DYEING OF COIR USING CAESALPINIA SAPPAN

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Introduction

A dye can generally be described as a colored substance that has an affinity to the substrate to which it is being applied. Dyes appear to be colored because they absorb some wavelengths of light preferentially. The dye is generally applied in an aqueous solution, and may require a mordant to improve the fastness of the dye on the fiber.Some dyes can be precipitated with an inert salt to produce a lake pigment, and based on the salt used they could be aluminum lake, calcium lake or barium lake pigments.There are two main classification of dyes- Synthetic and Natural dyes.

Human made organic dyes are called synthetic dyes. Many thousands of synthetic dyes have since been prepared.Some of the synthetic dyes are Acid dyes, Basic dyes,Vat dyes, Direct or Substantive dyes,Reactive dyes etc.

Natural Dyes are those obtained from natural sources (both plant and animal). Natural plant dyes are obtained from the leaves, bark, stem, root, seeds, fruits, etc of the plant either in dried form or in raw form. The demand for natural dyes is increasing day by day due to the following merits it has when compared to the synthetic dyes:

a) Less toxic effect on humans and environment when compared to the synthetic dyes.

b) Many natural dyes have pharmacological effects and possible health benefits.

c) They are obtained from renewable sources.

d) Natural dyes cause no disposal problems, as they are biodegradable.

e) Practically no or mild reactions are involved in their preparation.

f) They are unsophisticated and harmonized with nature.

g) Many natural dyes have the advantage they do not stain the adjacent fabrics in the washing process because of the non-substantive nature of the dye towards the fabric.

h) It is possible to obtain a full range of colours using various mordants.

Currently, there are no true environmentally friendly synthetic dyes available, and natural dyes, used considerately, are the only true green option to replace the negative effects of synthetic dyes. Natural dyes being biodegradable and renewable are a good substitute for synthetic dyes as they are in harmony with nature.

In India there are more than 450 varieties of plants that can yield natural dyes. In addition to their dye yielding characteristics most of them possess medicinal values too. Owing to the increasing demand for natural dyes, the need for extraction of natural dyes from locally available plants which are economical are to be thought of.

Keralam(Kerala) may stem from an imperfect Malayalam portmanteau fusing **kera** ("coconut tree") and **alam** ("land" or "location") .About one million people are employed in traditional industries manufacturing such items as coir on handlooms, and handicrafts in Kerala.Coir and coir products of Kerala are of great demand in and around the world.The world now looks forward for eco friendly products including naturally dyed coir and coir products.

Application of natural dyes on coir is of significant importance as coir being a natural fibre, the introduction of natural dyeing on coir paves way for production of 100% natural and eco friendly product. Being ligno cellulosic fibre, coir has natural affinity towards natural dyes. Application of natural dyes on coir in a large scale is safe, secure and ecofriendly. Many of the naturally obtained colours were found successful in dyeing on coir.

The Central Coir Research Institute, Kalavoor, the research centre of Coir Board recently initiated studies on application of natural vegetable dyes for developing shades on coir and used Pathimukham (Caesalpinia sappan), for developing different shades on coir. The work so far conducted in this respect is given below.

Caesalpinia sappan

Indian redwood, Sappan wood, Brazil wood, Pathimukham (Malayalam), Patamg (Hindi)

Kingdom : ***plantae***
Division : ***Magnoliophyta***
Class : ***Magnoliopsida***
Order : ***Fabales***
Family : ***Fabeaceae***
Genus : ***Caesalpinia***
Species: ***Sappan***

Caesalpinia sappan is a small to medium-sized, shrubby tree, 4-8 m tall; trunk up to 14 cm in diameter; bark with distinct ridges and many prickles, greyish brown; young twigs and buds hairy, brownish. Leaves stipulate, bipinnate, alternate, 20-45 cm long, 10-20 cm broad, with 8-16 pairs of up to 20 cm long pinnae; Flowers in terminal panicles, fragrant, Fruit a dehiscent pod, glabrous, thick, flattened. Seeds ellipsoid, flattened, 18-20 mm x 10-12 mm, brown. The generic name is after A. Caesalpini, 1519-1603, Italian physician.

