

## **Extraction And Application of Eco-Friendly Natural Dye Obtained From Barks of Gular Leaves on Khadi Fabric**

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### **Abstract**

*Dyeing of textiles with natural dye was started in the early stage by the traditional dyes was started in the early stage by the traditional dyers. In the century, a global awareness a already in place favoring of the use of natural resources for protecting the earth from pollution and ecological imbalance. As synthetics dyes are causing water pollution and waste disposal problems, so they are boardly disparaged in the world. Natural dyes are environmental friendly, biodegradable. They are attracting the awareness of people. In this study, environmental friendly dyeing of Khadi fabric was investigated using natural dye from Gular tree bark respectively. Khadi fabric was dyed Gular tree bark extracted dye solution. Colour strength, and fastness properties. The fastness properties results of all dyed Khadi fabric samples with Gular tree bark extract were in the range of good and excellent.*

**Keywords** -Natural dye, Gular tree, Antibacterial activity, Antifungal activity, colour fastness, light, washing, crocking, perspiration, water, perspiration.

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## **Introduction**

A growing interest in natural dyes in textile application is mainly due to its environmental friendly, an alternative economical, harmony with nature and biodegradability property. In many of the world's developing countries, however, natural dyes can offer not only a rich and varied source of dyestuff, but also the possibility of an income through sustainable harvest<sup>1</sup>

The natural colourants that are safer and eco-friendly in nature are emerging globally leaving synthetic colourants behind in the race. Natural dyes have many advantages over synthetic dyes.<sup>2</sup> Various parts of plants and animals are used to obtain various shades of natural dyes. The environment consequences are the reason or the importance of natural dyes around the globe.<sup>3</sup> A dye is a material that absorbed strongly in the visible region or physical attraction between the dye and the dyes substance.<sup>4</sup>

The use of non-allergic, non-toxic and eco-friendly natural dyes on textiles has become a matter of significant importance due to increased environmental awareness in order to avoid some hazardous synthetic dyes. To save the world, there is a call "to go back to nature" and patronize natural products.<sup>5</sup> The discovery of man-made synthetic dyes in the mid-19<sup>th</sup> century triggered the end of the large scale market for natural dyes. Synthetic dyes, which could be produced in large quantities, quickly superseded natural dyes or the commercial textile production enabled by the industrial revolution.<sup>6</sup>

In recent year natural dyes are again getting importance due to harmful effect caused by synthetic dyes during their production and use. They are compatible with the nature due to their non-hazardous nature and produce colours that are gentle, soft and subtle and create a restful effect.<sup>7</sup> It is known that textile materials and clothing are susceptible to microbial attack because they provide the basic requirements for microbial growth. Natural fibers which are made of cellulose and protein provide moisture, oxygen, nutrients and temperature for bacterial growth and multiplication.<sup>8</sup>

Synthetic antimicrobial are a cause of concern due to the associated side effects, action on non-target microorganisms. Hence, there is a great demand for antimicrobial textiles based on eco-friendly agents.<sup>9</sup> Although known for a long time for dyeing as well as medicinal properties, the structures and protective properties of natural dyes have been recognized in the recent past.<sup>10</sup>

India is famed for its rich biodiversity. Many of these plants and exhibit excellent antimicrobial activity.<sup>11</sup> According to Athurveda, Gular is one of the medicines which promote physical strength. Gular tree is astringent, ant diabetic, anti-asthmatic, anti-inflammatory, antioxidant, antiulcer, anti-pyretic and anti-diarrheal in action. Bark

of Gular tree is used to treat infections, swelling and inflammation.<sup>12</sup> It is very effective treatment for any kind of mouth problem and chicken pox. It can also be used to cure the swelling of other muscles, due to inflammation and stomach pain effectively.<sup>13</sup> Apply the paste evenly on the affected skin.<sup>14</sup> The present research was aimed to explore selected tree's bark as a source of antibacterial and antifungal natural dyes.

### **Materials And Methods**

#### **Materials:-**

**Source:** -The bark of Gular tree was collected from Tanshipur village, Haridwar district.



**Photo No.1:- Gular Tree Photo No.2:- Gular Bark's Dye**

#### **Experimental Methods:-**

**Dye Extraction:-** The clean air dried bark was chopped into small pieces and coarsely ground using electric grinder. Aqueous medium was prepared in 300 ml of water without using chemicals and maintained the pH 6 separately 30gm of dyestuff was added and the dye was extracted for 90 min. at 90 °C the solution was filtered.

