



## Eco-Friendly Dyeing of Cotton Fabric from Aqueous Herbal Extracts and its Antibacterial Activity

D.Sowmiya<sup>1\*</sup>, T.Poongodi<sup>2</sup>, S.Karpagam<sup>3</sup> and R.Sowbaraniga<sup>4</sup>

<sup>1</sup>Assistant Professor, Department of Botany, Nallamuthu Gounder Mahalingam College, Pollachi, Coimbatore, Tamil Nadu, India – 642001.

<sup>2</sup>Ph.D Research Scholar, Department of Botany, Nallamuthu Gounder Mahalingam College, Pollachi, Coimbatore, Tamil Nadu, India – 642001.

<sup>3</sup>M.Sc. Student, Department of Botany, Nallamuthu Gounder Mahalingam College, Pollachi, Coimbatore, Tamil Nadu, India – 642001.

<sup>4</sup>Assistant Professor of Biological Science, Department of Education, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India.

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### \*Address for Correspondence

#### D.Sowmiya

Assistant Professor,  
Department of Botany,  
Nallamuthu Gounder Mahalingam College,  
Pollachi, Coimbatore, Tamil Nadu, India – 642001.  
E. Mail: d.sowmiya22@gmail.com



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### ABSTRACT

Natural dyes are found to be environmentally friendly and possess many advantages over their synthetic counterparts. Among various clothing, cotton may act as a nutrient, becoming a suitable medium for bacterial and fungal growth. Therefore, an attempt has been made to study the dyeing capacity and antibacterial activity of some plants like *Ocimum sanctum*, *Acalypha indica*, *Phyllanthus reticulatus*, *Impatiens balsamia* and *Clitoria ternatea* and the mordant used were *Terminalia chebula* and *Acacia sinuate* on cotton fabric. The work comprises the preparation of dye and mordant from the parts of different plants by means of aqueous extraction. The dyeing ability of *A. indica*, *O. sanctum*, *P. reticulatus*, *C. Ternatea* and *I. Balsamia* showed good results when the mordant *T. chebula* was used. Among the fabricated clothes, *O. sanctum* and *A. Indica* showed good antibacterial activity with the zone of inhibition 1.00 mm, 0.5 mm respectively. It can be inferred from this study that the naturally dyed clothes showed high compatibility with the environment, softer colour shades, naturalness, cost effective and antibacterial activity.

**Keywords:** Dye, Mordant, Fabrication, Antibacterial, Gram positive and Gram negative





## INTRODUCTION

Medicinal plants are part and parcel of human society to combat diseases, from the dawn of civilization (Chaudhary *et al.*, 2010). Extracts of medicinal plants can be obtained from plant parts such as roots, berries, bark, leaves and wood. Many natural plant extracts have antimicrobial activity and wound healing properties. Antimicrobial agents either inhibit the growth (-static) or kill (-cidal) the microorganisms. The art of making natural dyes is one of the oldest practices and dates back to the dawn of civilization which does not cause any kind of pollution (Kannanmarikani *et al.*, 2015). Because of the excellent antimicrobial and eco-friendly dyeing properties exhibited by the plant extracts, these are used as textile finishing agents (Sarojyadav and Neelam M Rose, 2020). In India, there are more than 450 plants that can yield dyes. Clothing is our necessary thing which should be free from microbes to avoid many life threatening diseases. Over the last few decades, considerable research effort was made to produce antibacterial coatings on the surfaces of various objects such as garments and medical devices (Danese, 2002 and Lewis *et al.*, 2005). The current interest is to develop efficient, non-toxic, durable and cost effective antimicrobial finishing clothes with increased applications in medical, health care, hygienic products as well as protective cloth materials (Czajka, 2005 and Molloy *et al.*, 2008).

Cotton fibres are particularly suitable for manufacturing textiles for sports, non-implantable medical products and health care/hygienic products (Czajka, 2005). However the ability of cotton fibres to absorb large amount of moisture and act as nutrient which makes them more prone to microbial attack under certain conditions of humidity and temperature. (Gao *et al.*, 2008 and Gorensen *et al.*, 2007). Therefore, cotton fibres are treated with numerous chemicals to get better antimicrobial cotton textiles (Son *et al.*, 2006 and Tarimala *et al.*, 2006). Plant based antimicrobial compounds have great therapeutic potential as they have lesser side effects as compared with synthetic drugs and also little chance of development of resistance. Therefore, the present study has been carried out to investigate the dyeing capacity and antimicrobial activity of some medicinally important plants viz., *Ocimum sanctum*, *Acalypha indica*, *Phyllanthus reticulatus*, *Impatiens balsamina* and *Clitoria ternatea*.

