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Use of *Rhus Parviflora* Leaves as Natural Dyes: Determination of Optimum Dyeing Conditions and Assessment of Washing Fastness on Woollen Sample In Absence and Presence of Natural Mordant (*Symplocos Racemosa* Leaves)

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Abstract: Several plants have long been in use for traditional dyeing of fibres in Uttarakhand The present investigation is designed with an aim to use *Rhus parviflora* leaves as a source of natural dyes, to optimize conditions of concentration, time and mordanting method for dyeing woollen samples from the extracted dye and to improve the quality of shades using *Symplocos racemosa* leaves as natural mordant. An assessment of washing fastness with and without mordant has also been made.

Keywords: Natural dyes • Optimum conditions • Mordanting method

Introduction

Rhus parviflora is one of the noted vegetations of India in general and the Himalayas in particular. As for its geographical distribution, this is habited in the hills of Peninsular India, in the Punjab and Nepal Himalayas, generally found on their dry hot slopes and in Sri Lanka, Madhya Pradesh, Bhutan and Uttarakhand hills at an elevation ranging between 600 to 1100 m (Press, et.al., 2000) as per slope, aspect, soil conditions and combination with other forest species. *Rhus parviflora* is a shrub or a small tree attaining a height of 3 metre. The young parts are densely covered with dark grey pubescence. This polygamous or dioecious plant is usually sapiferous, the sap being often irritant. The wild edible fruit is called 'Satibayer' in Nepal (Bajracharya, 1980). Talking of its uses in therapy, records in Ayurvedic pharmacopoeia show that *Rhus parviflora* has therapeutic uses for Vāta vikāra, the complications related to neurological disorders including anxiety, insomnia, epilepsy and rheumatoid arthritis (Shrestha et al., 2012). In Ayurveda, it finds use in curing neurological and stomach disorders (Anonymous (2006) as well as in treating muscular inflammation (Manandhar, 1995). *Rhus parviflora* helps in curing abdominal disorders, heart ailments, teeth related disorders and urinary tract infection. Externally, it is used in dental care powders to help in minor ailments of oral and dental conditions. The fruit of *Rhus parviflora* is of immense importance in Ayurveda and used in Ayurvedic formulations. In Nepal, fruits of *Rhus parviflora* are also used for human consumption

and decoction of fruit or stem bark is used to cure dysentery (Bajracharya, 1980, Bhattarai, 1991). Bark extract is applied externally on wounds and small twigs are used for cleaning teeth (Semwal et al, 2010). In some tribal areas, infusions of leaves are given in cholera (Kumar et al. 2011).The leaves are locally employed in dyeing (Kundal et.al, 2014).

This paper aims at finding the optimum conditions of concentration, time and mordanting method for dyeing of wool with *Rhus parviflora* leaves using *Symplocos racemosa* leaves as mordant. The washing fastness assessment of the dyed woollen sample in absence and presence of mordant is also done.

Pic (a) *Rhus parviflora* leaves

Pic (b) *Symplocos racemosa* leaves

Materials and Methods

Collection of plant materials :

(1) ***Rhus parviflora* leaves:** The leaves were gathered from the mixed forest of Premnagar Pauri located at the altitude of 1400m in the month of October.

(2) ***Symplocos racemosa* leaves :** The collection of leaves was done in the month of October from Phalati (Mandakini Valley), Rudraprayag situated at a height of 1100m.

Fibre Preparation for Dyeing

Wool has been selected as the dyeing fibre for the present study. Before dyeing, it undergoes the following processes :

(1) **Skeining yarn:** To avoid tangling and to allow even penetration of dye in the fibre proper skeining is essential. The skein of wool was made by wounding around the arm from the hand and over the elbow.

(2) **Soaking :** A thoroughly wet textile dyes well. As such , the skein was soaked in the tap water for about 12 hours to get rid of the water soluble impurities.

(3) **Scouring :** This process involves cleaning of textile with hot water and neutral soap to allow uniform dyeing. Wool is scoured to remove the grease - '*lanolin*', a fatty substance present in the wool. The skein was boiled in a solution of soapy water and a little amount of washing soda and boiled for about two hours. After this the material was soaked in the soap bath overnight and then rinsed in hot water.

Determination of Rate of Exhaustion or Percentage Absorbance: The UV-Visible Shimadzu spectrophotometer (Model UV-1601) was used in determining the O.Ds (Optical Densities) or Absorbance of the dye bath before and after dyeing. In each case, distilled water was used as the blank to calibrate the instrument to zero absorbance. While using the instrument it was ensured that the wavelength was set to the maximum wave length (i.e. wavelength of

maximum absorbance λ_{max}) of the dye used at that point.