**Test solutions of natural dye:** -Test solution of a series of concentrations viz. 20, 50, 100, 250, 400 mg/ml were prepared by dissolving natural dye obtained from different leaves and barks in aqueous medium.

#### **Antibacterial screening test:-**

**Bacterial strains:** -Antibacterial activity of natural dye obtained from bark. The natural dye was tested against gram positive bacteria, Staphylococcus aureus and gram negative bacteria, Escherichia Coli. The bacterial strains obtained from IIT, Roorkee were used for evaluating antibacterial activity.

**Preparation of bacterial inoculums:** -Stock culture was maintained at 4°C on slopes of nutrient agar active culture for experiments was prepared by transferring bacteria in nutrient broth and that inoculated without agitation for 24 hrs. at 37°C

**Preparation of media:** -The medium was prepared by dissolving Muller Hinton Agar Medium (Himedia) in distilled water. The dissolved medium was autoclaved at 15 lbs pressure at 121°C for 15 minutes.

**Assessment of antibacterial activity of natural dye:** -The antibacterial activity of natural dye was tested against several bacterial isolated using agar well diffusion method. The culture plates were inoculated with 0.1 ml of standardized inoculums ( $1.0 \times 10^{10}$  PBS ml) of each bacterium and spread with sterile swabs wells of 0.9 mm diameter were punched into MHA petriplates containing the bacterial inoculums with sterile core borer. The wells were filled with test solutions of natural dye. After incubation for 24 hrs at 37°C, the plates were observed.<sup>15</sup>

**Antifungal screening test:-**

**Fungal strains:** -The in vitro antifungal activities of the natural dye obtained from bark. The natural dye was assessed against standard strains of two fungi namely *Chrysosporium* fungus and *Fusarium Oxysporium* fungus.. The fungal strains obtained from IIT, Roorkee were used for evaluated antibacterial activity.

**Preparation of fungal inoculums:** -For the antifungal assay, cultivated slants were used for preparing spore suspension in 0.9% saline water.

**Preparation of media:-**The medium was prepared by dissolving PDA media (Himedia) in distilled water and autoclaving at 121°C for 15 min.

**Antifungal activity assay:** -Antifungal activity of natural dye from different selected leaves and bark determined, using agar-well diffusion method. Spore suspensions (0.2 ml) were applied on the surface of the presterilized and autoclaved PDA petridishes and spread by using a sterile glass spreader. Wells of 0.6 mm diameter hole were made in the center of each of the PDA petriplates with help of sterilized cork border. The wells were filled with test solutions of natural dye.<sup>16</sup>

**Collection of fabric for dyeing**

**Fabric:-** Khadi fabric were purchased from Haridwar.

**Preparatory process of the fabric dyeing**

Scouring (ECE phosphate detergent) was done to prepare the fabric for dyeing.

**Preparation of final fabric**

Solution containing 0.5 ml mild detergent per hundred ml of water was prepared and heated at 50°C temperature. These fabrics was dipped into solution & stirred gently for about 30 minutes. Then it was rinsed under tap water till free from trace of detergent.

**Optimization of time & temperature for fabric dyeing**

A series of following experiments was conducted to determine the dyeing time and dyeing temperature:-

**Dyeing time:-** To optimize the dyeing time 3 option were considered i.e., 45, 60, 90 minutes than 90 minutes was found best results and this was selected for the study.

**Dyeing temperature:-** To optimize the dyeing temperature 3 options were 45, 60,

and 80 temperature then 80±%C temperature was found best results and this was selected for the study.

#### **Identification and naming of obtained colours**

The dyed samples were placed on a black background in a smooth from to receive natural dye light and were grouped by colour difference and given a colour name.

#### **Measurement of colour strength (K/S Value)**

The spectral reflections of the dyed samples were measured using a test flash Spectrophotometer (colorimeter).

#### **Test the properties (fastness) of dyed Khadi fabric**

Therefore the dyed fabrics need to be tested for their following color fastness properties:-

##### **Colour fastness to washing**

The washing fastness was determined. The dyed samples were evaluated for the change in colour and the degree of staining with the help of grey scales.

##### **Colour fastness to light (Sunlight)**

In this method the specimens were exposed to day light and the fastness was accessed by comparing the change of colour.

##### **Colour fastness to rubbing**

The rubbing fastness was carried out in dry as well as wet conditions. Assessment of test fabrics was carried out for the staining of the rubbing cotton cloth with grey scale.

