ISSN : 0974 - 7451 Volume 8 Issue 7

Environmental Science
An Indian Journal
Current Research Paper

ESAIJ, 8(7), 2013 [253-256]

Application and optimization of natural mordants in modern dyeing

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ABSTRACT

The application of *Myrica esculenta*, *Symplocos recemosa*, *Juglans regia* and *Hippophae rhamnoids* as natural mordants and *Myrica esculenta*, *Quercus floribunda*, *Rhus parviflora* and *Berberis kumaonensis* as natural dyes were optimized on wool yarns. The time of extraction, maximum concentration, colour shades and fastness properties were evaluated and the encouraging results were obtained.

KEYWORDS

Mordant;
Dye;
Fastness.

INTRODUCTION

Dyeing with natural dyes and natural mordants especially, vegetable dyes and vegetable mordants, presently aroused as a field of interest to chemists, textile dyers and the experts of fashion market. Since last two decades considerable work has been done on the survival and revival of traditional dyes[1-3] but there is no extensive report on vegetable mordants. This paper is the first report of the application and optimisation of natural mordants i.e. time of extraction, optimum concentration, colour shades, fastness properties (light and washing) with the few well known dye yielding plants.

MATERIALS AND METHODS

Selection of plant part

On the basis of the literature survey we had selected *Myrica esculenta* (leaves and bark)[4], *Quercus floribunda* (leaves)[5], *Rhus parviflora* (leaves and bark)[6] and *Berberis kumaonensis* (root)[7] for the extraction of colouring material, whereas *M. esculenta* (leaves and bark)[4], *Symplocos recemosa* (leaves)[4], *Juglans regia* (seed coat)[4] and *Hippophae rhamnoids* (seeds)[4] have been taken as a mordant plant.

Extraction

The crushed and air dried plant parts were extracted in water at 100^0C for 30, 60 and 90 min, separately. Each extracts were allowed to cool at room temperature and the optical density was checked separately. It gave maximum concentration of each extracts at different time intervals.

Dyeing

The scoured, skinned and wet white Marino wool sample 10 gm each were dipped in six different beakers containing 200 ml dye solution (dye bath). Each dye bath was heated for 1hr at 100^0C separately and then allowed to cool at room temperature. The wool sample removed and the optical density of left over

solution were checked.

Mordanting

Mordant is a substance that have a property of colour fastness added to the fabric and it prevent the fading of colour to washing or to light. The extract of mordant plants (as above) was standardized and mixed 10 ml each with the above dye bath separately. The pre- mordanting, post- mordanting and simultaneous-mordanting process were optimized separately with each dyeing. The 10 gm/ 200ml dye bath was heated up to 100^0C for 1hr and the optical density of the left over solutions was checked again.

Spectral analysis

The UV/VIS spectra of extracted dye/mordants were recorded on EI spectrophotometer. The percentage absorption calculated as following;

$$\text{Percentage absorption} = \frac{\text{OD before dyeing - OD after dyeing}}{\text{OD before dyeing}} \times 100$$

The UV absorption of each dye/ mordant was recorded between 200 - 400 nm.

TABLE 1 : Percentage absorption of different dyes between λ_{max} 200- 400 nm

Plant name	Wave Length (nm)	Max. time for Extraction of dye (min)	OD before dyeing	OD after dyeing	% abs.	Colour appearance
M esculenta (l)	300	90	.990	.560	43.3	Light brown
M,esculenta(b)	310	60	.990	.680	21.9	Brown
Q.floribunda(l)	220	90	.550	.343	34.0	Light brown
R.parviflora (l)	230	90	.743	.414	40.3	Creamish colour
R.parviflora(b)	220	60	.950	.220	56.8	Light red
B.kumaonensis(r)	220	60	.876	.303	65.11	Yellow

TABLE 2 : Percentage absorption of different dye materials with different natural mordants