The rate of Exhaustion or Percentage Absorbance was calculated as follows:

$$\text{Rate of Exhaustion (\%)} = \left[\frac{D1-D2}{D1}\right] x100$$

Where D1 = O.D. before dyeing

D2 = O.D. after dyeing

D1-D2 = amount of dye transferred into the fabric after dyeing

Optimization of Dyeing Procedure: For the present study, three parameters were considered:

Optimum concentration of dye: 10 g of *R.parviflora* leaves were soaked in varying volumes of hot water(200 ml,400 ml, 600 ml and 800 ml each for 30 minutes) and heated for a fixed time period(30 min).Then the solution was filtered and Optical Density (O.D.) of the filtrate was measured.After this, the woollen fabric was dipped in the solution for 30 minutes(Dyeing time = 30 min).The dipped fabric was then taken out of the solution , squeezed and spread to dry followed by the measurement of O.D. of the remaining solution. Using the above formula, percentage absorbance or rate of exhaustion was derived in each case. The concentration of dye corresponding to maximum percentage absorbance was finalized as the optimum concentration for each sample.

Optimum time: Optimum concentration (as determined in the previous step) was heated for different time intervals and filtered. The O.D. of the filtrate was determined. Thereafter, the woolen sample was soaked in the solution for 30 minutes after which it was taken out ,squeezed and spread to dry. Then the O.D. of the leftover solution was determined and percentage absorbance or rate of exhaustion was derived in each case. The value of time corresponding to maximum percentage absorbance was taken as the optimum time for each sample.

Mordanting method: After getting the optimum concentration and time of the dye, the woollen fabric was subjected to all the three types of mordanting (Pre, Post- and Simultaneous) .

Pre-mordanting : In this case , the selected fabric was first dipped and heated for 10 minutes in the mordant solution and then dipped in the dye solution and heated further for another 10 minutes . The fabric was taken out and spread to dry. The O.D.s were measured before and after dyeing.

Post-mordanting: In this case , the selected fabric was first soaked and heated in the dye solution and then in an equal volume of mordant solution for 10 minutes each. The fabric was taken out and spread to dry. The O.D.s were determined before and after dyeing.

Simultaneous mordanting: Equal volumes of the dye and mordant solutions were mixed together and the fabric was dipped in this. The solution was heated for 20 minutes. The fabric was taken out and spread to dry. O.D.s was measured before and after dyeing.

Assessment of Washing Fastness properties: The dyed wool samples were tested for washing fastness properties both at preliminary and laboratory levels. For preliminary observation, dyed fabrics were soaked in detergent solution for 30 minutes while laundrometer (Elite-An ISO 9001: 2008 CERT.CO. model) was utilized at laboratory level.

Table 1 Determination of optimum concentration

Sample	V(ml)	C(g/ml)	D1	D2	D1-D2
S-200	200	0.05	2.101	2.642	-0.541
S-400	400	0.025	1.307	0.718	0.589
S-600	600	0.017	0.900	0.241	0.659
S-800	800	0.0125	0.931	0.604	0.327

V=Volume of hot water taken for 10 g flowers

C=Concentration of solution = weight of flowers / volume of hot water taken =10/V (λmax:417nm)

Table 2 Determination of optimum time for dyeing wool (λ_{max} = 417 nm)

Sample	Tim (min)	D1	D2	D1-D2	% abs.
S-30	30	0.900	0.241	0.659	73.22
S-45	45	0.553	0.122	0.431	77.94
S-60	60	0.549	0.273	0.276	50.27

