Dyeing of wool with *Acacia pennata*

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Wool fabric has been dyed with an aqueous extract from the bark of *Acacia pennata* containing tannin as the major colourant. Dyeing with the combination of extracts of *Acacia pennata* and banana stem has also been carried out and improvement in depth of colour without altering the tone observed. The colour of the fabrics has been evaluated on computer colour matching system in terms of K/S and L' a' b' colour coordinates. The dyeing shows moderate to good fastness to washing, light and rubbing.

**Keywords:** *Acacia pennata*, Dyeing, Metallic mordant, Natural dye, Wool

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1 Introduction

The role of dyestuff industry in introducing contamination to the environment is increasingly being criticised. Many synthetic dyes lead to various harmful byproducts during their manufacture. A number of azo dyes, which release carcinogenic amines, have already been banned by most of the countries. Moreover, the effluent discharged from the dyeing units is also causing a lot of concern. There is an increasing realisation in the textile industry as well as among the textile consumers to develop and demand ecofriendly methods of dyeing. Natural dyes offer an important alternative as these are safe in use with minimum health hazards and cause less disposal problems.

Natural dyes have been used as a means to colour textiles for centuries. The dyes used till the later half of the nineteenth century were made of the natural raw materials such as roots, stems, barks, leaves, hard woods, berries and flowers of various plants and trees as well as parts of certain insects and shell fishes. Most natural dyes are non-substantive dyes, i.e. they have little colouring power within themselves and require the aid of mordants to improve their characteristics.

In recent years, there has been an interest manifested towards natural dyes; the reasons being manifold, such as ecological movements, biodegradability and better compatibility of natural dyes with environment. Therefore, various possibilities are considered for application of natural dyes.

This paper reports the results of the colouration of wool by using the extract from the bark of *Acacia pennata*. *Acacia pennata* is a large, thorny, climbing shrub found throughout India and Burma in situations which are not too dry. It is also found in most of the districts of Tamil Nadu and in Konkan area of Maharashtra. The bark also has medicinal use for the treatment of diseases of the blood, bronchitis, asthma and stomach complaints. The bark of the shrub contains 9% of tannin and finds major use in tanning of fishing nets.

Banana plant is not a tree, but a giant herb of the same family as lilies, orchids and palms. Scientific name of banana is *Musa acuminate colla* and family is Musaceae. Fibres from banana stem have already been obtained and it is found that the extract of stem has medicinal value for urinary stone dissolution.

The present work also explores the possibility of dyeing with a combination of extracts of *Acacia pennata* bark and banana stem.

2 Materials and Methods

2.1 Materials

Ready for dyeing wool fabric, supplied by Raymond Woollen Mills, Thane, was used for the study. Raw materials to extract colorants were *Acacia pennata* bark and banana stem. Copper sulphate and stannous chloride were used as mordants.

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2.2 Methods
2.2.1 Extraction of Colorants
The bark of *Acacia pennata* shrub and the banana stem were cut into small pieces. *Acacia pennata* bark (5 g) was extracted in 100 ml of water at boil for 1 h in Soxhlet apparatus. The content was cooled at room temperature and filtered. The banana stem pieces were squeezed to get the colourless extract. The extract was then used for qualitative dyeing without any further dilution.

2.2.2 Dyeing with *Acacia pennata*
Wool fabric was dyed at a material-to-liquor ratio of 1:20 in Rota dye. The dyebath containing the extract of *Acacia pennata* bark was maintained at pH 4 by the addition of acetic acid. The temperature was raised to 90°C over 30 min and the dyeing continued further for 1 h. The dyed samples were rinsed with water and then treated with 2 g/litre non-ionic detergent at 60°C. Finally, the samples were washed thoroughly with water, squeezed and dried.

2.2.3 Dyeing with Mixture of Extracts of *Acacia pennata* and Banana Stem
Wool fabric was also dyed in a similar manner using a mixture of extracts of *Acacia pennata* and banana stem in the proportion of 2:1.

2.2.4 Aftertreatment
The dyed samples were treated with two different metallic mordants (2% owm), viz. copper sulphate and stannous chloride at 60°C for 45 min. The treated samples were rinsed with water and then treated with 2 g/litre non-ionic detergent at boil. Finally, the samples were washed thoroughly with water, squeezed and dried.

2.2.5 Evaluation of Dyed Samples
2.2.5.1 Measurement of Colour Values
The dyed samples were assessed for L* a* b* colour coordinates and K/S values (illuminant D65/10° observer) on Spectraflash spectrophotometer with Datamatch 2.0 software (Datacolor International, USA).

2.2.5.2 Fastness Tests
The light fastness of the dyed samples was tested on Suntest CPS (Heraeus-B150, Germany) after partially exposing the samples to the xenon arc lamp for 16 h and graded for the colour change with the ratings.

For wash fastness test, composite samples of 10 cm × 4 cm were made for dyed fabrics using wool and cotton fabrics on either side of the dyed sample and fastness was tested according to ISO-2 test. Samples were then removed, dried and evaluated for the rating.

Both dry and wet rub fastness tests were carried out using Crockmeter machine.

3 Results and Discussion
The extracts of *Acacia pennata* bark and banana stem were obtained separately by boiling in water. It was found that the former extract is unstable to atmospheric storage conditions when kept even for a day. Hence, the dyeing needs to be carried out with the fresh extract only.

The natural dye obtained from *Acacia pennata* was used for dyeing of wool alone as well as in combination with extract of banana stem and then the dyed wool was aftertreated by two mordants, namely copper sulphate and stannous chloride.

Fig. 1 shows the K/S values for untreated dyed samples as well as for those treated with copper sulphate and stannous chloride. The K/S values are found to be maximum for copper sulphate treated sample followed by stannous chloride treated sample; the lowest value being for untreated sample. Similar results are also obtained for the dyeing with the combination of extract of *Acacia pennata* and banana stem although the overall K/S values are found to be little lower in this case.

Table 1 shows the colour characteristics of the natural dyed samples with and without mordants. The dyed samples do not show any significant tonal

![Graph](image-url)
variation on mordanting as is evident from the values of colour coordinates. Here, \( L^* \) represents lightness/darkness; \( a^* \), the red / green value; and \( b^* \), the yellow / blue value. It may be observed that the values for each colour coordinate vary between the tolerance limits of ±5, which is acceptable as visually these differences cannot be perceived.

Table 2 shows that the fastness properties of the samples dyed with *Acacia pennata* and post mordanted with copper sulphate and stannous chloride are better than those of the only dyed samples.

The dyeing with *Acacia pennata* bark and banana stem extracts together shows better fastness levels as compared to the dyeing with *Acacia pennata* alone. However, in the combination dyeing, the fastness levels do not improve further on mordanting. Thus, it seems that the use of banana stem extract itself acts as a good mordanting agent. This indicates the possibility of eliminating the use of non-ecofriendly mordants containing heavy metals, such as stannous chloride and copper sulphate, at the same time not changing the tones of dyeing significantly.

This new natural colorant, therefore, adds to the fast colours obtained in the category of yellow-brown shades for wool.

### References
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