

# Ecofriendly Dyeing of Silk using *Ficus elastica* Roxb. Extract

Rajashri Ramkrishna Nimbhorkar

Assistant Professor, Shrimati Ratnaprabhadevi Mohite Patil College of Home Science for women, Akluj

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**Abstract-** Natural dyes are a class of colourants extracted from vegetative matter and animal residues. The natural dyes derived from plants material represent a more sustainable source of colourants. A vast array of natural colourants obtained from natural sources such as plants, insects and microbes have been scrutinized in recent past for their use in different kinds of applications. Plants are the major source of natural colorants and almost all their parts such as stem, leaves, fruit, seeds and peels are used for extracting natural colour. Therefore present investigation is an attempt to introduce new shades to the colour palette of natural dyes by exploring parts of locally and abundantly available plants. Present investigation was focused on dyeing of silk fabric with *Ficus elastica* Roxb extract. Metal mordants ferrous and tin were used. Pomegranate rind and harda were used as natural mordants. Good to excellent fastness properties were obtained with antimicrobial properties.

**Index Terms-** Silk, *Ficus elastica*, Pomegranate rind, Harda

## I. INTRODUCTION

With the present awareness on environment, a lot of interest is being generated in recent years to use eco-friendly dyes on fibers. Natural dyes are sought and used for their much intrinsic value.



It is considered that natural dyes yield luster, soft light colours which are soothing to human eyes and have aromatic smell (Sharma 2005). Local plants are one source of natural colourant which is grouped

under plant sources. They are easily available in the country and can be considered as zero cost dyes as they are planted for other purposes. Plants are the major sources of natural colourants and almost all their parts such as stem, leaves, fruits, seeds and pills are used for extracting natural colour and they have antimicrobial, antifungal, insect repellent, deodorant, disinfectant and other medicinal values. (Jihad 2014). *Ficus* contains a huge tropical, deciduous and evergreen tree with more than 800 species. All *ficus* species contains latex like material within their vasculatures affording protection and self healing from physical assaults (Lansky 2008). *Ficus elastica* is a large, evergreen tree belonging to Moraceae family. It has dense crown of dark green foliage, epiphytic in early stages upto 30 m tall, aerial roots numerous and leaves elliptic. The plant contains a flavonoid, which exhibits anti-inflammatory activity. (Pullaiah 2006). *Ficus elastica* Roxb. is also known as rubber tree, its leaves possesses antimicrobial activity (Kiem 2012). The plant contains a flavonoid, which exhibits anti-inflammatory activity (Gupta 2009).

## II. MATERIALS

### • Textile substrate:

Silk offers a wide colouration possibility covering almost the entire spectrum of colours and hues due to its ready acceptability for a large range of dyestuffs. Hence 100% mulberry silk fabric is used for the present study.

- Ritha powder was used 20% owf for degumming of silk.
- **Mordants:**

Alum was selected as a sole mordant for the present investigation. According to literature search, it was found that Tin and Ferrous can give good results in terms of colour shade. Therefore pomegranate rind and harda were used as natural mordants. Tin and ferrous were selected as metal mordants for the present study.

- Leaves of *Ficus elastica* Roxb. were collected from local area.

### Methods:

- ❖ Mordanting was done with Alum as a sole mordant in binary combination with tin and ferrous as metal mordants with different proportions and alum in combination with pomegranate rind and harda as natural mordants with three different proportions. Pomegranate rind and harda was also used as a single mordant.

Mordanting was carried out for 45 minutes for each experimental silk sample.

- ❖ Leaves of *Ficus elastica* were collected from the local area and washed thoroughly with water. Dye extract was prepared by adding water and heating the solution for 60 minutes. Mordanted samples were transferred in to the dye bath. Dyeing was carried out for 60 minutes.

### III. RESULTS

Fastness of dyed or printed textile fabrics denotes the resistance which the fabrics opposes to varying or losing its shade when subjected to the action of various agents such as light, washing, rubbing, human perspiration etc. which can give rise to loss/change of shade and to staining of the other textiles.

#### Washing fastness of *Ficus elastica* Leaves dyed silk

| Mordant | Mordant Concentration | Fastness Properties |                     |                    |                   |                       |                     |
|---------|-----------------------|---------------------|---------------------|--------------------|-------------------|-----------------------|---------------------|
|         |                       | Change in Colour    | Staining on Acetate | Staining on Cotton | Staining on Nylon | Staining on Polyester | Staining on Acrylic |
| Alum    | 10:0                  | 2                   | 5                   | 5                  | 5                 | 5                     | 5                   |
| A + T   | 9:1                   | 3                   | 5                   | 5                  | 5                 | 5                     | 5                   |
| A + T   | 7:3                   | 3                   | 5                   | 5                  | 5                 | 5                     | 5                   |
| A + T   | 5:5                   | 3                   | 5                   | 5                  | 5                 | 5                     | 5                   |
| A + F   | 9:1                   | 3                   | 5                   | 5                  | 5                 | 5                     | 5                   |