Plant name	Mordants	O.D. before dyeing	O.D. after dyeing	% absorption	Colour imparted
Q. floribunda (l)	S. racemosa (l)	.811	.550	32.6	Brown
	M. esculenta (l)	.966	.620	35.9	Black
	M. esculenta (b)	.350	.200	42.80	Black. red
	H. rhamnoid (s)	.655	.510	22.20	Reddish brown
	J. regia (f)	.730	.410	43.8	Brownish red
R. parviflora (l)	S. racemosa (l)	.595	.337	26.7	Greenish yellow
	J. regia (f)	.554	.265	52.11	Creamish yellow
R. parviflora (b)	M. esculenta (b)	.467	.163	65.1	Reddish yellow
	J. regia (f)	.650	.410	38.3	Reddish brown
B. kumaonensis (r)	M. eselenta (l)	.840	.535	36.4	Yellow
	M. esculenta (b)	.690	.365	47.2	Bright yellow
	J. regia (f)	.734	.432	41.8	Reddish yellow

Abr: l= leaves, b= bark, r= root, f= seed coat, s= seed

TEST OF COLOUR FASTNESS

Test for colour fastness to light

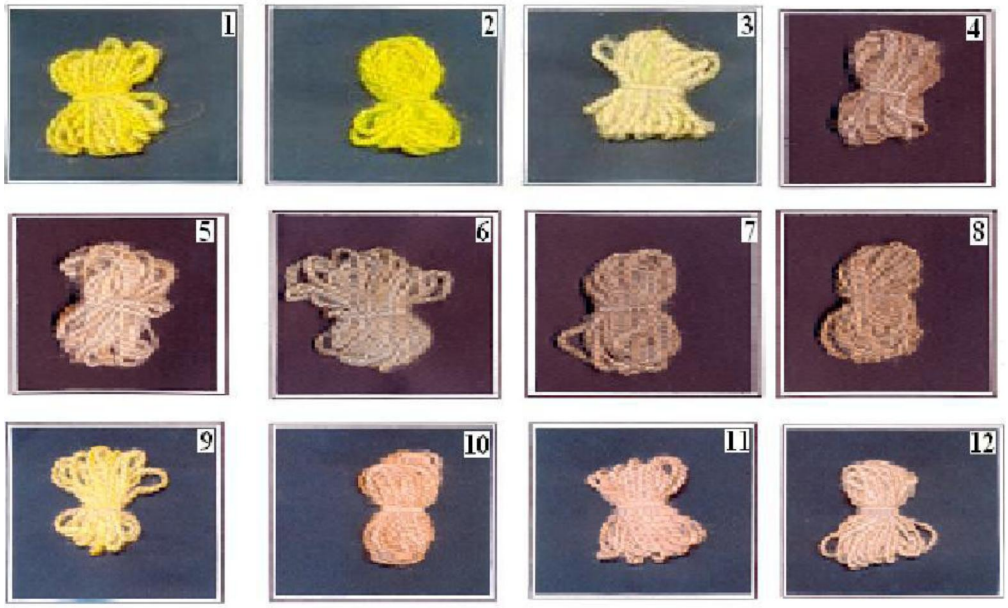
Each dyed sample was placed on a card-board frame along with blue standard rating. The sample was covered with a black sheet, that half of the sample covered and half exposed. The samples then placed inside the fadeometer and the samples then compared with the blue standard and rated.

Test for colour fastness to washing

To check the washing fastness the wool sample was placed between two pieces of undyed fabrics. The samples were dipped in the detergent solution for 30 min, and then rinsed in running water. The sheet of dyed and undyed samples were dried in shade and the samples were assessed on the basis of change in colour the sample as well as staining on the adjacent blank with the help of grey scale.

RESULTS AND DISCUSSION

The time of extraction optimized was 90 and 60 min for each dye and mordant sample and the values of their maximum concentration of extraction (% absorp-



1- M. esculenta (b) + B. kumaonensis (r)
2- M. esculenta (l) + B. kumaonensis (r)
3-B. kumaonensis (r)
4-Q. floribunda (l)
5-Q. floribunda (l) + S. racemosa (l)
6-Q. floribunda (l) + M. esculenta (b)
7-Q. floribunda (l) + H. rhamnoid (s)
8-Q. floribunda (l) + M. esculenta (l)
9-R. parviflora (l) + S. racemosa (l)
10-R. parviflora (b) + J. regia (f)
11-R. parviflora (b) + M. esculenta (b)
12-R. parviflora (l) + J. regia (f)