##### **Colour fastness to perspiration**

The selected sample was rated per colour fastness to perspiration both acidic and alkaline, with respect to change in colour and degree of staining on the adjacent fabric.

##### **Colour fastness to water**

Colour fastness to water is designed to measure the resistance to water of dyed fabric. The test measured the resistance to water of any colored textiles.

##### **Colour fastness to pressing**

Pressing fastness test of dyed textile products is performed to determine of resistance of textiles to ironing when it is wet and when it is damp.

#### **Results And Discussion**

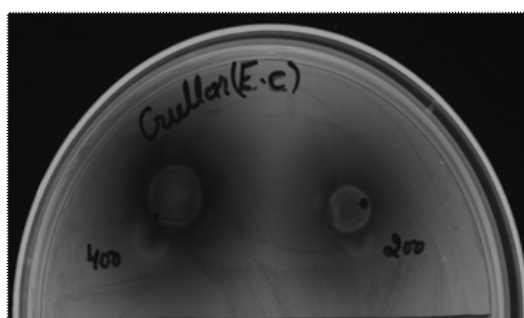
The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:-

##### **Evaluation of antibacterial and antifungal activity of natural dye**

##### **Antibacterial activities of dye extract from gular bark**

**Table 1- Antibacterial test against Escherichia coli**

SR. NO.	Natural dye	Zone of inhibition (mm)
	Concentration(mg/ml)	Escherichia coli
1.	250	1
2.	400	2

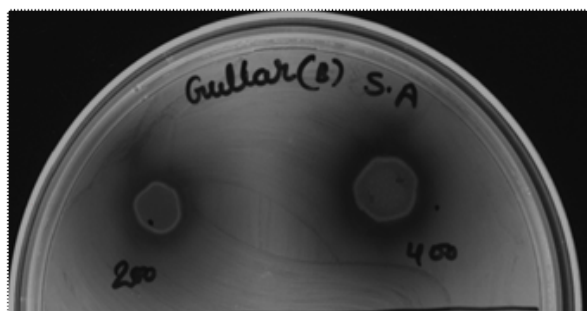


**Photo No.3:- Zone of inhibition (E. Coli) of gullar bark extract**

It is evident from table 1 that test solution of the natural dye at 400 ml concentration showed highest antibacterial activity against all tested microorganisms. Treatment of the natural dye at 250 ml concentrations showed minimum activity against test bacteria.

**Table 2- Antibacterial test against Staphylococcus aureus**

SR. NO.	Natural dye	Zone of inhibition (mm)
	Concentration(mg/ml)	Staphylococcus aureus
1.	250	1
2.	400	2



**Photo No.4:- Zone of inhibition of (Staphylococcus aureus) gular bark extract**

It is evident from table 1 that test solution of the natural dye at 400 ml concentration showed highest antibacterial activity against all tested microorganisms. Treatment of the natural dye at 250 ml concentrations showed minimum activity against test bacteria.

**Antifungal activities of dye extract from Gular Barks.**

**Table 3- Antifungal test against Chrysosporium fungus**

SR. NO.	Natural dye	Zone of inhibition (mm)
	Concentration(mg/ml)	Chrysosporium fungus
1.	20	-
2.	5	8



**Photo No.5:- Zone of inhibition of (Chrysosporium fungus) gular bark extract**

It is evident from data presented in table 3 that the natural dye from Gular bark tested at different concentration exhibited varying the degree of antifungal activity against the two fungal species. Highest reduction in the growth of Chrysosporium fungus test fungi is recorded with 50 ml volume of natural dye. Treatment of the natural dye at 20 ml concentration however, showed minimum activity against all the tested fungus.

**Table 4- Antifungal test against Fusarium Oxysporium**

SR. NO.	Natural dye	Zone of inhibition (mm)
	Concentration(mg/ml)	Fusarium oxysporium fungus
1.	20	-
2.	50	3



**Photo No.6:- Zone of inhibition of (Fusarium Oxysporium) gular bark extract**

It is evident from data presented in table 4 that the natural dye from Gular bark tested at different concentration exhibited varying the degree of antifungal activity against the two fungal species. Highest reduction in the growth of Chrysosporium fungus test fungi is recorded with 50 ml volume of natural dye. Treatment of the natural dye at 20 ml concentration however, showed minimum activity against all the tested fungus.