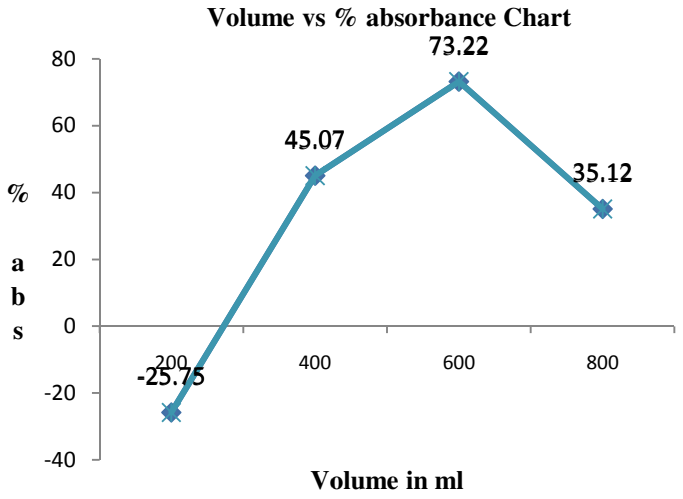


Figure1 Volume vs % absorbance Chart

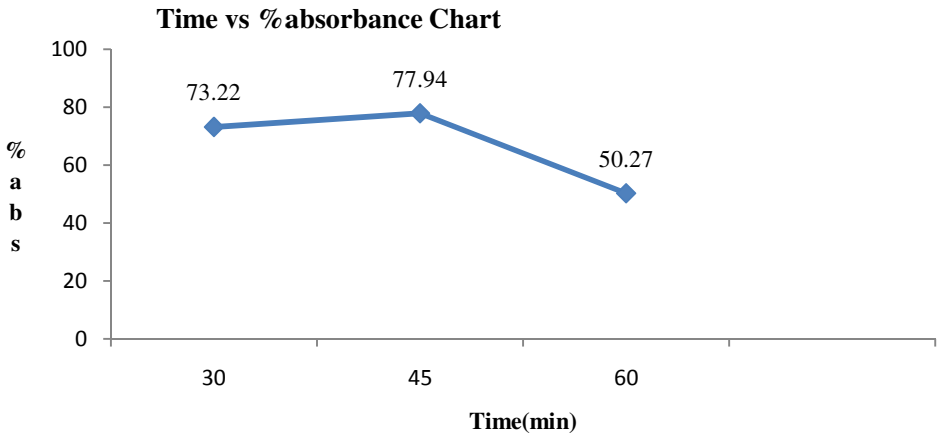


Figure 2 Time vs %absorbance Chart

Table 3 Mordanting of wool with *S. racemosa* leaves

Type of mordanting	D1	D2	D1-D2	% abs.	Shade obtained
Pre	2.270	2.341	-0.071	-3.128	Canary yellow
Post	2.270	2.642	-0.372	-16.387	Bright yellow
Simultaneous	2.270	2.729	-0.459	-20.22	Bright yellow

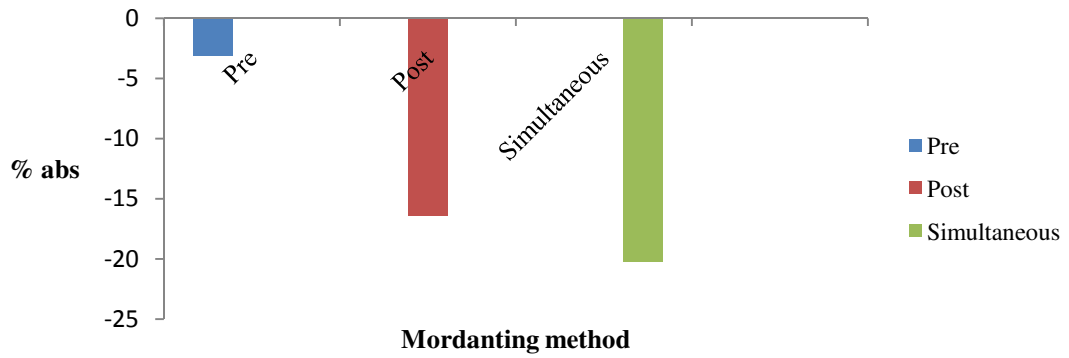


Figure 3 Time vs %absorbance Chart

Pic (c) : *Rhus parviflora* (600 ml,45 min)

Pic (d) : *Rhus parviflora* (leaves) + *S. racemosa* (leaves) : Pre mordanting

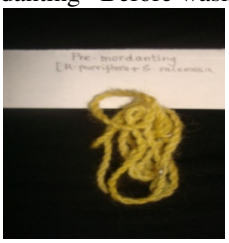
Without mordant

Pic (c) : *Rhus parviflora* (600 ml,45 min)-Before washing

Pic (e) : *Rhus parviflora* leaves (600 ml,45 min) –After washing

With mordant

Pic (d) : *Rhus parviflora* (leaves)+S. racemosa (leaves) : Pre mordanting –Before washing



Pic (f) : *Rhus parviflora* (leaves)+ *S. racemosa* (leaves) Pre mordanting –After washing

Table 4 Washing fastness of dye material without mordant

Plant name	Fibre	Shade before washing	Shade after washing	Effect	Washing fastness Rating
Rhus parviflora leaves	Wool (600 ml , 45 min)	Creamish yellow	Yellow	Slight change (brightening)	4

Table 5 Washing fastness of dye material with natural mordant

Plant name	Mordant	Shade before washing	Shade after washing	Effect	Washing Fastness Rating
Rhus parviflora (leaves)	*S. racemosa* (leaves)	Canary yellow	Canary yellow	No change at all	5

Results and Discussion

Table 1 clarifies that the wool sample corresponding to S-600 gave maximum percentage absorbance. It implies that the optimum concentration of *Rhus parviflora* leaves for dyeing wool is 10g per 600ml hot water. From Table 2 it is clear that the optimum time for dyeing 10g *Rhus parviflora* leaves in 600 ml hot water is 45 minutes. Thus, for dyeing wool 10g of leaves per 600ml hot water extracted for 45 minutes gave the best result.

For dyeing wool with *Rhus parviflora* leaves, , pre-mordanting method (pic.d) was found to be the most suitable one when S.racemosa leaves were used as mordant (Table 3).

Thus, the above dyeing procedure was optimized as follows :

- ✓ Optimum concentration of the dye = 10g per 600ml hot water =0.0167 g/ml
- ✓ Optimum time of extraction = 45 minutes
- ✓ Optimum mordanting method: Pre-mordanting method

Washing fastness assessment:

- ✓ The woollen sample displayed good to excellent washing fastness (4) when no mordant was used (Table 4).
- ✓ The woollen sample dyed with *Rhus parviflora* leaves and mordanted with *S. racemosa* leaves exhibited remarkable washing fastness (5) (Table 5).

Thus, the selected plant part (*R.parviflora* leaves) offers a good source of natural dyes and can be comfortably employed for dyeing woollen samples. These are quite fast towards washing and mordanting the dyed woollen sample enhances the shade and also improves the washing fastness.

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