## MATERIALS AND METHODS

### Mordant Selection and Preparation

Seeds of *Terminalia chebula* L. (Combretaceae) and *Acacia sinuate* (Lour.) Merr. (Fabaceae) (Fig.1) were selected for the present study which was used as mordant. The selected mordants were bought from herbal medicine shop in Pollachi. 50 grams of seed powder was added in 500 ml of water and allowed to boil for an hour. Then it was filtered, dried and stored for further use.

### Collection of Plant Samples for Natural Dye Preparation

The leaf powder of *Ocimum sanctum* (Lamiaceae) and *Acalypha indica* L. (Euphorbiaceae) (Fig.2), fresh flowers of *Impatiens balsamina* L. (Balsamiaceae) and *Clitoria ternatea* (Fabaceae), fresh fruits of *Phyllanthus reticulatus* Poir. (Phyllanthaceae) were chosen for the present study due to its high dye yielding capacity and antimicrobial property.

### Natural Dye Extraction

The collected leaf samples were shade dried and finely powdered using mixer grinder. 20 grams of the powdered sample was mixed with 200ml of water and boiled for an hour. The fresh flower and fruit samples were grinded by adding water in pestle and mortar and filtered using cotton cloth. The filtrates were stored for further use.

### Preparation of Cotton Fabric

Pure and sterile cotton clothes (5x5cm) were used as substrate and soaked in both mordants separately for 7 hours. Dried cotton clothes were dyed with natural extract obtained from *Ocimum sanctum*, *Acalypha indica*, *Phyllanthus reticulatus*, *Impatiens balsamina* and *Clitoria ternatea*. The dye ability of soaked cloth was studied by increasing the time from 0 hour to seven hours.





### **Antibacterial Activity**

The effectiveness of dyed clothes were tested for antibacterial activity against gram negative *Escherichia coli* and gram positive *Staphylococcus aureus*. Parallel streak method was adopted for the present study which is a qualitative test used to detect diffusible bacteriostatic activity on textile material. Muller-Hinton agar medium was used for parallel streak method.

## **RESULTS AND DISCUSSION**

The naturally dyed cotton fabrics showed good dyeing ability at different time intervals (Fig.3). After washing the dyed fabric using mild detergent, it was subjected to antibacterial activity. A good antibacterial activity was shown by *Ocimum sanctum* dye with the zone of inhibition 1.0 mm and *Acalypha indica* dye with the zone of inhibition 0.5 mm when used *Terminalia chebula* as mordant. The flowers of *Impatiens balsamia* and *Clitoria ternatea* and fruits of *Phyllanthus reticulatus* showed less antibacterial activity (Fig.4). Hence from the present study, it is suggested that antibacterial activity was found in naturally extracted plant dyed cotton cloth. The raw materials for making this eco friendly dye are cheaper when compared to other chemicals, so the commercial production must be encouraged at industrial level. The extract of *Acalypha indica* showed good dyeing ability and exhibit effective antibacterial activity on five antibacterial pathogens (Saravanan, et al., 2013). Senthilkumar and Karthi (2018) studied the antibacterial activity on two pathogens such as *Escherichia coli* and *Staphylococcus aureus* and the zone of inhibition is 26 and 27 mm respectively. Sumithra (2017) reported the aqueous extract of *Tribulus terrestris* and *Leucas aspara* showed zero antibacterial activity. But, our present study showed antibacterial activity for *Ocimum sanctum* and *Acalypha indica* for aqueous extraction.

## **CONCLUSION**

In the present study, Eco-friendly natural dyes were prepared from leaves of *Ocimum sanctum* (Lamiaceae) and *Acalypha indica* L. (Euphorbiaceae), flowers of *Impatiens balsamia* L. (Balsamiaceae) and *Clitoriaternatea* (Fabaceae), fruits of *Phyllanthus reticulatus* Poir. (Phyllanthaceae). In which, *Ocimum sanctum* dyed cotton fabrics showed high antibacterial activity when compared to dyed cotton fabrics. It can be inferred from this study that the naturally dyed clothes showed high compatibility with environment, softer color shades, naturalness, lower toxicity, cost effective and antibacterial properties.

### **Conflict of Interest**

Authors have no conflict of interest.

