Ecofriendly Dyeing with *Senegalia catechu* using biomordant

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ABSTRACT

In the last decade research in the field of textiles is focused on the sources of natural dyes and natural mordant. The flowers of *Senegalia catechu* have been used for dyeing process of wool with biomordant. Banana pseudostem sap was applied as a biomordant in this study. Dyeing process conducted by pre , simultaneous and post mordanting method. The evaluation of colour strength (K/S Value) also done. With the help of Kubelka- Munk equation colourfastness of dyed wool have been tested toward washing and light. Different shades were obtained due to varying concentration of dye. Simultaneous mordanting method given very good to excellent results of dyed wool samples.

KEYWORDS: Ecofriendly dyeing, Mordant, Banana pseudostem sap.

INTRODUCTION

Nowadays after focusing on the global standard of ecofriendlyness and examine the biodegradable characteristics of the natural vegetable materials, considerable research work is being undertaken with the research society around the world on the application of natural dyes in textile industry.

The term natural dye, cover all the dyes derived from natural resources such as plants, insects and animals (Sharma & Grover 2011). Natural dyes are excellent for their soft, non-poisons effect and antimicrobial effect out of that some natural dyes are famous for their lustrous formation of pastel colours. Sometimes it is possible to obtain some excellent shades from natural dyes after the use of mordants.

Most natural dyeing method is done with the use of mordants, most commonly mordants are heavy metal ions, but sometimes tannins. A mordant is a substance used to set dyes on fabrics or tissue section by forming a coordination complex with the dye which then attaches to the fabric or tissue. Each different material used as a mordant produce a different range of colors for each dye.

In 1856, William Perkins accidently synthesized a basic dye. With the origin of synthetic dyes, the use of natural dyes declined tremendously because of existing natural dyes failed to full fill the demand of the market (Singh & Purohit 2012).

Textile industries use acidic, alkaline and different fixative chemicals for dyeing purposes. Large amount of wastewater also discharged to the environment along with above chemicals resulting in bad effect to the ecological balance. Presently dye fixative used in different synthetic dyeing of fabrics often comes from heavy metals and after use disposed off to environment because of which they pollute water and soil systems.

The chemicals used in synthetic dyeing have been linked to health problems including cancer, immune system damage, behavioral problems and hormone disruption.

Banana (*Musa paradisiaca*) is a herbaceous plant belonging to the family Musaceae. It is known to have originated from tropical region of southern Asia. Apart from fruit banana generate huge quantity of biomass as waste in the form of pseudostem, leaves, sucker etc. On an average about 60 to 80 t/ha pseudostem is absolute waste of banana crop in most of state in India. Pseudo stem sap is a thick liquid and very light brown in colour. In this research work banana pseudostem sap which is generally considered as waste has been used as a natural mordant with natural dye.

MATERIAL AND METHODS:

MATERIALS:

Banana pseudostem sap, *Senegalia catechu*, wool fabric, *Acetic acid*.

METHODS:

PSEUDOSTEM SAP COLLECTION:

Collection of Banana pseudostem sap was done from Raver (Maharashtra). A sharp knife cut was placed into the stem of banana and the incision was left in one day. Plastic bottle was used for storage of sap in refrigerator until next step. Pseudostem sap was light brown in colour.

EXTRACTION OF COLOUR COMPONENT:

Dye from *Senegalia catechu* stem powder were extracted by preparing an aqueous solution of stem pieces (10 g in 100 ml distilled water) and the extraction process was carried out at a temperature range of 50-60°C for 90 minutes. Extract was then filtered through muslin cloth to yield the natural dye (Win & Swe 2008).

SCOURING: Scouring of wool has been done with a mild solution of 1-2 gpl Sodium Carbonate and 2 gpl Soap Solution for removing dirt and dust particles (Vanker et al 2009).

BIOMORDANTING:

The wool fabric samples were mordanted using constant amounts of banana pseudostem sap as mordant solution (5% owf) pH 4-5 at 70°C and M: L=1:100 for 60 minute (Aminoddin 2010).

