

Application of Biological Active Natural Dye Along With Some Synthetic Mordants on Wool Surface

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ABSTRACT

This study was focused on dyeing of wool fabric with antimicrobial natural dye which was obtained from the Bark extract of *myrica esculenta*. The extract of this plant was investigated for antibacterial properties and results were quite positive. This extract was also applied on wool fabric as a dye. Some mordants viz. Potassium aluminum sulphate, Stannous chloride, Ferrous sulphate and Tannic acid were used along with dye to give various shades to the colour. The dyed fabric then underwent some fastness tests like rubbing washing light etc to investigate the colour stability. The colour strength was also measured by K/S technique. All the results obtained were very good. Colour strength values and the dye uptake were high especially in case of Ferrous sulphate mordant.

Key words: Antimicrobial, dye, mordants, fastness properties wool.

I.INTRODUCTION

Color is one of the elements of nature that made the human living more aesthetic and fascinating in the world. Natural dyeing is as old technique as human civilization [1]. Natural colorants are dyes and pigmentary molecules that are obtained from plant, animal or mineral sources with or without chemical treatments [2, 3]. But due to the discovery of synthetic dye by William Perkin in 19th century natural dye replaced almost completely by synthetic dye. Even today in most of the regions, despite the availability of synthetic dyes, many people continue to use plant extracts for color fabrics, masks or food [4]. Natural dyes have also better biodegradability and generally have higher compatibility with the environment. They are nontoxic, non-allergic to skin, non-carcinogenic, easily available and renewable [5, 6].

From the last few decade a need has been felt by the environmentalist and chemists for discovery of new natural resources and pigments because synthetic dye is associated with number of environmental related issues. The production and evaluation of microbial pigments as textile colorants is currently being investigated [7]. The purpose of this research is to evaluate some antimicrobial extract and its application on fabric as a natural dye for this purpose *Myrica esculenta* plant was selected and its bark extract was used for experiment.

II.EXPERIMENT

2.1 Material and Method

Bark of the plant was collected from the Pauri Garhwal, it was dried under shade and then grinded into a fine powder. The plant was identified with the help of available literature and authenticated by Botanical Survey of India.

2.2 Preparation of extracts

The dried powder of bark was extracted with methanol using soxhlet apparatus and dried using vacuum rotary evaporator.

2.3 Determination of antibacterial activity

The agar cup diffusion method (Perez *et al.*, 1990) was modified. Soyabean casein digest agar (SCDA) was used for bacterial cultures. The culture medium was inoculated with the microorganism separately suspended in soyabean casein digest broth. A total of 8 mm diameter wells were punched into the agar and filled with plant extracts and solvent blanks (Ethanol). Standard antibiotic (Chloramphenicol, concentration 1mg/ml) was simultaneously used as positive control. The bacterial plates were then incubated at 37°C for 18 hrs. The antibacterial activity was evaluated by measuring the diameter of zone of inhibition observed.

2.4 Preparation of dyestuff

Aqueous dye solution was prepared, by adding 5 gm of powder in 100 ml of water. The extraction was done at 100°C for one hour at 6-7 pH. The hot solution was filtered and a clear solution was obtained which is used for dyeing wool fabric.

2.5 Mordants used

Three synthetic mordants and one natural mordant were used for mordanting viz. Potassium Aluminum sulphate, Stannous Chloride, Ferrous sulphate and Tannic acid.

Mordanting has been done in three ways i.e. Pre, Post and Simultaneous. The dyeing was carried out at 1:30 MLR (material to liquor ratio), for 40 min at 80°C. Dyeing and mordanting is done by using Rota-Dyeing machine. As we know that synthetic mordants are very toxic and their maximum use can create an environmental issue so only 1% of mordanting was done which is a permissible limit.

2.6 Different fastness properties

Dyed fabrics were then undergone different fastness tests viz. light, washing and rubbing etc. to optimize the best shade and best method of dyeing.

2.6.1 Test for color fastness to light

This test was carried out as per IS: 2454-1984 method. The dyed samples of 3 × 6 cm were fixed on a black cardboard in such a way that all samples were half exposed and half covered. This frame was placed inside the fadeometer fitted with mercury bulb tungsten lamp (MBTF). The specimens were brought out after 17 hour and color fading was assessed against the blue wool standards (BS 1006: BOI: 1978).

