Extraction of Eco-Friendly Natural Dye From Leaves And Barks of Eucalyptus Camaldulensis on Cottton, Silk, Wool And Linen Fabrics Using Soy Milk

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Abstract- *The Eucalyptus camaldulensis leaves and bark as a potential source for textile dyeing. The effiectiveness of Eucalyptus leaves and bark on cotton, silk, wool and linen treated with three different mordants such as alum, copper sulphate and ferrous sulphate were used, each at five per cent of weight of fabric (o.w.f) and with the material to liquor ratio (MLR) of 1:15. The variations in the colour strength and coordinates with respect to dyed without and with mordant showed a significance difference in colour obtained. The fabrics dyed using soy milk as pretreatment showed significant high colour strength and coordinates with respect to dyed without pretreatment. This suggests that Eucalyptus camaldulensis leaves and bark dye is a novel source for dyeing the cotton, silk, wool and linen fabric and manufacturing of eco-textiles.*

Keywords- Eucalyptus camaldulensis, mordants, MLR, soy milk, eco-textiles

I. INTRODUCTION

Natural dyes were extensively used since, ancient times for textile coloring. Natural dyes have a wide range of shades that can be obtained from various parts of plants, including roots, bark, leaves, flowers and fruits (Allen, 1971). Natural dyes are environmentally compatible, biodegradable, nontoxic, free of allergic effects, as well as available from a wide range of sources that includes coloring from plants, insects, fungi and minerals (Ibrahim, et.al 2010). The use of non-toxic and eco-friendly natural dyes on textiles has become a matter of significant importance because of the increased environmental awareness in order to avoid some hazardous synthetic dyes. However, worldwide the use of natural dyes for the colouration of textiles has mainly been confined to craftsman, small scale dyers and printers as well as small scale exporters and producers dealing with high valued eco-friendly textile production and sales (Samanta *et al.*, 2009).

Eucalyptus belongs to family Myrtaceae, and consists more than 800 spp. and widely distributed throughout different agro-climatic zones of the country, cultivated by farmers as high density energy plantations, border planting, Industrial plantations to meet out the raw material and reclamation of various type of degraded soils, and has high adaptability and drought resistance (Padam *et al.*, 2014).

Eucalyptus is one of the most important sources of natural dye that gives yellowish- brown colourants. The colouring substance of eucalyptus has ample natural tannins and polyphenols, varying from 10% to 12% (*Ali et al., 2007).* The major colouring component of eucalyptus bark is quercetin quercetin, which is also an antioxidant. It is used as a food dye with high antioxidant properties *(Vankar et al., 2006).* Eucalyptus leaves contain up to 11% of the major component, as well as tannin (gallic acid and ellagic acid) and flavonoids (quercetin, rutin etc.) as minor substances (*Chapuis-Lardy et al., 2002, Conde et al., 1997).*

II. MATERIALS AND METHODS

A. Sample Collection

The leaves and bark of *E. camaldulensis* was collected from FGRM Nursery, IFGTB, Coimbatore, India. After the collection of bark, washed thoroughly with water to remove impurities present on the surface of bark and later, soaked in 1% ascorbic acid. Then bark was cut into small pieces and shade dried for 2 weeks until the moisture content reduced. Later the barks were pulverized by using the mixer grinder and then sieved and stored in airtight glass containers.

Fig.1 Dried leaves of *Eucalyptus camaldulensis*

Fig.2 Dried barks of *Eucalyptus camaldulensis*

B. Textile Materials

The cotton fabric, degummed type was purchased from NTC Mills, Coimbatore, India. The silk fabric, plain weave and 100% ready for dyeing type was purchased from Siera Silk Mills PVT LTD, Bangalore, India and wool, plain (100% merino wool) ready for dyeing type was purchased from Sanjay Shah & Associates, Vapi, India and lenin fabric was purchased from local textile shops. Copper sulphate, Alum and Ferrous sulphate of analytical grade was purchased from S.D. fine chemicals, Mumbai. Soy bean were purchased from local market.