Figure 1

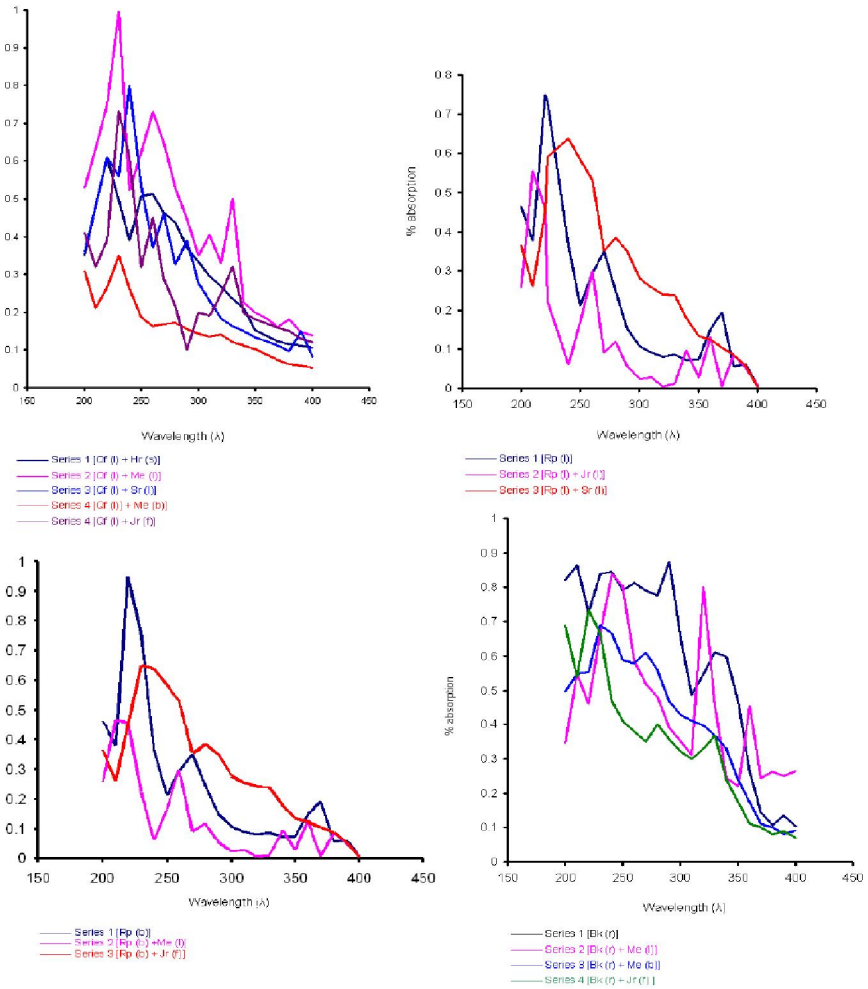


Figure 2

TABLE 3 : Percentage rating of different dyes

Plant name	Mordant	Colour imparted	Light fastness	Washing fastness
Q. floribunda (l)	S. recemosa (l)	Creamish yellow	3	2
	M. esculenta (l)	Blackish brown	2-3	2
	M. esculenta (b)	Brownish yellow	4-5	4
	H. rhamnoid (s)	Reddish brown	4-5	4
R. parviflora (l)	S. recemosa (l)	Creamish yellow	4	3-4
	J. regia (f)	Reddish brown	3	2-3
R. parvifloras (b)	M. esculenta (b)	Brownish red	4-5	4
	J. regia (f)	Creamish red	4	3-4
B. kumaonensis (r)	M. esculenta (l)	Bright yellow	4	3-4
	M. esculenta (b)	Yellow	4	3-4
	J. regia (f)	Reddish yellow	4-5	4

% rating: 1-2 poor, 2-3 fair, 3-4 good, 4-5 excellent

tion) was recorded between 200- 400 nm (TABLE 1). The dyes with mordant (10 ml each) showed better absorption on wool than the dye without mordants and the colour shades imparted were different with different mordants (TABLE 2, Figure 1), which were brighter and faster than the unmordanted dye. It has been observed that *M. esculenta* (bark) showed maximum % absorption with all dyes whereas *J. regia* (fruits) and *S. racemosa* (leaves) showed good % absorption with the experimental dyes (Figure 2). Further the sample dyed with mordants showed excellent to good washing and light fastness properties (TABLE 3).

CONCLUSION

The various experimental findings showed that mordants extracted from plants impart different colour shades with different plant dyes, which were stable to light and washing. The mordants of plants extracted out from its regenerated parts were totally free from chemicals, thus can be an excellent source of eco-friendly dyes to modern fashion market of high society.

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