2.6.2 Test for color fastness to washing using Launderometer (TC/ UICT/TEQIP)

Color fastnesses to washing of the dyed samples were determined as per IS: 764-1984 method. In this test the different dyed fabric were cut into pieces of 10 × 4 cm and placed between two pieces of undyed fabrics (wool and cotton) of same size all three layers were sewn from all side this is said to be the sandwich type of arrangement of fabrics. The washing is done by 5% non-ionic soap solution (cell det (R)) for 60 minute using Washing fastness tester (Launderometer) using 50 steel balls. The samples were rinsed in running water and dried in shade and then assessed with the help of grey scale (ISO: 05-A02) and (ISO- 105-A02) for loss of shade and extent of staining.

2.6.2 Test for color fastness to rubbing

This test was done as per IS: 766-1984 method using Crock meter. A piece of cotton was rubbed 10 times on a sample with the help of crock meter. Two types of rubbing were done, wet rubbing and dry rubbing. The staining on the wet and dry piece of fabric is evaluated with the help of grey scale as per ISO-105-A03.

2.7 K/S values (Determination of surface color strength) (Dye ability of dyed fabric)

The K/S value of the dyed and undyed wool fabrics was determined by measuring surface reflectance of the sample using a computer aided Mcbeth 200 plus reflectance spectrophotometer using the following Kubelka-Munk equation

$$\frac{K}{S} = \frac{(1 - R_{\lambda_{max}})^2}{2 R_{\lambda_{max}}}$$

Where K is the coefficient of absorption, S is the coefficient of scattering; $R_{\lambda_{max}}$ is the surface reflectance value of the sample at particular wavelength when maximum absorption occurs for a particular dye / colorant. The K/S values of dyed yarn is directly proportional to the amount of dye present in the material and it has been also found that generally K/S value get increase with mordants.

III.RESULTS AND DISCUSSION

Antimicrobial activity, the methanolic extract of plant, *Myrica esculenta* was tested for antimicrobial activity using agar well diffusion method at sample concentration 200µg/100 ml. The methanol extract of plant showed strong and broad spectrum antibacterial activity against *S. aureus*, *S. typhimurium*, *S. epidermidis*, *E. salazakii*, *E. gergovios*, *B. cereus*, *K. pneumoniae*, *E. coli*

Table-1 Antibacterial activities of kaphal bark extract in the concentration of 10 mg/ml

Strain		Zone of inhibition (mm) of extract	Zone of inhibition (mm) of antibiotic Chloramphenicol
1.	Salmonella typhimurium	7	33
2.	E.coli	17	26
3.	Staphylococcus epidermidis	9	28
4.	Enterobacter salazakii	7	26
5.	Enterobacter gergoviae	8	28
6.	Bacillus cereus	8	27
7.	Klebsiella pneumonia	8	26



Photographs of Zone of inhibition on various strains

IV.INVESTIGATION OF DYE ABILITY

The preliminary experiments shows that the bark extract of *Myrica esculenta* yield a wide range of color shades and so detail study was conducted to standardize the methods of extraction and application of dyes on wool. The results obtained are discussed below

4.1 FASTNESS TESTS

Color fastness to washing: The samples were assessed on the basis of change in color and staining on the adjacent fabrics with the help of grey scale. The rating is given in Table 2

Table 2: Rating of Fastness to washing for wool

S. no.	Mordant used	Mordanting Method	Color change	Staining	
				Cotton	Wool
1.	Pot. Alum. sulphate	Pre	4/5	4	5
		Post	4/5	5	4/5
		Sim.	4/5	4/5	4
2.	Tannic acid	Pre	4	4	5
		Post	4/5	5	4/5
		Sim.	4	4/5	4
3.	Ferrous sulphate	Pre	4	5	4
		Post	5	5	4/5
		Sim.	4	4/5	4/5
4.	Stannous chloride	Pre	4	5	5
		Post	5	5	4/5
		Sim.	4/5	4/5	4/5

4.2. Color fastness to rubbing

On the basis of results it was concluded that noticeable to negligible staining (4-4/5) grading was obtained with about all the mordant in case of dry rubbing, in case of wet rubbing, noticeable to slight (3/4-4) were obtained (Table-3)

Table 3: Rating of Fastness to Rubbing for Wool

S. no.	Mordant used	Mordanting	Staining (Wool)
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		method	Dry	Wet
1.	Pot. Alum. sulphate	Pre	4	3
		Post	4/5	4
		Sim.	4/5	3
2.	Tannic acid	Pre	4	3
		Post	4/5	4
		Sim.	4	$\frac{3}{4}$
3.	Ferrous sulphate	Pre	4	$\frac{3}{4}$
		Post	4/5	$\frac{3}{4}$
		Sim.	4/5	$\frac{3}{4}$
4.	Stannous chloride	Pre	4	$\frac{3}{4}$
		Post	4	$\frac{3}{4}$
		Sim.	5	4

4.3 Color fastness to light

Light is also a very important factor which effect the color, generally color get faded in sun light so this test gives very important information that whether the color applied on fabric is stable to light or not., results obtained are very good which are given below in the Table-4.

