

# **Handbook on Natural Dyes for Industrial Applications (Extraction of Dyestuff from Flowers, Leaves, Vegetables) 2nd Revised Edition**

**Author:-** Dr. Padma S Vankar

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Dyeing is the process of imparting colors to a textile material. Natural dyes are friendly and satisfying to use. They are obtained from sources like flowers, leaves, insects, bark roots etc. however, they are not readily available and involve an extraction process. With the advancement of chemical industry, all finishing procedures of textile materials have been growing constantly and, sustainable and ecological production techniques have become extremely crucial.

This is a single book which has information related to extraction of dyestuff from 19 common flowers, weeds, bark or leaves and its application on cotton silk and wool fabrics for textile industry.

The Handbook describes the step wise methodology of extraction, mordanting, dyeing with photos of the actual plants part used for extraction of Natural dye. Shade cards have been incorporated so that the full gamut of colors can be visualized from each dyestuff.

Major contents of the book are nature of material to be dyed, history of natural dyes, promotion of natural dyes, sources of natural dyes, mordanting the textiles for natural dyeing, quality standards for vegetable dyes, methods of dye extraction, dyeing methodology, chemistry of dye, some recent publications on natural dyes. This handbook is designed for use by everyone engaged in the natural dye manufacturing and explains different methods of dye extraction. Also contains addresses of machinery suppliers with their photographs.

It will be a standard reference book for professionals, entrepreneurs, those studying and researching in this important area.

## About Author

The Author Dr. Padma S Vankar, works as Principal Research Scientist, in Facility for Ecological and Analytical Testing (FEAT) at Indian Institute of Technology, Kanpur. She has been engaged in the screening and characterization of newer natural dyes for the past 10 years. She also works in the area of designing synthetic strategies for Eco-friendly dyes using microwave heating system. Using innovative technology for natural dyeing has been her main emphasis. The author has conducted several workshops throughout India in order to popularize

natural dyeing.

## PART I

### 1. HISTORY OF NATURAL DYES

Promotion of Natural Dyes

Sources of Natural Dyes

Constitutional Aspects

Requisites of a True Dye

Types of Dye

Chemical Entities Responsible for Colors

Classification Based on Chemical Nature

Classification Based on Colors

Classification Based on Colors

### 2. BASICS OF NATURAL DYEING

Advantages of Natural Colors/Vegetable Dyes

Natural Dyeing Principles

1. Nature of Material to be Dyed

2. Measurements of Mordants and Dyestuffs

3. Temperature

4. Agitation

5. Natural Dyes are Unpredictable

6. Wet Fibers Look Darker

7. Rinsing

8. Using Natural Dyes

Mordanting

Mordants

Mordanting of Cotton

Preparation of Fabric for Dyeing

Modifier

pH

Safety Measures Required in Natural Dyeing

Disposal of Mordants and Dyes

Vat Dye

Overdyeing

### 3. MORDANTING THE TEXTILES FOR NATURAL DYEING

Treatment of Fabric Before Dyeing

Methods of Mordanting

Common Mordants used in Natural Dyeing

### 4. STANDARDIZATION OF VEGETABLE DYES

Quality Standards for Vegetable Dyes

### 5. METHODS OF DYE EXTRACTION

Methodology

Subcritical Water Extraction

## PART II

Al

Alkanet

Balsam  
Bougainvillea  
Canna  
Carthamus  
Cassia Fistula  
Cineraria  
Cosmos  
Eucalyptus Bark  
Osbeckia Chinensis  
Parkia Javanica  
Pomegranate  
Sappan Wood  
Tectona Grandis  
Terminalia Arjuna  
Tulsi

## 6. DYEING METHODOLOGY

Materials

Selection of Plant Sources for Dye Extraction

Extraction of Colorants

Aqueous Extraction

Solvent Extraction

Equipment used for Dyeing and Analysis of Dyed Fabric and their Principle

Sonicator

Ultraviolet and Visible Spectrophotometer

Fourier Transform Infra Red Spectroscopy

Gas Chromatograph Mass Spectrometer

Inductively Coupled Plasma Optical Emission Spectrometer

Gas Chromatograph

Xenoster

Wash Wheel

Perspirometer

Crock Meter

Material to be Dyed

Specification of the Fabric

Physical Characteristic of Cotton

Chemical Composition of Cotton Fiber

Chemicals and Reagents Used

Methodology

Preparation of Cloth For Dyeing

Desizing

Scouring

Bleaching

Treatment of Fabric Before Dyeing

Pre Mordanting

Post Mordanting

Dyeing

Assessments Of Eco Friendliness

Assessment Of Antimicrobial Properties

## 7. CHEMISTRY OF DYE

Basic Concept of Dyes Color

Relation Between Color and Constitution

## Characterization of Natural Dyes

### Solubility Studies

1. Thin Layer & Column Chromatographic Studies
2. Ultra Violet-visible Spectrophotometric Studies
3. Fourier Transform " Infra-red Studies
4. High Performance Liquid Chromatographic Studies
5. Gas Chromatography"Mass Spectrophotometric Studies