C. Pretreatment of Fabrics

The soy beans were soaked with water overnight and were extracted using blender and then filtered. The soy milk was taken in the ratio of (1:2) with water. The fabrics was soaked in soy milk for 20 minutes and dried. The fabrics were separated into sets, one pretreated with soy milk and another set was without pretreatment. This is to check and compare the high dye fixation in fabrics as soy milk is rich in proteins.

III. AQUEOUS DYE EXTRACTION

The extraction of natural dye from *Eucalyptus camaldulensis* leaves and barks was done with distilled water in the M:L ratio of 1:15 for 90 minutes at 80±5ºC. Then the solution was cooled and filtered by using muslin cloth and used for dyeing.

IV. DYEING OF FABRICS

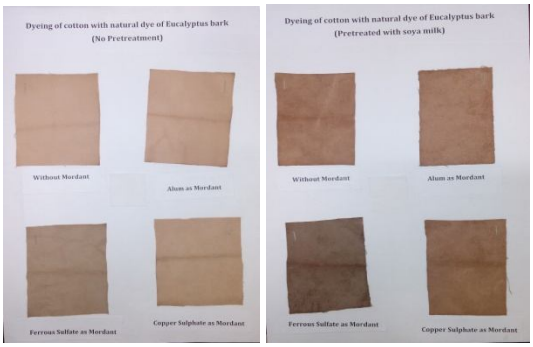
Scouring: The fabric was treated with non-ionic surfactant solution containing 2g/L each of soap and soda ash at 60˚C for 30 minutes to remove dirt and other stiffening agents.

Fig.3 Scouring of fabrics

After scouring the fabrics was simultaneous mordanted with mordants *viz.,* Alum (T1), Ferrous Sulphate (FeSO4) (T2), Copper sulphate (CuSO4) (T3), without mordant i.e. control (T0) with five per cent concentration of each mordant on weight of fabric (o.w.f) and compared with control (T10) no mordant. The dyeing was carried out at 80±5ºC in a dye bath for 1-1$^{1/2}$ hour. Then the dyed samples were subsequently washed and dried at room temperature.

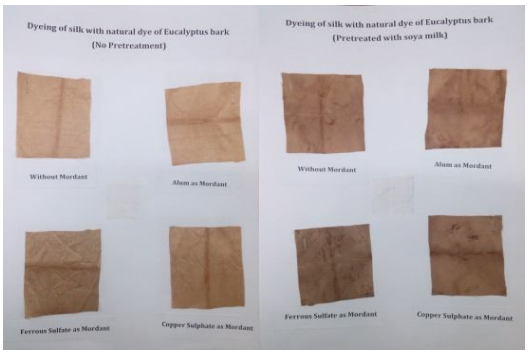
V. RESULTS AND DISCUSSION

The darker shades in colour of *Eucalyptus* dyed fabric is due to, tannin contains phenolic compounds that can form hydrogen bonds with the carboxyl group of protein fibres. Furthermore, there are other two possibilities involved such as (a) the anionic charge on the phenolic groups forms an ionic bond with cations (amino groups) on the protein substrate and (b) a covalent bond may also form an interaction between any quinine or semiquinone groups present in tannin and suitable reactive groups on the silk fabric (Agarwal and patel, 2002; Nattayya *et al.,* 2013). The dyed fabrics of *Eucalyptus camaldulensis* leaves and barks are shown below.