Under natural conditions Caesalpinia sappan grows mostly in hilly areas with clayey soil and calcareous rocks at low and medium altitudes. It does not tolerate too wet soil conditions.


Medicinal properties: Antibacterial, Anticoagulant, Blood purifier

A decoction of the wood is a powerful emmenagogue and, because of its tannic and gallic acids, is an astringent used in mild cases of dysentery and diarrhea. It is also given internally for certain skin ailments. The dried heartwood is widely used in oriental medicine, particularly against inflammation. Seeds serve as a sedative

Materials and Methods

Dye extraction from Caesalpinia sappan

Part of plant used: Bark (in powdered form)


Bark **powdered bark**

The powdered bark is boiled with water at 90^{o}C for about 40-45 minute. To the extract (after filtration) the bleached coir sample with respective mordants were added with respect to the mordanting methods with an M: L ratio 1:40. Dyeing time was set to 1hour. The sample taken out and soaping was done for 10-15 minutes at 60^{o}C.

Three different dyeing methods viz.

a) Simultaneous Mordanting
b) Pre Mordanting and
c) Post Mordanting were used in dyeing Caesalpinia sappan using different mordants.

a) Dyeing of bleached coir with Caesalpinia sappan [Simultaneous Mordanting]

1. Colour name : MEPHISTO
   % of Dye used : 10%
   Wt of coir yarn used : 10gm
   Mordant used : Alum (4%)
   M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath containing the mordant and set the temperature to 80 °C -85 °C. Work the sample for about 55-60 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 °C for 10-15 minutes

2. Colour name : ROSE SOIREE
   % of Dye used : 10%
   Wt of coir yarn used : 10gm
   Mordant used : Oxalic acid (10%) & SnCl2 (3%)
   M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath containing the mordant and set the temperature to 80 ° C -85 ° C. Work the sample for about 55-60 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 °C for 10-15 minutes

3. Colour name : ROSE of SHARON
   % of Dye used : 10%
   Wt of coir yarn used : 10gm
   Mordant used : SnCl2 (3%)
   M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath containing the mordant and set the temperature to 80 ° C -85 ° C. Work the sample for about 55-60 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 °C for 10-15 minutes

4. Colour name : SUNDOWN YESENRITE
   % of Dye used : 10%
   Wt of coir yarn used : 10gm
   Mordant used : Nil
   M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath containing the mordant and set the temperature to 80 °C -85 °C. Work the sample for about 55-60 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 °C for 10-15 minutes

5. Colour name : ONION SKIN PINK
   % of Dye used : 10%
   Wt of coir yarn used : 10gm
   Mordant used : CaCO3 (5%)
   M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath containing the mordant and set the temperature to 80 ^{o} C -85 ^{o} C. Work the sample for about 55-60 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 ^{o} C for 10-15 minutes

6. Colour name : MELLOW GLOW
% of Dye used : 10%
Wt of coir yarn used : 10gm
Mordant used : Oxalic acid (10%)
M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath containing the mordant and set the temperature to 80 ^{o} C -85 ^{o} C. Work the sample for about 55-60 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 ^{o} C for 10-15 minutes

b) Dyeing of bleached coir with Caesalpinia sappan [Pre Mordanting]

7. Colour name : MINERAL R
% of Dye used : 10%
Wt of coir yarn used : 10gm
Mordant used : K2Cr2O7 (4%)
M: L ratio : 1:40

Pre treatment: The bleached coir yarn is treated with K2Cr2O7 (4%) at 80 ^{o} C at an M: L ratio 1:20 for about 20 minutes. Dry
Dyeing: Add the pretreated coir yarn to the dye bath and set the temperature to 80 ^{o} C -85 ^{o} C. Work the sample for about 45-50 minutes. Take out the sample.
Post treatment: Soaping is carried out at 60 ^{o} C for 10-15 minutes

c) Dyeing of bleached coir with Caesalpinia sappan [Post Mordanting]