**Colour obtained from dyes**

In the study, Bony peach color was obtained from dyes in aqueous medium.

**Evaluation of colour strength of obtained dyes colours with colorimeter**

In the study, when the measurement carried out via the colorimeter were evaluated. Colour strength measurement values presented in table No 5:-

Sr.No.	Test Sample	Weave length	K/S
1.	Gular	420	0.74

Gular bark K/S value is 0.78 and L\* value is 58.189, a\* value 14.472 and b\* value 10.728.

**Analysis of fastness properties:-**

The dye applied on to the fabric and their fastness to light, washing, rubbing, perspiration, water and pressing was determined:-

**Evaluation of light fastness**

Dyed Khadi fabric was treated different eight natural dyes and then given the light test.

The results showing the numerical rating for change in colour and for colour staining are presented in the table no.6:-

**Table no- 6:- Evaluation of light fastness**

Sr. No.	Test Samples	Change in color
1.	Gular	2-3



Gular's bark dyed showed considerably changed to noticeably change (2-3) light fastness on Khadi fabric

#### **Evaluation of colour fastness to washing**

For colour fastness to washing, the samples were rated on the basis of change in colour as well as degree of staining of adjacent fabrics. Five point scale was used to evaluate both change in colour and staining. Results obtained were recorded in the table no 7:-

**Table no. -7:- Evaluation of colour fastness to washing**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1.	Gular	2	5

Gular's bark dyes used on Khadi sample showed considerably change (2) in colour but the staining on the adjacent fabric was negligible staining (5).

#### **Evaluation of colour fastness to rubbing (crocking)**

The Khadi samples of Khadi fabric were rated for colour fastness to crocking with in wet and dry condition with respect to change in colour and staining on adjacent sample for dyed sample. Results obtained were recorded in the table no.- 8 and 9:-

**Table no.- 8:- Dry rubbing results**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1.	Gular	5	4

Khadi fabric from gular dye showed Negligible or no change (5) in colour but the dry rubbing staining on the adjacent fabric was slightly changed (5).

**Table NO. 9:- Wet rubbing results**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
2.	Gular	4	4

Khadi dyed fabric from Gular dye showed slightly changed (4) in colour but the wet rubbing staining on the adjacent fabric was slightly change (4).

#### **Evaluation of colour fastness to perspiration**

The selected sample was rated per colour fastness to perspiration both acidic and alkaline, with respect to change in colour and degree of staining on the

adjacent fabric. The reading with grey scale was taken and recorded in table no. 10 and 11:-

**Table No. 10:- Acidic medium results:-**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1.	Gular	5	4

Gular dyed Khadi sample when subjected to acidic perspiration negligible or no change (5) in colour and degree of staining was slightly change (4) on fabric.

**Table No. 11:- Alkaline medium results:-**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1..	Gular	5	4-5

Gular dyed Khadi sample when subjected to alkaline perspiration showed negligible or no change (5) in colour and degree of staining was to slightly change to negligible or no change (4-5) on fabric.

**Evaluation of colour fastness to water**

For colour fastness to water the samples were rated on the basis of change in colour as well as degree of staining of adjacent fabrics. Five point rating scale was used to evaluate both change in colour and staining. The reading with grey scale were taken and recorded in table no. 12:-

**Table No. 12:- Evaluation of colour fastness to water**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1.	Gular	5	5

Khadi fabric from Gular dye showed negligible change or no change (4-5) in colour and degree of staining was negligible or no change (5).

**Evaluation of colour fastness to pressing**

The selected sample was rated per colour fastness to pressing, with respect to change in colour and degree of staining on the adjacent fabric. The reading with grey scale were taken and recorded in table no.13 and 14:-

**Table No. 13:- Dry pressing results:-**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1.	Gular	5	5

Gular dye used on Khadi sample showed negligible or no change (5) in colour in dry pressing but the staining on the adjacent fabric was negligible or no change (5) in dry pressing

**Table No. 14:- Wet pressing**

Sr. No.	Test Samples	Change in colour	Numerical rating for staining
1.	Gular	4-5	4-5

Gular dye used on Khadi sample showed slightly change to negligible or no change (4-5) in colour in wet pressing but the staining on the adjacent fabric was slightly change to negligible or no change (4-5) in wet pressing.

### **Conclusion**

The present work concluded that Gular can be a potential source of eco-friendly natural dye with remarkable antifungal activity and the gular colour fastness is normally slightly change to negligible or no change (4-5) but washing fastness not good.

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