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A Case Study

Improving the colour fastness of the selected natural dyes on cotton

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■ **ABSTRACT :** This paper reports the improving the colour fastness of the natural dye with dye fixing agents, extraction of the colourants from natural sources; effects of different mordants and mordanting methods; selection of fixing agents; dyeing variables; post-treatment process and analysis of colour improvement parameters with fixing agents for cotton dyed with natural dye; assessed colour improvement with rubbing colour fastness test.

■ **KEY WORDS:** Eucalyptus bark natural dye, Fixing agents, Colour fastness, Eco-friendly mordants

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Natural dyeing of the textiles is an age-old practice. It is the result of the quest of man for beauty of colouring his body, which made him discover the colouring matter from natural sources such as plants and animals. But the invention of synthetic dyes has limited the application of natural dyes. Natural dyes are considered to be very good for their colour experimentation, quality, excellent for their endurance and soft lustrous colouring. Even after a long period they retain beauty and charm. They do not create any pollution problems as they are applied with simple chemical reactions. The natural dyes have several advantages over synthetic dyes from the point of view of health, safety and ecology.

Materials and methods used in this study are given below :

In this article we reviewed improving the colour fastness properties of natural dyes with 5 dye fixing agents. Eco-friendly mordants such as alum, stannous chloride and ferrous sulphate. Eucalyptus Bark dye was selected for the study as this source produce fugitive colours on cotton. A pre-treatment with myrobalan was given for better dye uptake. After dyeing the sample were post treated with 5 dye fixing agents such as alum, ammonia, lime juice and calcium chloride for better colour fastness of natural dyes on cotton.

The dye extraction and treating procedures were standardized based on the procedures suggested by AICRP- Home science (1997). The treatments were given to the cotton samples and evaluation of treated samples in terms of colour fastness to sun light, washing, crocking and perspiration before and after treatment was undertaken by following the standard procedures laid down by Bureau of Indian standard Test Series IS 768-1956 for colour change and is 769-1956 for staining using geometric grey scale. The results were analyzed based

on the colour fastness of control samples to find out the impact of the treatments.

Alkaline method was suitable for extraction of dye from Eucalyptus Bark. The optimum time for extraction of dye liquor from the Bark 60 minutes. A dye material concentration of 4 per cent (2g/g of fabric) was selected. The optimum time for dyeing was 45 minutes for both then dye. Cotton fabric was pre treated with 20 per cent myrobalan concentration. Increase the tannin deposition which intern increased the depth of the shade obtained.

To improve the colour fastness 5 per cent solution of fixing was selected. Based on absorption values, depth of the shade and appearance three concentrations for each mordant was selected. In case of alum 5, 10 and 15 per cent and 1, 2 and 3 per cent concentrations of stannous chloride and ferrous sulphate mordants for cotton were selected for pre mordanting cotton fabric. Evaluation of colour fastness of test fabrics with two colour fastness tests were carried out on cotton fabric to evaluate the colours obtained from Eucalyptus Bark and also assess improvement in colour of the fabric treated with fixing agents (Agarwal *et al.*, 1992a and b).

Post-treatment with fixing agents :

This is a post-treatment given to dyed fabrics to aid fixing of dye on to the fabric. Five eco-friendly fixing agents such as vinegar, alum, ammonia, lime juice and calcium chloride were selected for the re-treatment. These fixing agents were selected, as they are common fixing agents used for dyeing fabrics. As per Dedhia (1998) first 5 per cent solution of each of the fixing agents was prepared. Five per cent of fixing agents produced noticeable changes in the dyed samples. Hence, 5 per cent fixing agent was selected. Later, the dyed fabric was placed in the solution for 30 minutes. Finally the fabric was removed, rinsed in warm soap solution and dried.

The most common serviceable conditions such as the following were selected for evaluation of the colour fastness of fabrics.