|       |      |   |   |   |   |   |
|-------|------|---|---|---|---|---|
| A + F | 7:3  | 3 | 5 | 5 | 5 | 5 |
| A + F | 5:5  | 3 | 5 | 5 | 5 | 5 |
| P     | 10:0 | 3 | 5 | 5 | 5 | 5 |
| A + P | 9:1  | 2 | 5 | 5 | 5 | 5 |
| A + P | 7:3  | 2 | 5 | 5 | 5 | 5 |
| A + P | 5:5  | 2 | 5 | 5 | 5 | 5 |
| H     | 10:0 | 4 | 5 | 5 | 5 | 5 |
| A+ H  | 9:1  | 4 | 5 | 5 | 5 | 5 |
| A+ H  | 7:3  | 4 | 5 | 5 | 5 | 5 |
| A+ H  | 5:5  | 4 | 5 | 5 | 5 | 5 |

Table represents washing fastness of wool and silk samples dyed with *Ficus elastica* leaf extract. Poor washing fastness i.e. 2 was recorded for dyed samples mordanted with 10% Alum. Tin and ferrous with its all proportions (9:1), (7:3) and (5:5) showed moderate wash fastness rated 3 for colour change. The natural mordant harda gave good results i.e. 4 with all combinations. (10:10) (9:1) (7:3) and (5:5) proportions for silk dyed samples.

The staining on adjacent acetate, cotton, nylon, polyester, acrylic mordanted with harda showed excellent results. In case of (A+T) with all its proportions (9:1), (7:3) and (5:5) mordanting with alum with all its proportions showed good results compared to other mordants, mordant combinations and

#### Perspiration fastness of *Ficus elastica* Leaves dyed silk

| Mordant | Mordant Concentration | Fastness Properties |                    |                  |                  |                    |                  |
|---------|-----------------------|---------------------|--------------------|------------------|------------------|--------------------|------------------|
|         |                       | Acidic              |                    |                  | Alkaline         |                    |                  |
|         |                       | Change in Colour    | Staining on Cotton | Staining on Silk | Change in Colour | Staining on Cotton | Staining on Silk |
| Alum    | 10:0                  | 5                   | 5                  | 5                | 5                | 5                  | 5                |
| A+T     | 9:1                   | 4                   | 5                  | 5                | 4                | 5                  | 5                |
| A+T     | 7:3                   | 4                   | 5                  | 5                | 4                | 5                  | 5                |
| A+T     | 5:5                   | 4                   | 5                  | 5                | 4                | 5                  | 5                |
| A+F     | 9:1                   | 4                   | 5                  | 4                | 4                | 5                  | 5                |
| A+F     | 7:3                   | 4                   | 5                  | 4                | 4                | 5                  | 5                |
| A+F     | 5:5                   | 4                   | 5                  | 4                | 4                | 5                  | 5                |
| P.      | 10:0                  | 5                   | 5                  | 5                | 5                | 5                  | 5                |
| A+P     | 9:1                   | 4                   | 5                  | 5                | 5                | 5                  | 5                |
| A+P     | 7:3                   | 4                   | 5                  | 5                | 5                | 5                  | 5                |
| A+P     | 5:5                   | 4                   | 5                  | 5                | 4                | 5                  | 5                |
| H       | 10:0                  | 5                   | 5                  | 5                | 5                | 5                  | 5                |
| A+H     | 9:1                   | 4                   | 5                  | 5                | 5                | 5                  | 5                |
| A+H     | 7:3                   | 4                   | 5                  | 5                | 5                | 5                  | 5                |
| A+H     | 5:5                   | 4                   | 5                  | 5                | 5                | 5                  | 5                |

The rating of acidic and alkaline perspiration fastness for silk samples dyed with *Ficus elastica* leaves observed in the present investigation are summarized in the above table.

#### Acidic Perspiration Fastness

10% alum as a sole mordant recorded excellent acidic perspiration fastness rated 5 for silk samples dyed with *Ficus*

*elastica* leaf extract. Negligible staining was observed on adjacent cotton and silk fabric. Good colour fastness towards acidic perspiration with absolutely no staining was observed on dyed silk samples. Both the natural mordants showed similar results. The results highlights the good to excellent performance of metal mordants, (Tin and Ferrous) and natural mordants (Pomegranate

rind and Harda) when used in combination with alum as a binary combination.

fastness towards alkaline perspiration rated 5. Negligible staining was recorded on adjacent cotton and silk fabric rated 5 in case of silk samples dyed with *Ficus elastica* leaf extract.

