



## Effect of Tannic Acid and Metallic Mordants on the Dyeing Properties of Natural Dye Extracted from *Justicea carnea* Bark

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### ABSTRACT

*This study is aimed at the production and application of natural dyes extracted from Justicea carnea and also to investigate the effect of tannic acid and metallic mordants on the dyeing properties of the natural dye. The alkaline extract of the dye was applied on the chrome-tanned leather without and with single and double pre-mordanting. It was found that pre-mordanting with tannic acid, ferrous sulphate, zinc sulphate and aluminum sulphate affect both the colour characteristics and fastness properties of the natural dye. Overall, double mordanting with tannic acid and ferrous sulphate gave the best results in terms of both colour depth and fastness properties.*

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### INTRODUCTION

Textile industry, at present, almost exclusively uses synthetic dyes and pigments based on non-renewable petrochemicals. The use of natural organic dyes obtained from renewable resources such as plants and trees have the potential for not only preserving the precious petrochemicals but also the all-endangered environment for our coming generations. In spite of their inferior fastness properties, natural dyes can be employed in the coloration of natural as well as synthetic fibers (S.A. Verissimo., *et al* 2001). Dyes are organic compounds which are widely used for imparting color to textiles. They are produced either chemically or from plants.

An interesting point about them is that unlike paint, they do not build up on the surface of the fiber but are absorbed into the pores of the material. This becomes possible because of two reasons. First, the size of the dye molecules is smaller than the size of the pores in the fiber. The dye molecules have a shape like narrow strips of paper, that is having length and breadth but relatively little thickness. This planar shape assists them to slip into the polymer system when the fiber, yarn or fabric is introduced into the dyebath, (Choudhary., *et al* 2006).

### METHODOLOGY

#### Dye Extraction

An alkaline extract of the dye was prepared by adding 10g of *Justicea carnea* to 125ml 0.3M sodium hydroxide solution in a flask. The mixture was heated, held at boil for 75min, allow to stand for cooling to room temperature and then filtered through a piece of filter paper. The filtrate will then be used for dyeing of leather samples

#### Dyeing without Mordanting

A control samples of 2g of leather sample was dyed in 100mL of the extract using 50g/dm<sup>3</sup> sodium sulphate (Na<sub>2</sub>SO<sub>4</sub>) without adjusting the pH of the dye bath. The temperature of the dye bath was raised to 80°C over 25min (2°C min<sup>-1</sup>) and maintained at this level for 100 min in the exhaust dyeing machine. Then, the leather was removed from the dye bath and rinsed successively in cold, hot and cold water before drying in air.

#### Dyeing after single mordanting

In single-stage mordanting, samples of leather were treated separately with tannic acid,

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ferrous (II) sulphate heptahydrate, zinc (II) sulphate and aluminum (III) sulphate hexadecahydrate, each at 4% on the weight of leather (o.w.l) Concentration using leather to liquor ratio of 1:15 at 60°C for 1h. The mordanted samples will then be rinsed in cold water and allowed to dry in air before dyeing at the same conditions as was used for dyeing the control sample.

### Dyeing after double-mordanting

In two -stage mordanting three leather samples, mordanted with tannic acid was mordanted once again separately with ferrous (II) sulphate heptahydrate, zinc (II) sulphate and aluminum (III) sulphate hexadecahydrate, each at 4% o w.l ( on the weight of leather) concentration using leather to liquor ratio 1:15 at 60°C for 1h . The double mordanted samples will then be rinsed in cold water and allowed to dry in air before dyeing at the same conditions as was used for dyeing the control sample.