DYEING:

Woolen fabric were immersed into dye baths of varying concentrations of dye (5, 6, 7, 8, 9, 10, 11 & 12% o.w.f.) maintained at M:L (material to liquor) ratio of 1:100 at 4-5 pH with constant concentration of banana sap and acetic acid (5ml) conditions. Temperature of dye bath was set to 70°C and kept at that temperature for 60 min with constant stirring to achieve uniform dyeing. Dyed woolen fabric samples were washed with tap water and dried at room temperature.

COLOR MEASUREMENTS:

The K/S value of the dyed woolen fabric was determined by measuring surface reflectance of samples using a spectrophotometer, with the help of the following Kubelka-Munk equation:

$$\frac{K}{S} = \frac{(1-R)2}{2R}$$

Where K is the absorption coefficient, S is the scattering coefficient, and R is the reflectance of dyed samples (Pruthi 2008).

COLOUR FASTNESS

The dyed material was tested for light fastness and washing fastness. The colour fastness is usually rated either by loss of depth of colour in original sample or is expressed by staining scale (Samanta and Agarwal 2009, Adeel et al 2009)

RESULT AND DISCUSSION

Wool fabric mordanted by banana pseudostem sap with varying concentration of *Senegalia catechu* have been subsequently dyed by using pre, simultaneous and post mordanting method as reported earlier. All the dyed samples have been assessed for their colour strength (K/S) value.

Dyed sample also have been evaluated for their colourfastness behavior to washing and light. Results are given in Table 1.

MEASUREMENT OF K/S VALUE:

Various hues of colour were obtained from pre, simultaneous and post mordanted wool with catechu as shown in graph 1.The different concentration of dye not caused different in hues of colour but changed in the K/S values.

In simultaneous mordanting method highest K/S value was obtained 27.18 with 12% dye whereas in post mordanting process the lowest value of K/S was as 22.27 with 5% dye. It has been showed that the colour strength of dyed fabric increased when the concentration of dye has increased up to some level and then went down or become constant after increasing the concentration of dye.
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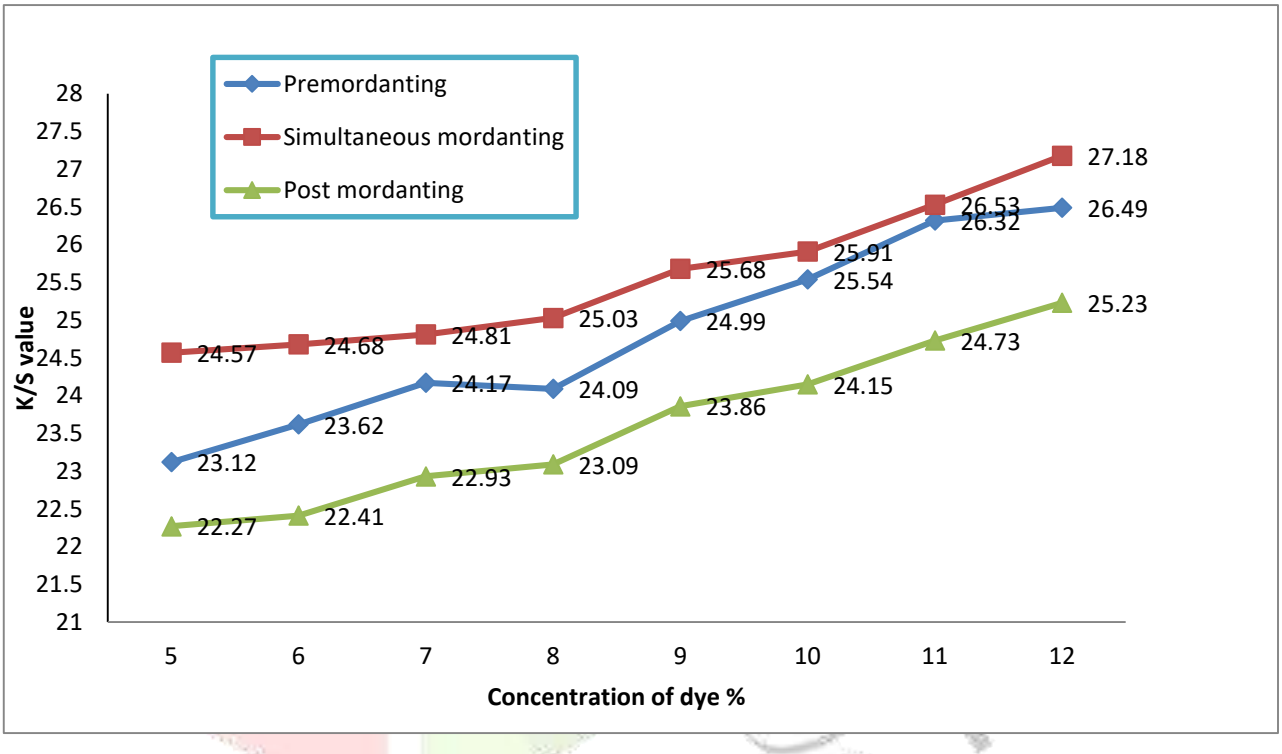
The relative comparison of these different mordanting methods showed the best results with simultaneous mordanting techniques.

