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Home Science

DYEING OF SILK WITH NATURAL DYE KOKUM RIND (GARCINIA INDICA) AND MYROBALAN AND GOOSEBERRY AS MORDANT

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ABSTRACT Dyeing with natural sources like Garcinia Indica is a powerful source of dyes for textile dyeing. Garcinia Indica is a very popular fruit from Maharashtra. It has various health and beauty benefits. It is also used as medicinal purpose. In the present study, Garcinia Indica was used as source of dyes on silk fabric. Myrobalan and Gooseberry were used as eco-friendly mordants on silk fabric. Standardization was carried out for each and every parameter. Parameters like optimization of medium of extraction, alkali concentration, dye concentrations, dyeing time, extraction time, and so on was successfully conducted. Darker shades were obtained after dyeing and mordanting. A standard recipe for dyeing of silk with Garcinia Indica was successfully developed. There will be a vast scope of this kind of natural dyeing in future.

KEYWORDS : natural, mordant, extraction, silk, dyeing, myrobalan

INTRODUCTION

Dyeing from natural sources is the oldest way of colouring textiles. The first colours used to dye fabrics were obtained from vegetable sources. The dye on a finished garment, by its nature, is chemically stable – that makes a dye color fast [1].

The use of natural colours for dyeing fabrics has been in practice since ancient times, where most of the dye colour are obtained from the plants parts (leaves, flowers, stem, roots, fruits and pods).

The word 'natural dye' covers all the dyes derived from the natural sources like plants, animal and minerals. Natural dyes are mostly non-substantive and must be applied on textiles by the help of mordant, usually a metallic salt, having an affinity for both the colouring matter and the fibre [2].

In the present study an attempt has been made to optimize the dyeing conditions for dyeing of silk fabrics with natural dye Kokum Rinds (Garcinia Indica) with natural mordants Myrobalan, and Gooseberry.

Selection of the natural dye:

Kokum semi-dried rinds were purchased from the Mira Road, Mumbai at the rate of Rs.80/kg. Kokum rinds were subjected to alkaline extraction. Kokum butter is obtained from the fruit of the

kokum tree (botanical name: Garcinia Indica), which grows in the western parts of India (Maharashtra and Goa). The fruits are spherical with diameters of 2.5–5.0 cm. They are a reddish-purple in colour and contain between 3 and 8 large black seeds containing 32–40% fat.

Plate -1 Kokum Fruits

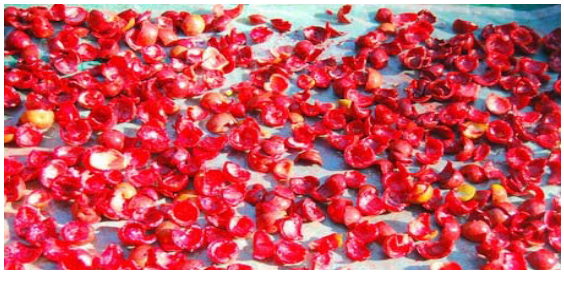

Plate -2 Kokum Fresh Rinds

Plate -3 Kokum Dried Rinds

Plate -4 Kokum Dried Rinds Powder

Selection of Mordant

1. Myrobalan (Terminalia Chebula)

Terminalia chebula is a flowering evergreen tree native to Asia. The fruits of this tree are extensively used in traditional medicine system. The pericarp of mature fruits of Harad tree constitutes the drug. They are rich in hydrolysable tannins (pyrogallic) and very astringent and with good light fastness. The amount of tannin in myrobalan varies from 18.2% to 52% and has a strong smell [3].

Plate -5 Myrobalan Fresh Fruits

Plate -6 Dried Myrobalan

Plate -7 Dried Myrobalan Powder

2. Indian Gooseberry (Phyllanthus Emblica)

Gooseberry contains tannin which prevents oxidation of the vitamin and renders the fruit a valuable anti-scorbutic in the fresh and as well as in dry condition. It is used as a remedy for anemia, jaundice. Tannin containing Gallic acid, in its molecule is naturally present in this fruit, prevents or retards oxidation of the vitamin [4].

