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Original Article

Extraction of Natural Dyes from the locally available plant sources

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Abstract

Natural dyes have been a component of human existence throughout the beginning of time. Natural dyes offer a sustainable way to color the fabric, fiber and yarns. Natural dyes are more environmentally friendly and have superior biodegradability. Synthetic dyes have a greater range of colour options, are more useful, simpler to use, and are more cost-effective. Yet, there are drawbacks to synthetic dyes as well, one of which is the waste produced during the staining procedure. In this experimental study, the process of extraction from leaves of different locally available plants have been done, application of the extracted dyes onto cotton fabric and silk fabric has been experimented and then fastness tests were performed. It is found that the exposure of the dyed fabrics to the sunlight for specified period of time has not changed the color. The search for natural dyes from plants can be continued and methods for extraction of dyes from these sources can be researched in future.

Keywords*: natural dyes, mordant, , sunlight fastness, cotton fabric, silk fabric*

Extraction of Natural Dyes from the locally available plant sources

Introduction

Natural dyes have been a component of human existence throughout the beginning of time. One of the effects of growing environmental awareness is the use of natural dyes to colour textiles and other materials. In general, natural dyes are more environmentally friendly and have superior biodegradability. They are also less harmful and prone to allergy reactions than synthetic colours. Demand for textiles rises as people's appetites for colour grow. Synthetic dyes are mostly used in the colouring process for the textile industry. Synthetic dyes have a greater range of colour options, are more useful, simpler to use, and are more cost-effective. Yet, there are drawbacks to synthetic dyes as well, one of which is the waste produced during the staining procedure. Because the waste from synthetic dyes may contain chemicals or even heavy metals, it is bad for aquatic habitats.

Many rivers flowing in vicinity of the textile processing units have excessive levels of ammonia, according to laboratory test samples. It may result in water hardness, which has detrimental effects on health. As a result, there is a need for alternative methods to lessen the impact of textile industry waste, and switching to natural dye seems to be one of the best options. Natural colorants have captured everyone's attention in today's world of increased environmental consciousness. Natural dyes used in food are tested for safety, however the majority of natural dyes used in craft dyeing and with potential for wider application lack this information. Consumable natural items are frequently thought to be safer and superior to synthetic products because they are natural. If natural dyes are to be utilised more widely and in industrial processes, their safety must be established. Turmeric (Curcuma longa), a yellow dye, was derived from the ground root of Indian saffron plants, while indigo, a blue dye, was extracted from the leaves of a leguminous plant. The only yellow dye that could be applied to cotton or silk without the use of a mordant was turmeric. . However, turmeric is susceptible to light, soap, and alkali, which significantly lowers its value. The main ingredient in the colouring of black and blue is logwood. It was used with different mordents on cotton, silk, and wood for a variety of colours, but its fastness to light was usually quite poor. The Egyptian mummies discovered in tombs with henna-dyed nails are proof that henna (Lawsonia inermis) leaves are an old dye. It is currently used in many nations to colour fingernails, eyebrows, and hair.

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Henna is used as an auspicious ritual in the majority of Indian states to dye the palms and fingernails during religious holidays, weddings, and other occasions. Henna flour is mixed with water to form a paste, which is then applied to the surface to be coloured. It is applied as a pack when dying hair, and it gives hair an orange red colour by acting as a substantive pigment for keratin. It does not induce skin irrigation and is safe.

In our nation, this plant is used in Ayurvedic medicine, farming, and for colouring human body parts' hair. To dye silk and wool textiles, natural dyes made from turmeric, kapila, and onion coat are used. The natural yellow pigments produced by these three plants.

Here, we discuss the process of extracting natural dyes from following plant leaves and extraction of natural dyes from them. Application of the extracted dyes was done onto cotton fabric and silk fabric and then fastness tests were performed.

1. Plumeria alba leaves (Chafa)
2. Lawsonia inermis (locally known as Mehandi)
3. Mangifera indica (Mango)
4. *Musa acuminata (Banana)*
5. *Alstonia scholaris (Badam)*
6. *Morus alba (Mullberry)*
7. *Murraya koenigii (Curry leaves)*

Materials and Methods:

Collection of plant materials (leaves)

The selected plant materials i.e. leaves of Plumeria alba, Lawsonia inermis, Mangifera indica, *Musa acuminate, Alstonia scholaris, Morus alba, Murraya koenigii were obtained from SRMP College campus in Akluj, Dist. Solapur and in the vicinity of the college. The leaves were then washed to remove the dirt from them, chopped into small pieces for effective extraction process.*

Collection of cotton and silk fabrics

Cotton fabric (100% cotton) was collected from a local shop at Akluj and Mulberry silk (100% silk) fibre was collected from Silk emporium, Pune.

Scouring of Cotton fabric and Degumming of silk fabric

For this purpose, 10% (owf) Ritha powder was used. The fabrics (cotton 10% on weight and silk 10% on weight) were treated in a mixture containing ritha powder in water for 30 min. Both the fabrics were processed for removing the unwanted materials from them.

Preparation of dye extract

Aqueous extraction method was applied in this study to extract the natural dyes from the leaves of selected plants. Material to liquor ration was kept 1:40. The chopped leaves of plants were boiled in water bath for 100^0C for 60 min. Continuous stirring was done during the process.

