ancient dyeing procedure

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Abstract

Vegetable dyes and their uses are known in ancient time more than 2000 years ago. It was found that the discovery of synthetic dyes reduce the use of natural dyes and consequently the export of same was affected in large extent. However due to non toxic nature, eco-friendly behaviour and properties to impart variety of colours once again natural dyes are getting more attention of chemists and dyers. The present paper deals with optimization of dyeing and mordanting of wool and cotton samples with fruit rind of *Juglans regia* and standardization of ancient dyeing procedure and also the fastness studies of dyed samples toward light and washing.

Introduction

The *Juglans regia* (Ankhrot) belong to family Juglandaceae is a large tree. Flowers are green, male and female appearing with the leaves. The bark of *Juglans regia* (Ankhrot) were known to contain substances that could be used for colouring the fabrics, cloths, utensils, and house hold implements. The colouring matter presents in the bark of *Juglans regia* is a mixture of Lignins, Tannins, Anthocyanins and Xanthones. The bark is credited with astringent properties. The fresh bark powder and seed coat of the plant are used as biopesticide in agriculture. (Gaur, 1999 and Lemmens and Soetijipto, 1991).

Materials and Method

The fruit rinds of the plant were collected from the forests of Ranichauri Distt.- Tehri Garhwal, Uttrakhand. During rainy season, and dried in shade. All the chemicals used as mordant were of L.R/A.R and BDH fine chemicals. The white wool and cotton samples were freed from traces of protein, gums and oil impurities by washing it with detergent or soap for a required periods, followed by kneading, squeezing and rinsing with lot of water, till it was free from traces of detergent. It was then dried in shade and ironed before dyeing and mordanting, the cotton and wool samples wer soaked for an hour. The optical density was recorded by using digital spectrophotometer.

The optimum concentration of dye material and the time for extraction of the dye and dyeing of cotton and wool were found out by taking different concentration of dye material (2-12gm) in different beakers.

In order to find out optimum time for dyeing one gram of cotton and wool fibers was added to seven beakers and dyed for 30, 45, 60, 75, 90, 105, and 120 minutes. The samples were stirred occasionally to obtain an even dyeing. The dyed samples were taken out from beakers and dried in shade. The evenness of dye, depth of shade and overall appearance are evaluated by a panel of judges. The highest percentage rating was calculated by Judgment Table 2.

Number of shades were obtained by mordanting the cotton and wool with different concentration of mordants such as chrome, alum, copper sulphate, ferrous sulphate, stannous chloride etc. and also using

Table-1: Optimum concentration of dye materials

Conc. of Dye material g/100 ml of water	Optical density	Percentage rating
2 gm	0.081	52
4 gm	0.097	55
6gm	0.121	60
*8 gm	*0.137	*67
10 gm	0.128	59
12 gm	0.123	62

Wavelength 320 mn
*Selected sample

The optimum time for extraction of dye was found out by extracting the optimum concentration of dye material at 80 ^{0}C for 30, 45, 60, 75, 90, 105 and 120 minutes and the optical density of the liquor was measured (Table II).

Table-2: Optimum time for extration of dye and dyeing

Time for extraction of dye(min.)	**Cone. of dye material (gm)**	**Optical Density**	**% absorption**	**%rating**
30	8	0.142	0.72	
45	8	0148	0.75	
60	8	0.153	0.82	
*75	8	*0.162	*0.84	*0.84
90	8	0.160	0.83	
105	8	0.161	0.82	
120	8	0.161	0.82	

Wavelength 320 mn
*Selected sample

the pre-mordanting (mordanting before dyeing) Post-mordanting (mordanting after dyeing) and simultaneous mordanting (dyeing and mordanting together in same pot.)

Analysis of samples towards light and washing fastness

The dyed samples of cotton and wool to be tested for the light fastness were cut into specimens of 3x 6cm, numbered and mounted on a cardboard frame. The blue wool and cotton sample (five of each) standard having a light fastness rating from low to high (1 low-5 high cotton, 1 low-5 high wool) were stapled on cardboard strip. A strip of thick black chart paper was pinned in such a manner that half of it lies on the specimen and the standards thereby leaving the samples half exposed and half covered (Bird, C.L. 1972). A strip of thick black paper was put inside the fluorescent lamp. The specimens and standards were checked at regular intervals. The samples were compared with blue wool and cotton standards and rated. The different methods of mordanting produce good range of colours having various shades ranging from dark brown to brownish black, black to greenish, brown to black. The premordanting method gave the best results/colours with Stannous Chloride and Ferrous Sulphate. A variety of shades was also obtained with post and simultaneous mordanting process.

The washing fastness of sample was done by marking the specimens of 5 x 7 cm size and placed between two layers of the fabric of the same size. These layers were seen from a complex specimen. The soap or detergent solution was prepared by dissolving 10 gram of soap or detergent in 1000ml of water. Each composite sample was treated with soap solution in Launderometer for 30-40 minutes at a temperature of 60 ^{0}C. The samples were then removed and rinsed thoroughly under running tap water, dried and ironed. The rating of washing fastness was done on the basis of the staining of the fabrics. Washing brought a considerable change in the colour of dyed sample Chrome, Alum and Stannous chloride mordanted samples showed very poor fastness. Cotton was stained with SnCl2 whereas wool was noticeably stained with Alum (Sati *et al.,* 2003).

Ferrous Sulphate mordanted samples has fair washing fastness while Copper Sulphate and Chrome mordanted samples have poor to fair washing fastness. Chrome and $SnCl_2$ showed slight stain on wool.

Results and Discussion

From the data of Table 1 and 2 it is evident that 8gm of rind power was optimum to give the maximum optical density of dye liquor while 75 minutes of extraction time and dyeing time was found to be optimum. Best shades of colours were obtained by using 12 gm of Alum, 5 gm of Chrome, 8 gram of $CuSO_4$, 10 gram of $SnCl_2$ and $FeSO_4$ respectively per 100gm of wool and cotton.

In present study it was observed that cotton samples was noticeable stained with Stannous Chloride using post mordanting technique, while wool was noticeably stained with Alum using same procedure. The washing fastness of both sample of cotton and wool was found fairly good.

Efforts was also made to mordant the samples with naturally occurring mordants of plants origin like bark of *S. racemosa*, seed rind of *P. granatum,* bark of *M. esculenta* etc. which produces a number of beautiful shades on wool and cotton samples.

The whole study points out that the dye extracted form fruit rind of *Juglans regia* can be use to obtained

array of colours either alone or in combination with mordants (natural/synthetic) with different fabrics. The optimization of mordanting has not only rendered the dyed wool with good wet fastness but has also helped in achieving eco-friendly processing parameters in terms of effluent within tolerance limit for the residual heavy metal content.

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