Plate 8 Gooseberries Fresh Fruits

Plate 9 Dried Gooseberries

Plate – 10 Gooseberry Powder

Selection of fabric:

The 100 % pure silk fabric was used as substrate. Silk fabrics were purchased from Saroj Fabrics, Vile Parle, Mumbai at the rate of Rs.450/ metre.

Degumming of silk fabric:

The 100% silk fabric was degummed in an aqueous soap solution (15gm/L) for 1 hour at boiling temperature.

Optimization of dyeing variables

i. Selection of medium of dye extractions

10 grams of the semi-dried Kokum rinds were extracted in 100 ml of alkaline, acidic and aqueous medium of water. Alkaline solution was prepared by dissolving 0.3 grams of sodium carbonate in 100 ml of water. Acidic solution was prepared by dissolving 1 ml of HCL in 100 ml of water and aqueous with 100 ml of water. The dyes were extracted for 30 minutes. The dyes were filtered and silk sample were dyed for 30 minutes. Best medium of dye extraction (alkali) was selected on the basis of K/S value.

ii. Optimization of alkaline concentrations

For optimization of alkaline concentration method, 0.5gm, 0.25gm, 0.75gm, 1gm, 1.5gm, 1.25gm, 2gm, 2.5gm of sodium carbonate were taken in 100 ml of

water. 10 grams of kokum rinds was added in different concentrations of sodium Carbonate and boiled for 30 minutes. Solution was filtered and silk fabric was dyed in prepared solution for 30 minutes. Optical density was recorded before and after dyeing and % absorption was calculated. Best concentration of alkali was selected for further study.

iii. Optimization of dye concentrations

Different concentrations i.e. 5 grams, 7.5 grams, 10 grams, 12.5 grams and 15 grams of kokum rinds were taken in 5 different beakers by dissolving the optimized alkaline concentration in 100 ml of water and extracted for 30 minutes. After extraction, the optical density was noted. Silk fabric was dyed for 30 minutes. Optical density was noted. % absorption was calculated. Best dye concentration was selected.

iv. Optimization of dye extractions time

Optimized dye concentration was taken and extracted for 15 min, 30 min, 45 min, 60 min and 75 min. Optical density was recorded. To each solution, silk fabric dyed for 30 minutes. Optical density was recorded after dyeing. % absorption was calculated. Best extraction time was selected.

v. Optimization of dyeing time

Kokum dye was extracted by using optimized alkaline concentration, dye concentration, extraction time. Silk fabric was dyed for 15 min, 30 min, 45 min, 60 min and 75 mints. Sulk fabric was dyed and optical density were recorded before dyeing and after dyeing. % absorption was calculated and on the basis of highest dye absorption. Best dyeing time was finalized

vi. Optimization of mordant concentrations

Different concentration i.e. 5 grams, 7.5 grams, 10 grams, 12.5 grams and 15 gms of Myrobalan, and Gooseberry were prepared in 100 ml of water. Dye liquor was prepared by using optimized alkali concentration, dye concentration in 100ml of water. Extracted for 30 minutes and optical density was noted. Silk fabric was dyed for optimized dyeing time. Simultaneous method was followed for optimization of mordant concentrations. Optical Density was recorded after dyeing. % Absorption was calculated. Best concentration of each mordants were selected.

vii. Optimization of Mordant Extraction Time

For optimization of mordants extraction time, optimized concentrations of each mordants were extracted for 15 min, 30 min, 45 min, 60 min and 75 min. Dye liquor was prepared by adding optimized alkali concentration and dye concentration, filtered and added 100 ml of extracted mordants in 100 ml of dye liquor. Optical density was noted. Silk fabric dyeing was carried out for optimized dyeing time.

