

**STUDY OF NATURAL DYES: EXTRACTION,
FUNCTIONAL PROPERTIES AND THEIR
APPLICATIONS**



BY

H.A.D. SEWMI NIMASHA



FTC 73

Project Report
Library - EUSL

DEPARTMENT OF BIO SYSTEM TECHNOLOGY

FACULTY OF TECHNOLOGY

EASTERN UNIVERSITY, SRI LANKA

2021

ABSTRACT

Textile industries provide economic boost to many countries in the world. However, it pollutes environment due to the usage of synthetic dyes in textile industries. Synthetic colors are made from petroleum, leaving human health and aquatic biodiversity at risk. Certain synthetic dyes are poisonous and carcinogenic by nature and therefore it should be replaced with more environmentally friendly colors.

Natural dye extraction process is so complex, it is critical to assess the solubility of the natural dyes before beginning. Most of the researchers have reported that there have seven extraction methods. Those are aqueous extraction, solvent extraction enzymatic extraction, fermentation extraction, extraction with microwave & ultrasonic energy, supercritical fluid extraction, alkaline or acid extraction. Each extraction procedures have their own set of benefits and drawbacks are discussed in this review. "Mordant" used to set the dye on fabrics. It enhances the color and help to improve the fastness of the dye. Even for the same natural dye, different types of mordants produce distinct colors. As a result, the final color, brightness & color fastness qualities are controlled not only by the dye itself but also by the mordants concentration expert management. Natural dyes are especially well suited and pleasant for the manufacture of high value green products, as well as for the environment as a whole. The majority of researchers have stated that the majority of natural colors have therapeutic value, that some can fight illness and inflammation, that others can improve blood circulation, and can protect the human body from UV radiation without harming.

Thus, revival of natural dye application on textiles and summary of earlier researches on standardization of its method of extraction, mordanting, dyeing process variables, functional properties and even natural finishing, etc. have been elaborated organized manner in this review.

TABLE OF CONTENT

| Content | Page No. |
|--|-----------------|
| ABSTRACT | i |
| ACKNOWLEDGEMENT | ii |
| TABLE OF CONTENT | iii |
| LIST OF TABLES | v |
| LIST OF FIGURES | vi |
| ABBREVIATION | vii |
| CHAPTER 01 | 1 |
| INTRODUCTION | 1 |
| 1.1 Background | 1 |
| 1.2 Objectives | 4 |
| 1.3 Methodology | 4 |
| CHAPTER 02 | 5 |
| LITERATURE REVIEW | 5 |
| 2.1 Textile dyeing | 5 |
| 2.2 Different types of dyes | 6 |
| 2.2.1 Natural dye | 6 |
| 2.2.2 Synthetic dye | 13 |
| 2.3 History of natural dye | 16 |
| 2.4 Characteristics of natural dye | 17 |
| 2.5 Extraction and separation of natural dyes | 18 |
| 2.5.1 Solvent extraction | 19 |
| 2.5.2 Aqueous extraction | 19 |
| 2.5.3 Enzymatic extraction | 20 |
| 2.5.4 Fermentation | 21 |
| 2.5.5 Extraction with microwave or ultrasonic energy | 22 |
| 2.5.6 Supercritical fluid extraction | 23 |
| 2.5.7 Alkaline or acid extraction | 23 |
| 2.6 Mordant and different types of mordants | 24 |
| 2.6.1 Metallic mordants | 26 |
| 2.6.2 Oil type mordant | 28 |

| | |
|--|-----------|
| 2.6.3 Tannin & tannic acid | 28 |
| 2.7 Mordanting methods | 29 |
| 2.8 Characterization and chemical/biochemical analysis of natural dyes | 29 |
| 2.8.1 Macro & microchemical analysis | 30 |
| 2.8.2 UV visible spectroscopic study | 30 |
| 2.8.3 Chromatographic analysis | 31 |
| 2.8.4 Test of toxicity | 31 |
| 2.9 Application of natural dyes on textiles | 32 |
| 2.9.1 Health Safety of Lingerie Product | 32 |
| 2.9.2 Health Safety of Home Textiles | 32 |
| 2.9.3 High-Grade Silk & Wool Fabric | 33 |
| 2.9.4 Modern Textiles | 33 |
| 2.9.5 Different Coloration of Clothing Products | 34 |
| 2.10 Fastness properties of naturally dyed textiles | 36 |
| 2.10.1 Color Fastness | 36 |
| 2.10.2 Light Fastness | 39 |
| 2.10.3 Wash Fastness | 41 |
| 2.10.4 Rub Fastness | 43 |
| 2.11 Functional properties of naturally dyed textiles | 44 |
| 2.11.1 Antimicrobial/antibacterial property | 44 |
| 2.11.2 UV protection | 48 |
| 2.11.3 Deodorizing | 50 |
| 2.10.4 Moth proof and insect repellent | 51 |
| 2.10.5 Mosquito repellent | 52 |
| CHAPTER 3 | 53 |
| CONCLUSIONS | 53 |
| SUGGESTIONS | 54 |
| REFERENCES | 55 |

LIST OF TABLES

| | |
|---|----|
| TABLE 2:1: NATURAL DYES FROM DIFFERENT PARTS OF PLANTS/TREES..... | 9 |
| TABLE:2.2: SOURCES OF DIFFERENT COLORED DYES AND MORDANTS..... | 26 |
| TABLE: 2.3: IMPORTANT DYE YIELDING PLANTS WITH PIGMENTS..... | 34 |
| TABLE: 2.4: COLOR FASTNESS PROPERTIES OF NATURAL DYES | 37 |
| TABLE: 2.5: LIGHT FASTNESS PROPERTIES OF NATURAL DYES..... | 40 |
| TABLE: 2.6: WASH FASTNESS PROPERTIES OF NATURAL DYES..... | 42 |
| TABLE :2.7: RUB FASTNESS PROPERTIES OF NATURAL DYES..... | 43 |
| TABLE:2.8: NATURAL DYES WITH A RESPONSIBLE COMPONENT FOR ANTIMICROBIAL PROPERTIES..... | 46 |
| TABLE:2.9: NATURAL DYES WITH RESPONSIBLE COMPONENT FOR UV PROTECTION PROPERTIES..... | 50 |
| TABLE: 2.10: DYEING PRINCIPLE AND FUNCTION OF DYES | 52 |

LIST OF FIGURES

| | |
|---|----|
| FIG:2.1 NATURAL COLORANTS CLASSIFICATION | 7 |
| FIG:2.2: LAC DYE | 9 |
| FIG:2.3: CRIMSON ANIMAL DYE | 10 |
| FIG:2.4: KERMES SCALE INSECTS | 10 |
| FIG:2.5: TYRIAN PURPLE..... | 11 |
| FIG:2.6: MINERAL ORIGIN COLORANTS | 11 |
| FIG:2.7: EXTRACTION OF INDIGO DYE FROM <i>COUROUPITA GUIANENSIS</i> AND | 21 |
| FIG:2.8: LAYOUT OF EXTRACTION OF HENNA DYE | 22 |
| FIG:2.9: POSSIBLE STRUCTURES OF PELARGONIDIN WITH FeSO_4 ON SILK | 24 |