Evaluation of colour fastness tests :

Dry crock fastnesses of eucalyptus bark dye on cotton:

Dry crock fastness of Eucalyptus Bark dye on cotton mordanted with eco-friendly mordants and post-treated with various fixing agents.

The dry crock fastness grades of control exhibited good to excellent resistance to colour change and colour staining. Alum mordanted cottons showed good to excellent resistance to colour change due to dry crocking. Stannous chloride and ferrous sulphate mordanted cottons exhibited good resistance to colour change. All mordanted samples. Except, 1 per cent alum and 1 per cent stannous chloride mordanted cottons had good resistance to colour staining to colour staining due to dry crocking (Table 1).

All the dye fixing agents used for treatment such as vinegar, alum, ammonia, lime juice and calcium chloride had contributed for excellent fastness in terms of colour change and colour staining due to dry crocking. All mordanted samples showed improvement over control (Jayakar, 1979; Mahale, 2002, Mahale and Sunanda, 2000).

Table 1 : Dry crock fastness properties of eucalyptus bark dye on cotton

Mordant	Mordant Conc. G/100g of fabric	Fastness grades											
		Control		T_1		T_2		T_3		T_4		T_5	
		CC	CS	CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
Alum	5	5	5	5	5	5	5	5	5	5	5	5	5
	10	5	4/5	5	5	5	5	5	5	5	5	5	5
	15	4	4/5	5	5	5	5	5	5	5	5	5	5
Stannous chloride	1	4	5	5	5	5	5	5	5	5	5	5	5
	2	4	4/5	5	5	5	5	5	5	5	5	5	5
	3	4	4/5	5	5	5	5	5	5	5	5	5	5
Ferrous sulphate	1	4	4/5	5	5	5	5	5	5	5	5	5	5
	2	4	4/5	5	5	5	5	5	5	5	5	5	5
	3	4	4/5	5	5	4/5	4/5	5	5	5	5	4/5	4/5

Percentage: 3%; Mordants: alum, stannous chloride, ferrous sulphate extraction medium: alkaline alkali conc. 1g/100ml. Dye extraction time: 60 min. Mordanting time: 30 min. Dyeing time: 45 min. Note: vinegar (CH_3COOH), T_2- Alum Alk $(SO_4)_2$, T_3-Ammonia (NH_3), T_4- Lime juice, T_5- Calcium chloride ($CaCl_2$)

Wet crock fastnesses of eucalyptus bark dye on cotton:

The wet crock fastness of eucalyptus bark dye on cotton mordanted with eco-friendly mordants and post-treated with various fixing agents.

The wet crock fastness grades of control showed very fair to good resistance to colour change and colour staining. Alum and stannous chloride mordanted samples showed very fair to good resisatnce to colour change. Ferrous sulphate mordanted samples showed only very fair resistance to colour change and staining in all mordanted samples (Table 2).

Post-treatment with vinegar exhibited good to excellent resistance to colour change and staining due to wet crocking. Good to excellent resistance to colour change was noticed in alum, stannous chloride and ferrous sulphate mordanted samples, except 3 per cent ferrous sulphate mordated cottons, exhibited excellent resistance to staining due to wet rub fastness. Post-treatment wit vinegar had improved the wet crock fastness of mordanted samples in terms of resistance to colour change and colour staining over control (Mairal and Shah, 2001).

Alum post-treated cottons showed excellent resistance to colour change due to wet crocking. Good to excellent resistance to staining was found. The wet crock fastness of cottons mordanted with minimum per cent of the mordant showed excellent resistance to staining than higher concentration. All other mordanted samples exhibited good resistance to colour staining due to wet crocking. Alum post-treated cottons registered much improvement in wet crock fastness in all mordanted samples over control.

Post-treatment with ammonia with seemed to have imparted excellent resistance to colour change in all mordanted samples due to wet crocking over control. Resistance to staining was also found to be good to excellent. Majority of the mordanted samples showed excellent resistance to staining due to wet crocking.