Optical density was noted after dyeing. % absorption was calculated. Best mordant extraction time was selected.

viii Optimization of Mordanting Methods

There are three methods of mordanting. All three methods were used for three best concentrations of each mordants.

- **Pre- Mordanting** - Firstly, mordant was extracted and silk fabrics was treated with mordant and then dyed in the dye liquor.
- **Simultaneous Mordanting**- In simultaneous mordanting case, mordanting and dyeing occurred simultaneously in the dye bath.
- **Post-Mordanting**- In this method, fabric was first dyed in the dye liquor and then same fabric was mordanted.

Depending on the % absorption, best mordanting method was selected.

RESULTS AND DISCUSSION

Optimization of Medium of Extraction

Kokam dye was extracted in three mediums i.e., alkaline, acidic and aqueous. Best result was found for alkaline medium of extraction which was used for further study.

Table 1 Optimization of medium of dye extraction

Medium of Extraction	K/S Values
Alkaline	1.0937*
Aqueous	1.0523
Acidic	1.0868

Optimization of Alkali Concentrations

Table 2. Optimization of Alkali

Alkaline Conc. (g/100ml)	OD Before dyeing	OD After dyeing	% Absorption
0.5 gms	1.642	0.752	54.2*
0.25 gms	0.461	0.225	51.1
0.75 gms	1.384	0.735	46.89
1 gms	0.951	0.728	23.44
1.5 gms	1.738	1.326	23.7
1.25 gms	0.866	0.669	22.79
2 gms	0.915	0.817	10.71
2.5 gms	1.073	0.990	7.73

It is clearly indicated from above Table- 2 that more dye absorption was observed with less concentration of sodium carbonate up to 0.5 gm. A further increase in alkalinity resulted in decrease in the absorption of the extract.

Optimization of Dye Concentrations

The highest absorption was found for 15 grams dye concentration per 100 ml. It seems that an increased in dye concentration resulted increased in the absorption. But after that in the concentration of 17.5 g/100 ml there is no increase in dye absorption. Therefore conc. 15 g/100ml was selected as best conc.

Table- 3 Optimization of dye concentrations

Dye Concentrations (gms/100ml)	OD Before dyeing	Od After dyeing	% Absorption
5 grams	1.618	1.052	34.98
7.5 grams	1.785	1.497	16.13
10 grams	2.585	2.102	18.68
12.5 grams	1.999	1.286	35.66
15 grams	1.486	0.948	36.2*
17.5 grams	1.400	0.932	36

Optimization of Dye Extraction Time

The dyeing time and its influence on the obtained absorbance were found in order to achieve maximum colour strength. The silk fabric was dyed with kokum rinds extracted at boiling for different durations i.e. (15 min, 30 min, 45 min, 60 min, 75 min).

Table -4 Optimization of dye extraction time

Dye Extraction Time(minute)	OD Before dyeing	OD After dyeing	% Absorption
15 min	2.590	2.415	6.75
30 min	2.219	2.042	7.97
45 min	2.114	2.109	23.65
60 min	2.257	2.006	11.12
75 min	2.575	1.862	27.68*

Results from Table 4 exhibited that absorbance value was found to be maximum when dye was extracted using Kokum rinds at 75 minutes (27.68 %) Optimization of Dyeing Time

Table- 5 Optimization of dyeing time

Dyeing Time (minute)	Before dyeing	After dyeing	% Absorption
15 min	10.18	2.120	1.904
30 min	1.998	1.750	12.41
45 min	2.174	2.130	2.02
60 min	2.172	1.895	12.75
75 min	2.129	2.124	23.48*

The Optical density was increased when the fabrics were dyed for longer time. This is due to the fact that absorption of the dye molecules might happen because of dyeing for longer time. As shown in Table 5 the maximum dye replenishment was obtained with increase in time i.e. 75 min. But in Shortened dyeing time, balance in color was attained at 45 and 60 min. Hence, the best dyeing time has been selected as 75 minutes, since the dye uptake was better and stability of the dye was maintained. This indicated that the silk fabric absorbed for dye when it was dyed for longer time.