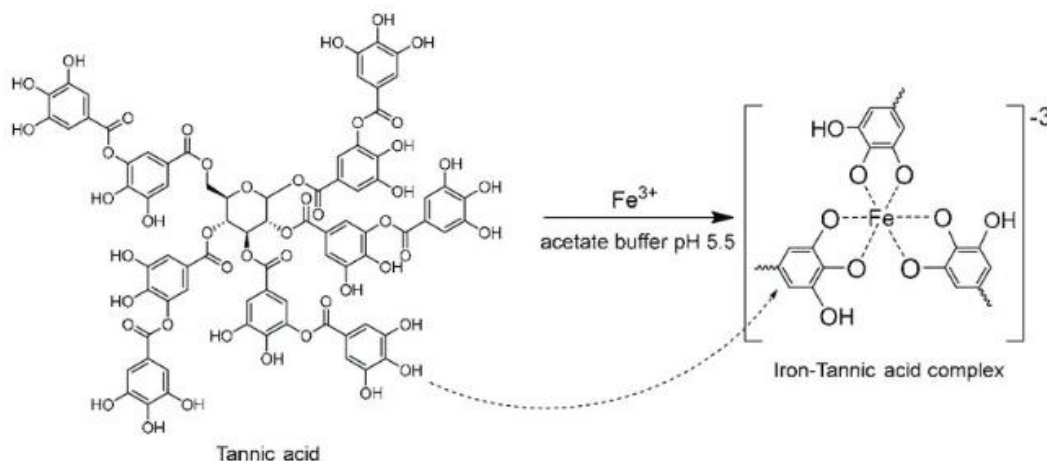
### Colour Fastness Test

Washing fastness of the dyed samples was tested according to BS EN ISO 105-C10:2007 at 60°C for 0.5h. Light fastness of the dyed samples was tested according to BS EN ISO 105 -BO2:1999 using Xenon Arc lamp. Rubbing fastness of the dyed samples was tested according to BS EN ISO 105-X12:2002<sup>11</sup>.

## RESULTS AND DISCUSSION

Effect of mordanting on colour fastness properties of dyed cotton: Table-1.0 gives fastness properties of chrome-tanned leather dyed with *Justicea carnea*, without and with mordanting. Washing fastness, in terms of colour change, increase up to 1/2 grade when ferrous sulphate and zinc sulphate are used in mordanting while washing fastness in terms of staining to cotton increases up to 1/2 grade when all mordants are used alone and in case of tannic acid and ferrous sulphate used together. This could be attributed to the formation of insoluble colour complex on fabric.

Furthermore, sample without mordanting also had good washing fastness, because *Justicea carnea* extract containing tannins/polyphenols which also act as mordant. Dry rubbing fastness improves up to 1 grade when mordanting is done with aluminium sulphate alone and tannic acid and ferrous sulphate used together. There is no improvement in wet rubbing fastness properties due to mordanting. It rather decreases in all cases except when tannic acid and zinc sulphate is used together. As far as light fastness in concerned, it increases due to mordanting in all cases. Light fastness is improved in most of the cases the double mordanting with tannic acid and ferrous sulphate, followed by single mordanting with ferrous sulphate.



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**Table 1.0:** Phytochemical Screening of Plant Extract

S/N	Constituent	Availability
01	Tannins	+
02	Alkaloid	+
03	Saponins	+
04	Flavonoid	-
05	Steroid	+
06	Glycoside	+

S/N	Constituent	Availability
07	Terpenoid	-
08	Phlobotannin	+
09	Oxalate	+
10	Phenol	+
11	Quinones	-
12	Coumeric	+

KEY: + = Present, - = Absent

**Table 2.0:** Fastness Properties of Leather Dyed with *Justicea carnea* Leaf Extract

Sample	Rub Fastness		Light Fastness
	Dry	Wet	
Without Mordant	4-5	4	3-4
Tannic Acid	4	4	4
Ferrous Sulphate	4-5	4-5	4
Zinc Sulphate	5	4-5	4-5
Aluminium Sulphate	4-5	4-5	4-5
Tannic Acid + Ferrous Sulphate	5	5	5
Tannic Acid + Zinc Sulphate	4	4	4-5
Tannic Acid + Aluminium Sulphate	4	4	4-5

## CONCLUSION

Chrome-Tanned Leather was successfully dyed with natural dye extracted from *Justicea carnea*, with and without mordanting, achieving reasonably good overall colour fastness properties. Mordanting results not only improve the colour depth and brightness in some cases but also leads to improvement in colour fastness properties. While mordanting with tannic acid enhances the colour depth the most, mordanting with ferrous sulphate best results in the improvement of colour fastness properties. Double mordanting with tannic acid and ferrous sulphate gives the best overall results, both in terms of colour depth and fastness properties.

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