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Bio Mordanting of *Prosopis Juliflora* Bark Pigment Dyeon Polyester Fabric

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Abstracts

In this present study, *Prosopis juliflora* bark dye adsorption on polyester fabric materials was carried out. Many research, focuses on replacing the synthetic pigments with eco-friendly natural pigmentsThe polyester fabric is normally dyed with chemical dyes which has the severe limitations such as toxicity and environmental issues. This aim of present research is an ecofriendly dyeing process for polyester fabric with bark extracted pigment from *Prosopis juliflora.* The depth bark was collected and powdered; color was extracted by using boiling method. The crude extract was spectroscopically analyzed to identify the absorbance range of natural pigments. The dyeing process is of 130◦C for 60 minutes for 20gram of fabric followed by neutralization and soaping. The quality of the dyed polyester fabric materials was analyzed in terms of their color strength and color fastness properties. The dyed textile effluent was analyzed that it has reduced total dissolved solid contents compared to commercial dyeing. This *Prosopis juliflora*pigment has showed best antibacterial activity against *E. coli*and *S. aureus.*This study suggeststhattheheartwood of the *Prosopis juliflora*plant has an unusually high amounts of coloring agents with antibacterial properties and dyeing potentials.

Keywords:*Prosopis juliflora, Polyester fabric, Antibacterial activity.*

Introduction

Wastewater in the dyeing industry constitutes a major source of water pollution globally. In addition to the textiles other industries such as pharma, paper and cosmetics consumes large amount synthetic dyes in their effluents [1]. There is severe climate change for global warming, extreme pollution from many industrial developments. The large number of synthetic dyes represent an enormous challenge to waste water treatment because the chemically stable dyes can readily bypass the conventional waste water treatment systems [2].

Basically, the synthetic dyes are very hazardous, toxic and irritant. But the natural dyes from the plant sources or any biological sources are nontoxic and has the better biodegradability and leads to ecofriendly environment.Biobased dyes offer a potential alternative to synthetic dyes, triggering intensive research during recent years. The shift from synthetic dyes to natural dyes can also benefit other industrial fields, for instance, forest-based industry, as the low-value waste and side streams can be applied in dye production which are more profitable.The majority of natural dyes have a weaker affinity foradsorption on cellulosic materials, such as cotton and vis-cose,thanonprotein-basedmaterials,suchaswoolandsilk, because cellulosic materials acquire a negative chargein water, which causes a repulsive interaction with the dyemolecules [12].

Prosopis juliflora belongs to the family Fabaceae and is commonly known as mesquite. It is a fast growing, thorny deciduous,drought-resistant plant and has a wide crown and deep-rooted. It is native to Central and South America - spreading from southern Mexico toPanama and from the Caribbean Islands

to northern South America and an invader species in India that competes with the native species. It grows in all kinds of soil conditions, including wastelands at altitudesrangingfrom0to1,500m above sea level [3].

This Prosopis juliflora plant is an invasive plant that can grow to heights of about 12 mwith a trunk of up to 1 m if grown in favorable conditions. Over the years, environmentalists have raised concerns about the Prosopis plant mainly because of its ability to colonize large tracts of the land including arid and semiarid land, sometimes leading to loss of biodiversity [4].Considered as one of the most unwanted species by the International Union for Conservation of Nature,theProsopisjuliflora plantisanoxiousandinvasiveweed. The presence of flavonoids such as catechin, epicatechin, gallo-catechin, mesquitol and other derivatives of flavonoids have already been established to be present in the acetonic extracts of the heartwood of this plant [5]. This was of specific interest, given that it has been previously proven that natural dyes that yield the colours yellow and brown are usually composed flavonoids of Prosopis juliflora that are suggested to be responsible for its dyeing properties, reliable fastness and varying shades based on selected mordanting techniques.Pigments play a major role in food and textile industries as colorants. Though these pigments have been explored and exploited for their biological activities, they have not been studied as a colorant for industry. This study focusses on the ways in which the pigments of prosopis juliflora can be used for textile application.

2. Materials and methods

2.1 Media and chemicals

Polyester filament knitted single jersey fabric (160 g/m2) was sourced from the knitting division Eastman Exports Global Clothing Private Limited Knitting Division. Nutrient broth, glycerol,glucose, Mueller Hinton agar and mineral salt medium were used pigment activity enhancement an antibacterial activity assay. Sodium hydroxide and fatty alcohol ethoxylated surfactant used for dyeing of polyester were purchased from Himedia Private Limited, India. Demineralized water used for media preparation andquality drinking water was used in dyeing experiments.