Filtration

The extracted dye material was then filtered with the help of cloth straining and unwanted residue was thrown off. Filtrate was cooled to room temperature.

Preparation of mordent

Alum was used as sole mordent in this process. Alum (10% owf) was dissolved in water and heated to 100^0C and both the fabrics were treated with this solution for 45 min.

Actual dyeing of the fabrics

Dyeing of mordented cotton and silk fabrics was done in separate dye baths by exhaust dyeing method simultaneously. Dyeing was carried out at 100^0C with continuous stirring for 60 min. Dye baths were cooled to room temperature and allowed to stand for 15 min.

Washing and rinsing

The dyed fabrics were then washed thoroughly under running tap water and rinsed again with water to remove excess dye from the fabrics.

Fastness Tests

The treated fabrics were then tested for sunlight and soap washing fastness. Intermittent observations were done.

Results and discussions

After extraction, the dye was applied to the cotton and silk fabrics. Washing and rinsing removed the excess dye from the fabrics. The sunlight fastness tets were done for both the fabrics for each extracted dye.

Following results were obtained.

Table No. 1 For the leaves extract of Plumeria alba leaves (Chafa)

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Pale Green	Shade of green
2	Pale Green	Shade of green
4	Pale Green	Shade of green
6	Pale Green	Shade of green
8	Pale Green	Shade of green

Table No. 2 For the leaves extract of Lawsonia inermis (locally known as Mehandi)

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Brown	Brown
2	Brown	Brown
4	Brown	Brown
6	Brown	Brown
8	Brown	Brown

Table No. 3 For the leaves extract of Mangifera indica (Mango)

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Brown	Brown
2	Brown	Brown
4	Brown	Brown
6	Brown	Brown
8	Brown	Brown

Table No. 4 For the leaves extract of *Musa acuminate (Banana)*

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Light Brown	Brown
2	Light Brown	Brown
4	Light Brown	Brown
6	Light Brown	Brown
8	Light Brown	Brown

Table No. 5 For the leaves extract of *Alstonia scholaris (Badam)*

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Light Brown	Brown
2	Light Brown	Brown
4	Light Brown	Brown
6	Light Brown	Brown
8	Light Brown	Brown

Table No. 6 For the leaves extract of *Morus alba (Mullberry)*

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Light Brown	Brown
2	Light Brown	Brown
4	Light Brown	Brown
6	Light Brown	Brown
8	Light Brown	Brown

Table No. 7 For the leaves extract of *Murraya koenigii (Curry leaves)*

Time of exposure to sunlight (in hours)	Colours observed	
	Cotton fabric (100%)	Silk fabric (100%)
0	Green	Dark green
2	Green	Dark green
4	Green	Dark green
6	Green	Dark green
8	Green	Dark green

It is clear from the observations mentioned in above tables that as the time of exposure of dyed fabric to the sunlight in air is increased, there are changes in the colour of the fabrics. In some cases changes are not so prominent, but in other cases there are noticeable changes in the color. The exact time exposure for each dye material and fabric material can be detected as per the need of the colour it imparts to the fabric.

Future aspects

The study of extraction of natural dyes from various plant materials available in the area can yield an array of natural dyes which can replace the existing chemical dyes. The hazardous effects on environment due to the use of chemical dyes have proved detrimental in many ways. Green technology favours the use of such natural components which are available in volumes in nature. The novel, cheap and feasible technologies should be developed for the extraction of such dyes from plants and also the techniques of applications of these dyes to various fabrics should also be studied experimentally. It will surely provide us with a rich source of natural products in the textile industry. Optimization of each aspect of this experiment can also be done to get the desired results.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

1. **Chauhan et.al (2013)** carried out phytochemical analysis of fruit of Opuntia elatior Mill and confirmed the presence of betacyanin pigment.
2. **Ganesan et.al (2017)** applied natural dye extracted from red prickly pear (*Opuntia Ficus Indica*) for dyeing of silk fabric. Natural mordant (Myrobalan) and synthetic mordant (Copper Sulphate) were used. The colour fastness properties of the dyed fabric found to be improved in post mordanting with the use of synthetic mordant.
3. **Kundal et.al (2017)** discovered the new dye yielding plant *Ficus cunia* for dyeing Polyester, Cotton and Wool fabric. Wide range of colour shades can be obtained by different mordants. The washing, rubbing and light fastness properties can be good to excellent grade.
4. **Sarvanan et.al (2013)** extracted dye from *Odina wodier* using metal and natural mordants for dyeing of silk fabric. The dyed silk fabric exhibits good antibacterial as well as anti-fungal properties.
5. **Swamy et.al (2014)** extracted dried leaves of Madhulica longifolia for silk dyeing. Silk was mordanted with alum, tannic acid and tartaric acid. Mordanted samples showed improved fastness properties. Post mordanted samples showed good to very good rating to wash fastness.
6. **Sangeetha et.al (2015)** dyed silk fabric using Lemon leaves extract with different mordants. Yellow to maroon shades can be obtained by using natural mordants pomegranate rind, harda and babool Bark.