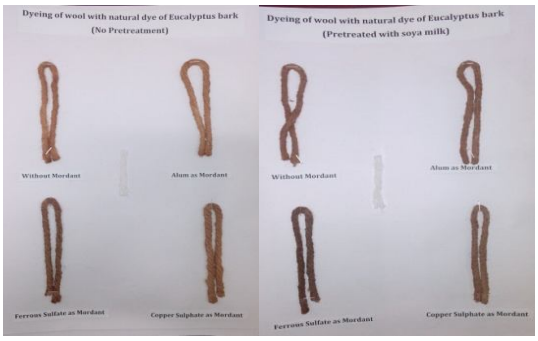
1 **2**

A



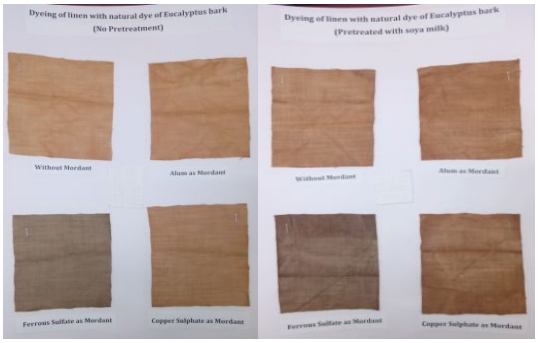
1 **2**

B



1 **2**

C



1 **2**

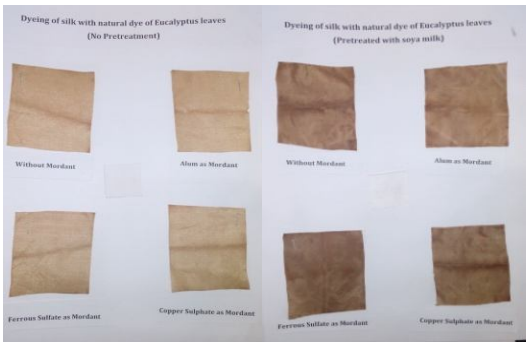
D

A- Cotton **B**- Silk **C**- Wool **D**- Linen

Dyed fabrics of *E. camaldulensis* barks

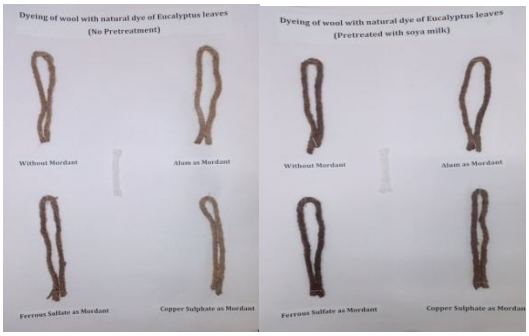
1 **2**

A



1 **2**

B



1 **2**

C

1 **2**

D

1-Without Pretreatment **2**- Pretreated with Soy milk

Dyed fabrics of *E. camaldulensis* leaves

The dyeing of *E. camaldulensis* leaves and barks on different fabrics like cotton, silk, wool and linen shows high dye uptake and good colour fixation. The dyeing of bark on different fabrics shows brown, yellowish brown and coffee brown colour and in leaves, light brown, grayish brown and greenish brown colour are observed. The high colour fixation was observed in fabrics pretreated with soy milk. The dye treated with ferrous sulphate as mordants shows high dye uptake and colour fixation as compared to other mordants. Thus *E.camaldulensis* leaves and barks can be used as potential source of natural dye for cotton, silk, wool and lenin fabric.

VI. CONCLUSION

In the present study, the natural dye obtained from *E. camaldulensis* leaves and barks on cotton, silk ,wool and lenin fabrics has successfully used as an eco-friendly dye to obtain different shades of brown colours. The use of different mordants enhances and fixes the dye on the fabrics. The pretreated fabrics with soy milk shows good colour fixation on the fabrics compared to untreated fabrics due to its rich protein contents. Ferrous sulphate as mordant shows best results on color fixation and high dye uptake. *E. camaldulensis* leaves and barks is definitely serves as a source of raw materials for fabrics dyeing in future. We assure that this natural dye as a valuable source instead of synthetic dyes. The eco dyes in addition to dyeing also having pharmaceutical properties. Thus leaves and bark dye of *E. camaldulensis* can be commercialized for eco friendly fabrics dyeing by small scale industries or cottage industries.

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