2.2 Identification and pigment extraction

The barks of *Prosopis juliflora*plant were collected from Erode, Tamilnadu, India during the month of September. Barks were washed with tap water and followed by rinsing with double distilled water and shade dried for a week. Then the bark was chopped and powdered finely using grinder and the powdered bark was stored in air tight container at room temperature for pigment extraction purposes.The 20 grams of stored bark powder was mixed in 200ml (1:20 Ratio) of distilled water and boiled for 30 minutes using heating mandle. Then the pigment was centrifuged at 8000rpm for 5 minutes and the supernatant was filtered using Whatman filter paper. The filtered pigment was collected and stored at 4◦C for further dyeing purpose.

2.3 Dyeing of polyester fabric

Polyester fabric dyeing process consumes less water, as it can retain 0.4% moisture, and also negates the use of salts and other chemicals used in the dyeing of cotton fabric. For polyester dyeing, pH of Prosopis juliflorapigment was adjusted using NaOH & HCl and the dyeing was carried out at 130oC. The pH level ranges from 3 to 9.

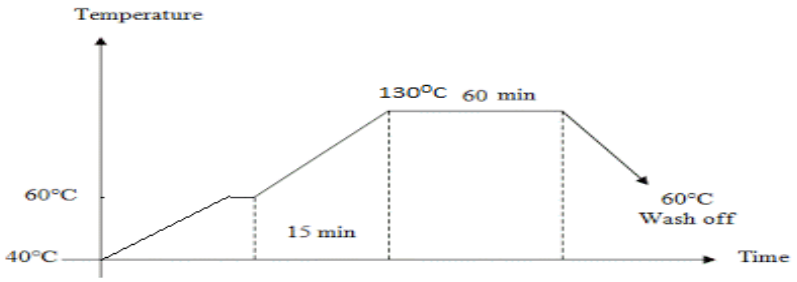

Fig. 1– Polyester fabric dyeing process

The Prosopis juliflorapigment solution itself used as the dyeing liquor. Aftertreatment, the dyed fabric was subjected to washing using fatty alcohol ethoxylated surfactantusing the concentration of 2 g/l for 20 minutes at 80oC temperature. After treatment, the fabric was washed with hot and cold water and dried using hot air oven. The unfixed dyes were removed from the fabric and this process was repeated until the bath recovered after treatment is void of any colour.

2.4 CCM characterization and color fastness

The Prosopis juliflorapigment dyed polyester fabric was characterized by computer color matching and colorfastness properties. CIE chromaticity color space encompasses the color as tristimulus value. The color tristimulus values are denoted in L* for the lightness and a* and b* for the color components. This color measurement will guide to findProsopis juliflorapigment level of adherence to the dyed fabric. The colour fastness to rubbing, washing and light fastness were tested based on ISO 105-X12, ISO 105-C10 and ISO 105-B02, respectively.

2.5 Antibacterial activity and effluent analysis

The *Prosopis juliflora*pigment antibacterial activity was tested using agar well diffusion method by Mueller Hinton agar.

Media	Components	Composition (g/L)
Mueller Hinton agar	Peptone	17.5
	Meat extract	2
	Starch	1.5
	Agar	17
	pH	7(+/-) 0.2

Table – 1 Mueller Hinton Agar Media Composition

The antibacterial activity was tested against *Bacillus subtilis, Lactobacillus, Escherichia coli, Pseudomonasaeruginosa* and *Staphylococcus aureus.* The culture was inoculated and incubated for 48 hours. Based on the zone of inhibition, the level of antibacterial activity was measured. The dyed effluent on was tested for their pH level and total dissolved solids content.

3. Results and Discussions

3.1 Identification of *Prosopis juliflora*

The Prosopis juliflora barkwas collected, after washing and drying were powdered and sieved which resulted in 800 g fine powder. The bark powder was dark brown in color, raw powder was stored in air tight container.The aqueous extraction method was used to extract the Prosopis juliflora bark

pigment and it was processed for further studies on antibacterial activity under laboratory conditions. Thestudy of bacteria, in a laboratory with limited resources, often involves the use of living cultures.

Fig.2 – *Prosopis juliflora* Bark

3.2 Dyeing of Polyester Fabric

The dyed fabric is foundlight brown color in shade. The Prosopis juliflora plant pigment pH ranges from 3 to 9. This dark brown colour solution of the pigment is taken as bath liquor for dyeing. But the resulting fabric is light brown in colour and for further investigation, the color giving compound from the dyed fabric is extracted and analyzed using analytical techniques. Table 3 shows the computer color matching values. Tristimulus values show that color values for the different treated pH of polyester fabric and color strength values are calculated. The dyed effluent pH and total dissolved solids was very low when compared with the commercial effluents. Table 4 shows the effluents pH and TDS.