Post-treatment with lime juice had contributed for good to excellent resistance to colour change due to wet crocking mordanted cottons dyed in eucalyptus bark dye. Good to excellent resistance to staining was observed in mordanted samples. Alum and stannous chloride mordanted samples showed excellent resistance to colour change. Good resistance to colour change was found in ferrous sulphate mordanted samples dye to wet crocking. Excellent resistance to staining was noticed in alum mordanted samples. Stannous chloride mordanted samples showed good to excellent resistance to staining. In case of ferrous sulphate mordanted samples, good resistance to staining was observed. Post-treatment with lime juice had also registered improvement in wet crock fastness with negligible stains over control.

Calcium chloride mordanted cottons showed good to excellent resistance to colour change due to wet crocking. Good to excellent resistance to staining varied as per the mordant used. All mordanted cottons except 3 per cent ferrous sulphate mordanted cottons, exhibited excellent resistance to colour change due to wet crocking. Good to excellent resistance to staining was observed in alum and stannous chloride mordanted samples. Ferrous sulphate moprdanetd cottons also showed good resistance to staining this indicated much improvement over control. Similar work related to the present topic

Table 2 : Wet crocking fastness properties of eucalyptus bark dye on cotton

Mordant	Mordant Conc G/100g of fabric	Fastness grades											
		Control		T_1		T_2		T_3		T_4		T_5	
		CC	CS	CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
Alum	5	4	4	5	5	5	5	5	5	5	5	5	5
	10	4	3/4	5	5	5	4	5	5	5	5	5	5
	15	3/4	3/4	4	5	5	4	5	4	5	5	5	4
Stannous chloride	1	4	4	5	5	5	5	5	5	5	5	5	4
	2	4	3/4	5	5	5	4	5	5	5	4	5	4
	3	3/4	3/4	4	5	5	4	5	4	5	4	5	5
Ferrous sulphate	1	3/4	3/4	5	5	5	5	5	5	4	4	5	4
	2	3/4	3/4	4	5	5	4	5	5	4	4	5	4
	3	3/4	3/4	4	4	5	4	5	4	4	4	4	4

Dye percentage: 3%; Mordants: Alum, stannous chloride, ferrous sulphate Extraction medium: alkaline; Alkali conc. 1g/100ml; Dye Extraction Time: 60 min; Mordanting time: 30 min; Dyeing time: 45 min; Note: Vinegar (CH_3COOH), T_2-Alum $AlK(SO_4)_2$, T_3-Ammonia (NH_3),T_4- Lime juice, T_5- Calcium Chloride ($CaCl_2$)

was also done by Kumaresan *et al.* (2011); Singla *et al.* (2013) on cotton and Bhavani and Sharada Devi (2012) on banana carpet yarn.

Conclusion :

Among the mordanted eucalyptus bark dyed post-treated cottons, vinegar post-treatment had contributed in deepening the dye shades and leveled dyeing incase of alum and ferrous sulphate mordanted samples. It was unsuitable for stannous chloride mordanted samples. All mordanted samples showed improved dry and wet crock fastness over control.

Alum post-treatment had contributed for even dyeing and increased in depth of shade in case of stannous chloride and ferrous sulphate mordanted samples. Superior dry crock fastness was observed in all mordanted samples. Much improvement in wet crock fastness in all mordanted samples was observed over control.

Ammonia post-treatment had not contributed for production of good shades in all mordanted samples the dry and wet crock fastnesses of all mordanted cottons were improved.

Lime juice post-treatment had contributed for production of better shades in all mordanted samples with level dyeing. Improvement in dry and wet crock fastness of eucalyptus bark dye was observed on mordanted cottons.

Calcium chloride post-treated samples had not contributed for obtaining better shades but even dyeing was found in all mordanted samples. The dry crock fastness of all mordanted samples increased without any staining, the wet crock fastness of alum and ferrous sulphate mordanted cottons alone increased over control.

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