## **ACKNOWLEDGEMENT**

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## **REFERENCES**

1. Dr.Senthilkumar, B. Karthi (2018), 'To study antimicrobial effect on cotton fabric of natural dye extract of Tulsi with Myrobalan mordanting Method'. *Internal Journal of Science and Research*. 8(8), 2138-2139.
2. Sumithra. M (2017), 'Eco friendly herb extracts treated on cotton fabric using antibacterial activity'. *International Journal of Scientific Research in Engineering*. 2(1), 8-11.
3. Yuan Gao and Robin Cranston (2008), 'Recent Advances in Antibacterial Treatments of Textiles'. *Textile Research Journal* 78(1), 60-72.





4. Kannanmarikani, et al, (2015), 'Assessment of Dyeing properties and quality parameters of natural dye extract from *Lawsonia inernis*'. *European Journal of Experimental Biology* 5(7), 62-70.
5. Cragg G. M, et al, (1997), 'Natural products in drug discovery and development'. *Journal of Natural Products* 60(1), 52-60.
6. Chaudhary H. J, et al, (2012), 'In vitro analysis of *Cupressus sempervirens* L. Plant extracts antibacterial activity. *Journal of Medicinal Plants Research* 6(2), 273-276.
7. R. Czajka, (2005), 'Development of Medical Textile Market'. *Fibre and Textiles in Eastern Europe* 13(1).
8. Kumaresan. M et al, (2012), 'Application of eco friendly natural dye on cotton using combination of mordants'. *Indian Journal of Fibre and Textile Research* 37(2), 194-198.
9. SarojYadav et al (2020), 'Assessment of wash durability of Eucalyptus Herbal extract derived Antimicrobial finish'. *Plant Archives* 20(1), 16-20.
10. Cowan M. M (1999), 'Plant Products as Antimicrobial Agents'. *Clinical Microbiology Reviews*. 12(4), 564-582.
11. GarimaBhardwaj, et al (2015) 'Antibacterial Activity in different extracts of *lantana camera* against enterpathogens' *Innovare journal of Science* 3, 4-5.
12. P. Saravanan et al,(2013) 'Extraction and Application of eco friendly Natural Dye obtained from Leaves of *Acalyphaindica* Linn on cotton fabric' *International Research Journal of Environment Science* 2(12), 1-5.
13. G. Kowsalya Devi, et al, (2020), 'Development of Natural herbs on knitted fabric to impact microbial finishing for eczema patients' *International Research finishing of Modernization in Engineering Technology and Science* 2(9), 1626-1628.

#### Plants used as Mordants

*Terminalia chebula* L.



seeds

powdered sample

*Acacia sinuata*(Lour.)Merr



seeds

powdered sample

Fig. 1- Plants selected for mordant preparation

#### Plants used for natural dye preparation

*Ocimum sanctum* L.



Fresh Leaves

Dried leaves

Powdered sample

*Acalypha indica* L.



Fresh Leaves

Dried leaves

Powdered sample

Fig. 2- Selected plants for Natural dye preparation





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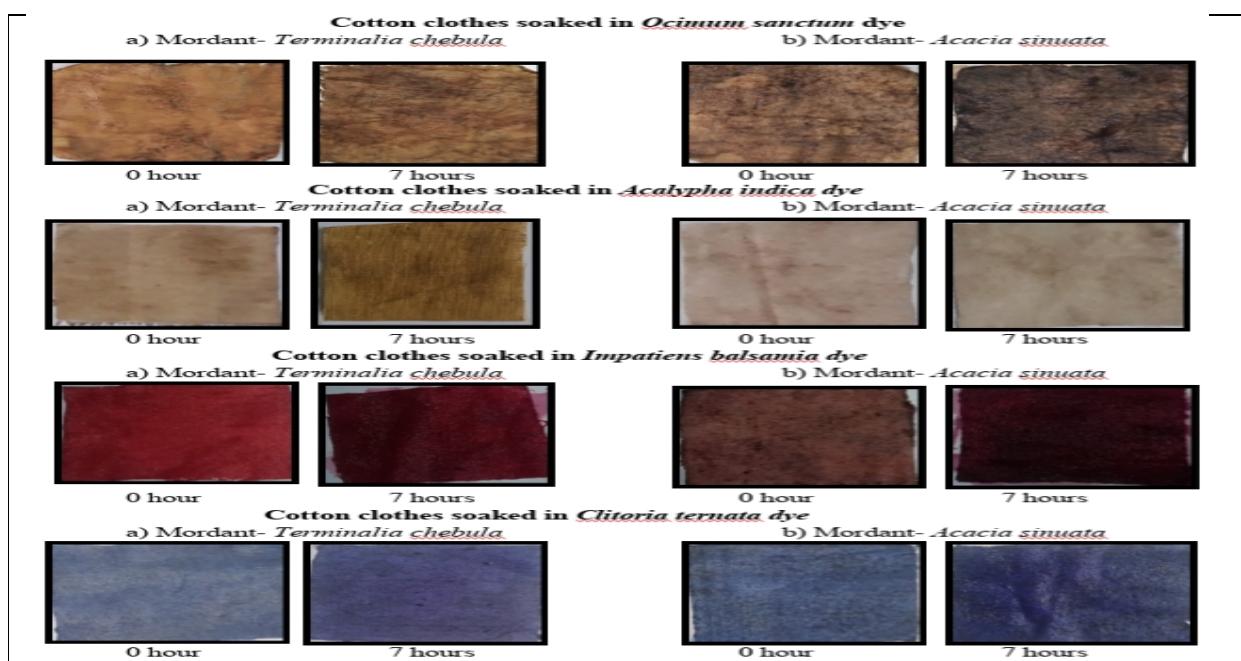