Table 4: Rating of Fastness to Light for Wool

S. no.	Mordant used	Mordanting method	Rating values Wool
1.	Pot. Alum. sulphate	Pre	6
		Post	5/6
		Sim.	5/6
2.	Tannic acid	Pre	6
		Post	6/7
		Sim.	5/6
3.		Pre	6

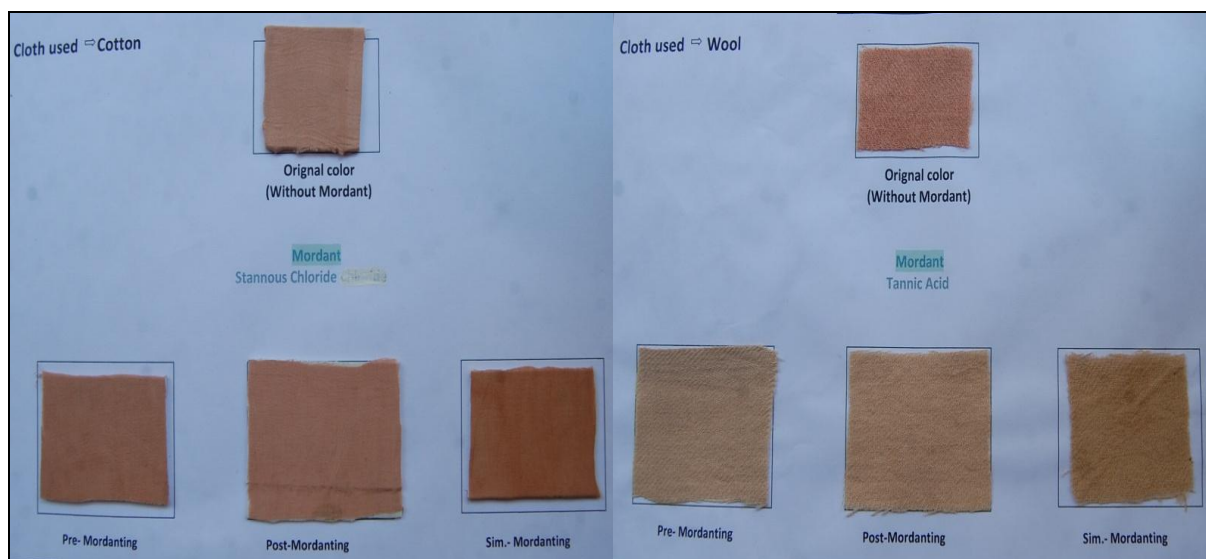
4.	Ferrous sulphate	Post	7
		Sim.	6
	Stannous chloride	Pre	6
		Post	6/7
		Sim.	6

4.4 Dye Ability Test (K/S Values)

The color strength of dyed fabric was scrutinized using computer color matching. It has been seen that maximum color is absorbed in case of Ferrous Sulphate in Simultaneous mordanting method **Table 5**

Table 5: K/S Values of dyed wool sample

S. no.	Mordant Used	Mordanting method	K/S Values Wool
1.	Pot. Alum. Sulphate	Pre	3.3170
		Post	3.4691
		Sim.	2.9031
2.	Tannic acid	Pre	2.5878
		Post	2.4694
		Sim.	2.2919
3.	Ferrous sulphate	Pre	7.0543
		Post	8.6427
		Sim.	2.9408
4.	Stannous chloride	Pre	2.3011
		Post	2.2127
		Sim.	2.1858



V.CONCLUSION

At the end it has been concluded that wool fabric dyed with the natural dye extract from *Myrica esculenta* not only gives the wide variety of shades but its anti bacterial property also give extra protection to the fabric. As natural dye is safe to use with no chemical processing and no environmental issue but if it is antimicrobial it will defiantly increase the life of fabric. The fastness analysis of the dyed fabric was also reveals that dye obtained from this plant is quite effective and hence *Myrica esculenta* is a effective antimicrobial dye yielding plant.

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