8. Colour name : BOIS de ROSE
% of Dye used : 10%
Wt of coir yarn used : 10gm
Mordant used : CuSO4(3%)
M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath and set the temperature to 80 ^{o} C -85 ^{o} C. Work the sample for about 45-50 minutes. Take out the sample
Post mordanting**:** The dyed yarn is mordanted using CuSO4 (3%) at room temperature for about 20 minutes
Post treatment: Soaping is carried out at 60 ^{o} C for 10-15 minutes.

9. Colour name : LONDON SMOKE
% of Dye used : 10%
Wt of coir yarn used : 10gm
Mordant used : FeSO4 (2%)
M: L ratio : 1:40

Dyeing: Add the bleached coir yarn to the dye bath and set the temperature to 80^{o}C-85^{o}C. Work the sample for about 45-50 minutes. Take out the sample

Post mordanting**:** The dyed yarn is mordanted using FeSO4 (2%) at room temperature for about 20 minutes

Post treatment: Soaping is carried out at 60^{o}C for 10-15 minutes

The fastness to light of shades obtained after dyeing with Caesalpinia sappan using different mordants were measured using Xeno Test apparatus and Blue Wool Standards. The results are furnished below in Table 1

Table 1: Light Fastness Ratings of the colours obtained from Caesalpinia sappan

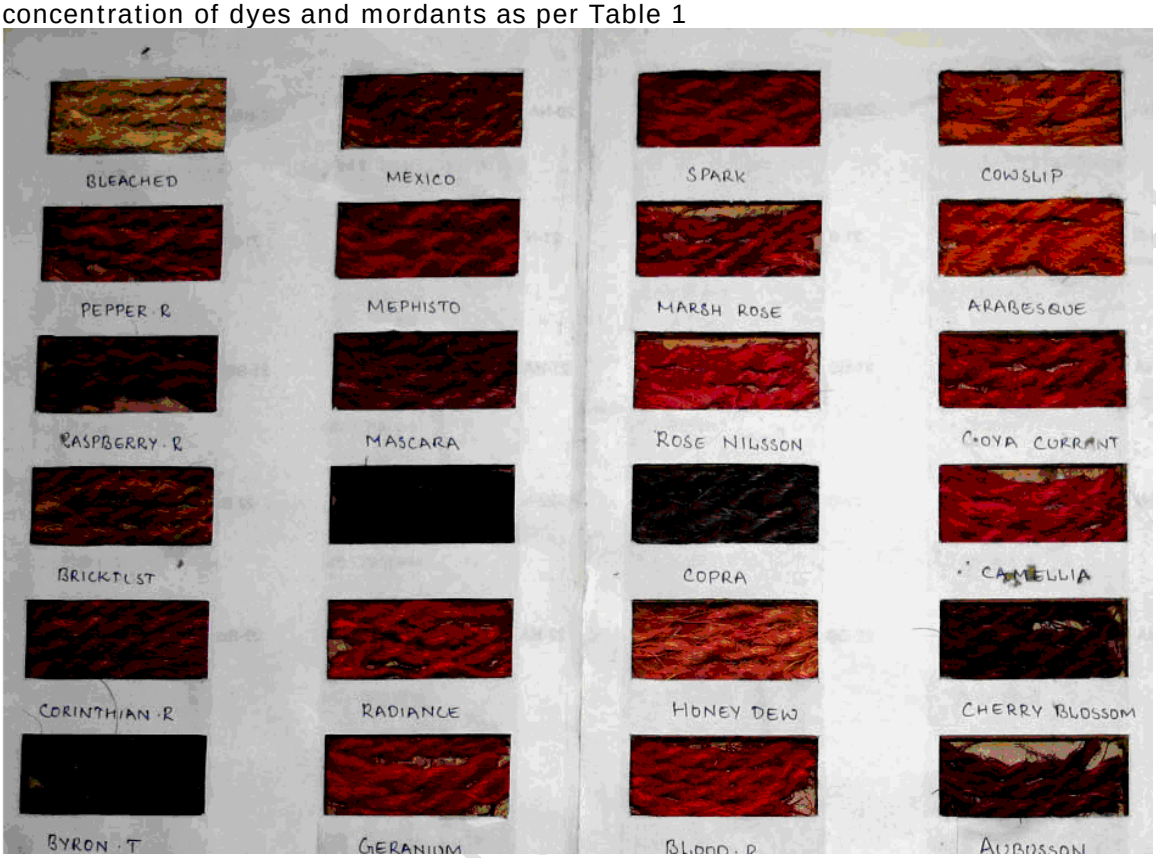
(Blue Wool Standards) using Xeno Test

Colour Name	Mordants Used	% Dye used	% Mordants Used	Fastness Rating
MEPHISTO	Alum	10%	4%	**3-4**
ROSE SOIREE	Oxalic acid SnCl2	10%	Oxalic:10%, SnCl2: 3%	**1-2**
MINERAL R	K2Cr2O7	10%	4%	**3-4**
BOIS de ROSE	CuSO4	10%	3%	**3-4**
LONDON SMOKE	FeSO4	10%	2%	**4**
ROSE of SHARON	SnCl2	10%	3%	**2-3**
SUNDOWN YESENRITE	----	10%	-----	**2-3**
ONION SKIN PINK	CaCO3	10%	5%	**1-2**
MELLOW GLOW	Oxalic acid	10%	10%	**1-2**

*Test Method: AATCC 16H-1998-Colour fastness to light, Air-cooled Xenon Arc lamp***.**

The following are the colours obtained from Caesalpinia sappan