Graph-1 colour strength of dyed wool



FASTNESS OF DYED SAMPLE:

Good to excellent washing fastness have achieved in pre mordanted wool between fastness grades of 3-5. The light fastness of dyed sample has moderately good to excellent. Simultaneous mordanting wool sample have showed very good to excellent washing fastness. The light fastness ranged between good to excellent for all treated samples. Post mordanting samples subjected to washing showed moderately good to excellent for all dye concentrations. The light fastness grades obtained between moderately good to excellent.

Results shown that when the concentration of *Senegalia catechu* dye increased the fastness of samples boosted up at some extent on constant temperature and pH. But fastness of wool fabric sample remain unchanged after a definite level of dye concentration.

S.No.	Concentration of Dye (Percentage %)	Mordant Concentration (Percentage %)	Acetic Acid (Percentage %)	Pre Mordanting		Simultaneous mordanting		Post Mordanting	
				Washing Fastness	Light Fastness	Washing Fastness	Light fastness	Washing fastness	Light fastness
1	5	5	5	3	3	4	4	3	3
2	6	5	5	3	3	4	4	3	3
3	7	5	5	3	3	4	4	3-4	3
4	8	5	5	4	4	4	4-5	4	3-4
5	9	5	5	3-4	4	4-5	5	4	4
6	10	5	5	4	4	5	5	4	4
7	11	5	5	5	4-5	5	5	5	5
8	12	5	5	5	5	5	5	5	5

Table-1: colour fastness of dyed wool with banana pseudostem sap mordant using pre, simultaneous and post mordanting.

Fastness Grades: 1-Very Poor, 2- Poor, 3- Moderately Good, 4- Good, 5- Excellent

CONCLUSION:

- On the basis of above research work it is revealed that the banana pseudostem sap, as a mordant can be successfully used for dyeing of wool to obtain a wide range of soft, pestle and light colours.
- Evaluation of colour strength of dyed wool samples shown that the simultaneous mordanting method has higher colour strength than pre and post mordanting.
- In regards to colorfastness, test samples exhibited excellent fastness to washing and light.
- The study carried out is significant in terms of dyeing biomordanting, colour strength and colour fastness by natural ways it natural dyeing predominates then it would be safer for mankind and get rid off of hazardous effects of chemical dyeing.
- Present investigation of natural dyes also helps to preserve the traditional art of dyeing and definitely will improve the popularity of natural material in public.
- Thus the small scale research outcomes will be beneficial for dyers, users and nature too to make environment free from such chemical pollutants.

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