Optimization of Mordant Concentrations

Optimization of Myrobalan Concentrations

The results are shown in figure 8. The myrobalan mordant concentration which gave maximum absorbance value was 7.5 grams which was selected as optimum.

Table- 6 Optimization of Myrobalan conc.

Mordant Conc. /100ml Myrobalan)	OD Before Dyeing	OD After Dyeing	% Absorption
5 gms	2.633	2.591	1.591
7.5 gml	3.344	2.479	25.86*
10 gms	2.474	2.320	6.22
12.5 gms	3.016	2.681	11.1
15 gms	3.326	2.862	13.95

Optimization of Mordant Concentrations- Gooseberry

Table- 7 Optimization of mordant concentration – Gooseberry

Mordant Conc. / 100 ml (Gooseberry)	OD Before Dyeing	OD After Dyeing	% Absorption
5 grams	3.098	3.033	2.09
7.5 grams	3.428	3.325	3
10 grams	3.106	2.964	4.57*
12.5 grams	3..382	3.322	0.11
15 grams	3.385	3.351	1

The results are shown in figure 9. The gooseberry concentration which gave maximum mordant uptake was 10 grams which was selected as optimum.

Optimization of Mordant Extraction Time

Table- 8 Optimization of mordant extraction time – Myrobalan

Mordant Extraction Time for Myrobalan (minute)	Before dyeing	After dyeing	% Absorption
15 min	2.684	2.604	2.98
30 min	2.721	2.246	17.4
45 min	2.614	1.904	27.16*
60 min	1.895	1.750	7.65
75 min	2.998	2.970	0.93

Table- 9 Optimization of mordant extraction time – Gooseberry

Mordant Extraction Time for Gooseberry (minute)	Before dyeing	After dyeing	% Absorption
15 min	2.544	2.315	9.00
30 min	2.010	2.004	0.29
45 min	2.852	2.655	6.90
60 min	2.602	2.06	20.83*
75 min	2.205	2.108	4.39

It is clearly indicated from Table 9, 10 that best mordant extraction time was 45 minutes for myrobalan and 60 minutes for Gooseberry.

Optimization of Mordanting Methods

It has been shown in Table10, 11 that highest value of dye absorption was obtained in simultaneous mordanting method in case of myrobalan than the pre and post mordanting methods.

Whereas in case of Gooseberry post mordanting was selected as best method of mordanting as compared to pre and simultaneous mordanting.

Table- 10 Optimization of mordanting method- Myrobalan

Mordanting Method (Myrobalan)	Before dyeing	After dyeing	% Absorption
Pre-Mordanting	1.826	1.497	18.01
Simultaneous	3.020	2.107	30.23*
Post-Mordanting	1.825	2.356	27.09

Table 11. Optimization of mordanting method- Gooseberry

Mordanting Method (Gooseberry)	Before dyeing	After dyeing	% Absorption
Pre-Mordanting	2.014	1.920	4.66
Simultaneous	2.516	1.974	21.54
Post-Mordanting	1.974	1.456	26.24*

Standardized recipe for dyeing of silk fabric with kokum dye

Medium of dye extraction: Alkali
Amount of Alkali (sodium carbonate): 0.5 g/100 ml
Dye concentration: 15g/100 ml
Dye extraction time: 75 mints
Dyeing Time: 75 mint

Mordant Myrobalan / Gooseberry

Myrobalan

Mordant extraction time: 45 mints
Mordanting method: simultaneous

Gooseberry

Mordant extraction time: 60 mints
Mordanting method: post

It has been concluded that kokum rind can be used for successfully for dyeing of silk fabric using myrobalan and gooseberry as mordents.

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