Sample No:	pH	L*	a^*	b^*	c^*	h^*
PJ - 1	7	81.23	5.99	6.23	8.65	46.14
PJ - 2	4	81.99	4.70	9.74	10.82	64.25
PJ - 3	9	-	-	-	-	-
PJ - 4	3	72.15	6.94	10.19	12.33	56.75
PJ - 5	5	74.33	6.58	10.43	12.33	57.74
PJ - 6	6	75.03	5.45	9.29	10.77	58.59
PJ - 7	8	75.70	3.64	9.17	9.87	68.35

Table – 3 Computer color matching values

Sample no	pH	Effluent pH	TDS
PJ - 1	7	7.12	242
PJ - 2	4	4.05	190
PJ - 3	9	9	270
PJ - 4	3	3.25	175
PJ - 5	5	5	210
PJ - 6	6	6.03	230
PJ - 7	8	8.12	255

Table – 4 Effluent analysis

3.3 Color fastness report

Color quality is more important in textile application to promote the fabric to the next stage of garmenting. Generally, color quality assessed in two ways i.e., multi-fibre staining and color change after washing. The table 5 shows that Prosopis juliflora pigment absorbance on polyester has excellent property to withstand the wash fastness and it has excellent color fastness properties on textile application

Sample no		Wash	Water	Alkali	Acid
PJ – 1 to 7	Acetate	4-5	4-5	4-5	4-5
	Cotton	4-5	4-5	4-5	4-5
	Nylon	4-5	4-5	4-5	4-5
	Polyester	4-5	4-5	4-5	4-5
	Acrylic	4-5	4-5	4-5	4-5
	Wool	4-5	4-5	4-5	4-5
	Colour change	4	4	4	4

Table – 5 Color fastness results

3.4 Antibacterial activity

The antibacterial activity of Prosopis juliflora bark pigment was studied by using agar well diffusion method against five bacteria such as Bacillus subtilis, Lactobacillus, Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureusin Mueller Hinton agar plates. Among these five bacteria the best antimicrobial activity of the pigment was observed against the E. coli and S. aureus.The figure 3 shows the zone of inhibition of these two bacteria increased when the concentration of the pigment increased.

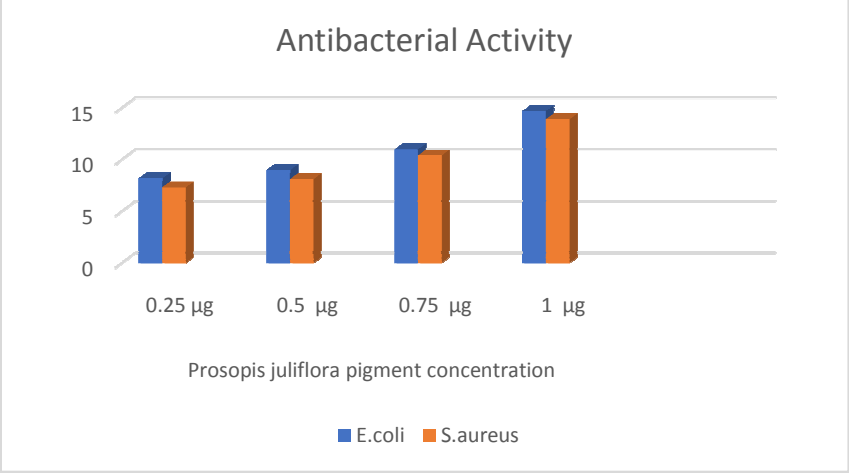

Fig 3 – Antibacterial activity of *Prosopis juliflora* pigment

From this the antibacterial activity of the pigment has been dose dependent. The zone of inhibition on each plate with various concentrations were examined for the inhibitory growth of bacteria.

Conclusion

This work represents the efficient pigment synthesis from the bark extract of *Prosopis juliflora.* This dyeing of polyester fabric with natural pigment from *Prosopis juliflora*bark is a new approach in textile coloration. The aqueous extracted bark pigment was light brown in color. The colorfastness to wash, rubbing was moderate to good demonstrating with other commercial dyes for the polyester fabric. The dyed textile has very low pH and total dissolved solid contents so it gives immense benefit to the environment. The bark pigment has natural antibacterial activity, and it shows highest antibacterial activity against*E. coli* and *S. aureus.* Based on the dosage of the pigment concentration the level of inhibition raised. In future the studies for the enhancement of light fastness properties will be carried out. This will be the best alternatives to synthetic dyes from nature and for other development in natural dyeing process and more ecofriendly.

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