The following shade card shows the colours obtained from Caesalpinia sappan using different concentration of dyes and mordants as per Table 1



Dyeing of Coir/Sisal blended yarn using Caesalpinia sappan

Coir/Sisal blend fine quality yarn was dyed for the purpose of making bags using Caesalpinia sappan. Two colours with good light fastness were selected and tub dyed.

1. **% of Dye used : 10%**
   Wt of yarn used : 3.5 kg
   Mordant used : K2Cr2O7 (3%)
   M: L ratio : 1:25

Pre treatment: The bleached coir/sisal yarn is treated with K2Cr2O7 (3%) at 80 ^{o}C for about 20 minutes.

Dyeing: Add the pretreated coir yarn to the dye bath and set the temperature to 80 ^{o}C -85 ^{o} C. Work the sample for about 1.30 hours. Take out the sample.

Post treatment: Thorough hot wash and cold wash

2. **% of Dye used : 15%**
   Wt of yarn used : 3.5 kg
   Mordant used : FeSO4 (2.5%)
   M: L ratio : 1:25

Dyeing: Add the bleached coir/sisal yarn to the dye bath and set the temperature to 80 ^{o}C - 85 ^{o}C. Work the sample for about 45-50 minutes. Take out the sample

Post mordanting**:** The dyed yarn is mordanted using FeSO4 (2.5%) at room temperature for about 20 minutes
Post treatment: Thorough hot wash and cold wash

The above dyed yarn was used as weft for weaving mattings using cotton as warp and also as warp for weaving fabric for bags.


Fabrics made out of C.sappan dyed coir / sisal

Conclusion

A variety of colours were obtained from a single dye using different mordants on the same substrate (coir). A range of red, yellow, brown, purple etc were obtained from Caesalpinia sappan using different mordants at different concentrations hence paving way for a new development where a single natural dye can substitute a number of synthetic dyes in a comparatively economical and eco friendly manner.