### Alkaline Perspiration Fastness

Data represented in the table indicates that 10% Alum, pomegranate rind and harda as a single mordant showed excellent

### Rubbing fastness of *Ficus elastica* Leaves dyed silk

| Sr. No. | Mordant | Mordant Concentration | Fastness to Light |     |
|---------|---------|-----------------------|-------------------|-----|
|         |         |                       | Dry               | Wet |
| 1.      | Alum    | 10:0                  | 4                 | 4   |
| 2.      | A + T   | 9:1                   | 4                 | 4   |
| 3.      | A + T   | 7:3                   | 4                 | 4   |
| 4.      | A + T   | 5:5                   | 4                 | 4   |
| 5.      | A + F   | 9:1                   | 4                 | 4   |
| 6.      | A + F   | 7:3                   | 4                 | 4   |
| 7.      | A + F   | 5:5                   | 4                 | 4   |
| 8.      | P       | 10:0                  | 5                 | 5   |
| 9.      | A + P   | 9:1                   | 5                 | 5   |
| 10.     | A + P   | 7:3                   | 5                 | 5   |
| 11.     | A + P   | 5:5                   | 5                 | 5   |
| 12.     | H       | 10:0                  | 5                 | 5   |
| 13.     | A + H   | 9:1                   | 5                 | 5   |
| 14.     | A + H   | 7:3                   | 5                 | 5   |
| 15.     | A + H   | 5:5                   | 5                 | 5   |

The rating for dry and wet rubbing fastness was recorded for the silk samples dyed with the leaves of *Ficus elastica*. Alum in binary combination with tin and ferrous with all proportions showed good results towards dry and wet rubbing fastness. In case

of natural mordants pomegranate rind and harda (A+P) and (A+H) with all proportions exhibited excellent dry and wet rubbing fastness.

### Light fastness of *Ficus elastica* Leaves dyed silk

| Sr. No. | Mordant | Mordant Concentration | Fastness to Light |
|---------|---------|-----------------------|-------------------|
| 1.      | Alum    | 10:0                  | 3                 |
| 2.      | A + T   | 9:1                   | 3                 |
| 3.      | A + T   | 7:3                   | 3                 |
| 4.      | A + T   | 5:5                   | 3                 |
| 5.      | A + F   | 9:1                   | 3                 |
| 6.      | A + F   | 7:3                   | 3                 |
| 7.      | A + F   | 5:5                   | 3                 |
| 8.      | P       | 10:0                  | 3                 |
| 9.      | A + P   | 9:1                   | 3                 |
| 10.     | A + P   | 7:3                   | 3                 |
| 11.     | A + P   | 5:5                   | 3                 |
| 12.     | H       | 10:0                  | 2                 |
| 13.     | A + H   | 9:1                   | 3                 |
| 14.     | A + H   | 7:3                   | 3                 |
| 15.     | A + H   | 5:5                   | 3                 |

Table highlights the degree of light fastness of wool and silk samples dyed with leaves of *Ficus elastica*. It can be stated from the data that silk samples dyed with *Ficus elastica* leaf extract exhibited moderate light fastness rated 3 towards almost all the

samples. Only the sample mordanted with harda as a single mordant recorded poor light fastness.

### Antimicrobial properties of silk dyed with *Ficus elastica* Roxb against selected microbes.

| Dyed Samples with Code | Diameter of Inhibition Zone - 38 (mm) |                             |
|------------------------|---------------------------------------|-----------------------------|
|                        | Tested Microbes                       |                             |
|                        | <i>Staphylococcus aureus</i>          | <i>Klebsiella pneumonia</i> |
| FLSF7                  | No growth                             | No growth                   |

The antimicrobial property of silk dyed with *Ficus elastica* leaf extract was assessed. During the assessment, silk sample mordanted with only Alum+Ferrous in binary mordant combination with (7:3) proportion was selected and inhibition zone was recorded against *Staphylococcus aureus* and *Klebsiella pneumoniae*. Table clearly indicates that silk samples when dyed with leaf extract indicates the presence of antimicrobial activity against both the tested micro-organisms.

#### IV. CONCLUSION

*Ficus elastica* Roxb. produced variety of dark and pale brown colour with using metal mordants. Drastic change was noticed in case of natural mordants. Both the natural mordants produced pale colours. Fastness properties observed were good to excellent for all the fastness agencies. It can be stated that *Ficus elastica* Roxb. can prove a new source in field of natural dyeing. Silk fabric can be dyed and produces good colour range using different mordants and their combinations.

The dyed samples showed good to excellent fastness properties. Dyed samples also recorded anti microbial properties.

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#### AUTHORS

**First Author** – Rajashri Ramkrishna Nimbhorkar, Assistant Professor, Shrimati Ratnaprabhadevi Mohite Patil College of Home Science for women, Akluj. E- mail - rajashri.nimbhorkar@gmail.com