### Mordants used in Dyeing

#### Mordant

#### Tannins and Tannic Acid

#### Metal Salts or Metallic Mordants

#### Oil Mordants

#### Techniques used for Dyeing

#### Mechanism of Dyeing

#### Fastness Properties

#### Fastness Properties of Dyed Materials

#### Evaluation of Eco-friendliness

#### Companies Selling through Natural Dyes through Internet

#### Estimates of Dye Requirements

#### Some Important Natural Dyes

#### Blue Dyes

#### Red Dyes

#### Yellow Dyes

## 8. SOME RECENT PUBLICATIONS ON NATURAL DYES BY THE AUTHOR

### 1. Dyeing Cotton, Silk and Wool with Brassica Oleracea or Purple Cabbage

#### Introduction

#### Vegetable Chosen

#### Studies on Cotton, Silk and Wool

#### Chemicals Used

#### Nature of the Colorant

#### Extraction of Colorant

#### Optimization of Extraction Condition

#### Extraction Amount and Time Required

#### Extraction Temperature

#### pH of Extraction Medium

#### Mass to Liquor Ratio

#### Determination of pKa

#### Chemical Characterization of the Colorants

#### Treatment of Fabric before Dyeing

#### Dyeing

#### Color Measurements

#### Results and Discussion

#### References

### 2. Dyeing Wool Yarn with Hibiscus Rosa Sinensis (Gurhhal)

#### Abstract

#### Introduction

#### Materials and Methods

#### Materials

#### Flower Color Chosen

#### Studies on Wool

#### Chemicals Used

#### Methods

Extraction of Colorant  
Scouring of Wool  
Mordanting  
Dyeing  
Measurement of Color Strength  
Chemical Composition of the Colorant  
Results and Discussion  
Optimization of Mordants with K/S and Color Hue Changes  
Fastness Properties  
Conclusion  
References  
3. Sonicator Dyeing Cotton and Silk with Ixora Coccinea Flower

Abstract  
Keywords  
Introduction  
Materials and Methods  
Materials  
Flower Color Chosen  
Substrates  
Chemicals  
Methods  
Extraction of Colorant  
Preparation and Optimization of Aqueous Extract of Ixora  
Chemical Composition of the Colorant  
Scouring of Cotton and Silk  
Mordanting  
Dyeing  
Measurement of Color Strength  
Optimization of Mordants with K/S and Color Hue Changes  
Results and Discussion  
Fastness Properties  
Conclusion  
References  
4. Dyeing with Celosia Cristata Flower on Modified Pretreated Wool

Introduction  
Flower Colour Chosen  
Studies on Wool  
Chemicals Used  
Extraction of Colourant  
Pretreatment  
Mordanting  
Dyeing  
Chemical Composition of the Colorant  
Results and Discussions  
References

5. Dyeing Silk and Wool with Plumeria(Pink) Flower  
Abstract  
Keywords  
Introduction  
Materials and Methods  
Materials  
Flower color chosen  
Substrates

Chemicals

Methods

Extraction of colorant

Preparation and Optimization of Aqueous Extract of Pink Plumeria

Chemical Composition of the Colorant

Scouring of Cotton, Silk and Wool

Mordanting

Dyeing

Sonicator Dyeing

Measurement of Color Strength

Optimization of Mordants with K/S and Color Hue Changes

Results and Discussion

Fastness Properties

Conclusion

References

6. Dyeing Cotton, Silk and Wool with Cayratia Carnosa Gagn. or Vitis Trifolia

Introduction

Fruits Chosen

Studies on Cotton, Silk and Wool

Chemicals Used

Extraction of Colorant

Pretreatment

Mordanting

Dyeing

Chemical Composition of the Colorant

Measurement of Color Strength

Fastness Properties of Dyed Fabrics

Results and Discussions

References

7. Dyeing with Nerium Oleander Flower on Pretreated Wool

Introduction

Materials and Methods

Materials

Flower Color Chosen

Studies on Wool

Chemicals Used

Methods

Extraction of Colorant

Scouring of Wool

Mordanting

Dyeing

Measurement of Color Strength

Chemical Composition of the Colorant

Results and Discussion

Fastness Properties

Conclusion

References

8. Dyeing Terricot and Cotton Fabric with Lac Dye in Sonicator

Abstract

Introduction

Extraction

Dyeing Properties of Lac Dye

Results and Discussion

## References

### 9. Commercial Viability of Dyeing Cotton with Aqueous Extract of Lawsonia (Heena) Using Ecofriendly Mordants

Introduction

Materials and Methods

Fastness Testing

Dyeing Cost

Results and Discussion

For Eco-friendliness

Pesticides

Characterisation of Eco-Friendliness

Conclusion

References

### 10. Photographs of Machinery with Supplier's Contact details

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**NIIR PROJECT CONSULTANCY SERVICES**, 106-E, Kamla Nagar, New Delhi-110007, India.

**Email:** [npcs.india@gmail.com](mailto:npcs.india@gmail.com) **Website:** [NIIR.org](http://NIIR.org)

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