Fig. 3- Soaked cotton clothes in different natural dyes

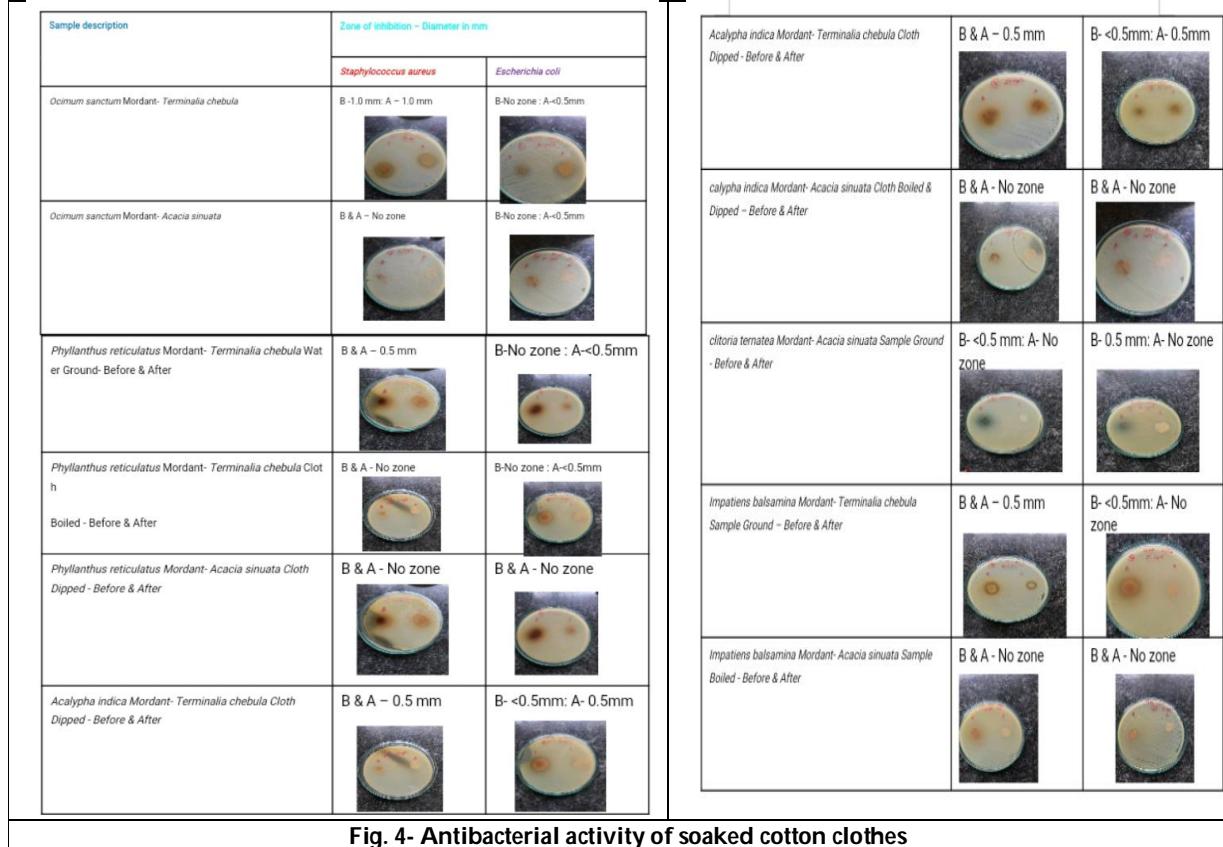


Fig. 4- Antibacterial activity of soaked cotton clothes

