

Original Research Article

<https://doi.org/10.20546/ijcmas.2023.1206.008>

## Anti-UV Properties of Baco (Organic Cotton+Banana) Fabric Dyed with *Terminalia arjuna* as Dye and Selected Mordants

Daksha  and Meenu Srivastava 

Department of Textiles and Apparel Designing, College of Community and Applied Sciences,  
MPUAT, Udaipur, Rajasthan, India

\*Corresponding author

### ABSTRACT

#### Keywords

Natural dye,  
*Terminalia arjuna*,  
UV protection,  
Baco, Blend,  
Colour fastness

#### Article Info

**Received:**

xx May 2023

**Accepted:**

xx June 2023

**Available Online:**

xx June 2023

Ultraviolet (UV) radiations are carcinogenic, repeated UV exposure causes damage to skin cells and leads to develop skin cancer. Present research work has been undertaken to develop eco-friendly Bacofabric blend of Organic cotton and Banana having UV protective action along with good colorfastness properties by extracting the dyes using *Terminalia arjuna* at various dyeing concentrations. Optimal results were achieved by dyeing at 80 °C for 90 minutes using the pre-mordanting method with different mordants. The developed dyed samples very good results in terms of colour fastness to washing and sunlight. Findings showed that the mordanted samples have high dye uptake with excellent UPF values. These results are very important for industrial application with the application of *Terminalia arjunadye* on Baco fabric in providing UV protection to textiles for varied end uses.

### Introduction

Vitamins Organic cotton composed of hollow fibres that are naturally soft, cool, breathable, and absorbent (Patil, 2020). Majority of the banana waste biomass is pseudo-stem, which produces high-quality fiber (Balda *et al.*, 2021) have high strength, light weight, low elongation, fire resistance, strong moisture absorption, great potential, and biodegradability (Bhatnagar *et al.*, 2015) and have long been known to have antibacterial or anti-UV properties, making them a green, environmentally friendly option (Sangeetha *et al.*, 2015). As the

present trend throughout the world is shifting towards the use of eco-friendly and biodegradable commodities, the demand for natural dyes is increasing day by day as a result interest in the use of natural dyes in fabric coloration has been growing (Ashrafi *et al.*, 2018).

A revived interest in natural dyes has emerged as a result of increased awareness of the environmental and health risks involved with the manufacturing, processing, and usage of synthetic dyes (Kanchana *et al.*, 2013). By keeping all this point in mind to impart all these properties in one fabric the

researchers developed a blend fabric dyed with natural dye to improve the color fastness properties and to increase the UV protection properties of the fabric.

## **Experimental Procedure**

### **Procurement of the raw materials**

The *Terminalia arjuna* dye and selected mordants (*Terminelia chebula*, *Punica grantum*. Potassium aluminium sulphate, Ferrous sulphate, Stanous chloride) used in present research were procured from the department of Textiles and Apparel Designing, CCAS, MPUAT, Udaipur and the Baco fabric blend of organic cotton and banana fibre was procured from the Pahartah Fashion Llp, Himachal Pradesh.

### **Dye extraction from *Terminalia arjuna***

The collected arjuna root were dried in sunlight and later crushed to small pieces before being used for dye extraction. The dye extraction was performed by mixing the plant material and distilled water in the weight ratio of 1:10 and boiling for one hour (Mongkholrattanasit, 2016). After that, the resulting solution was filtered to remove the residue.

### **Standardization of dyeing conditions**

Four dyeing conditions, i.e. dye extraction time, dyeing time, mordant concentration and dye concentration were optimized for colouring of Baco fabric blend with selected dye and mordant.

### **Optimization of dye extraction time**

10 grams of dye powder was added to three beakers containing 100 ml of was boiled at 80<sup>0</sup>Celsius to optimize the dye extraction time. After being kept at room temperature for 12, 24, and 48 hours. On the basis of optimized dye extraction time 24 hours was selected.

### **Optimization of Dyeing time**

The dyeing treatment was given for three different time durations i.e. 60, 75 and 90 minutes and on the basis of optimized dye time 90 minutes was selected.

### **Mordant and dye concentration**

Pre-mordanting techniques were used with five different types of mordants (*Punica granatum*, *Terminalia chebula*, Potassium aluminium sulphate, Ferrous sulphate, and Stanous chloride) at concentrations of 5% and 10% for natural mordants and 2% and 4% owf for chemical mordants.

The dye concentration was varied between 20% and 30% owf. Based on percent dye absorption value 30% dye concentration, 10% concentration for natural mordants, and 2% concentration for chemical mordants were chosen. Baco fabric was dyed for 90 minutes at 80<sup>0</sup>C with MLRof 1:100 (Tiwari *et al.*, 2019). The samples that had been dyed were then rinsed with cold water and dried by air. For testing washing and light fastness properties Gauge IS: 764:1979 and IS/ISO105 standard test methods were used.

## **Results and Discussion**

### **Effect of dyeing on fastness properties**

The wash and light fastness characteristics of Baco fabric samples dyed with *Terminalia arjuna* and various mordants using the pre-mordanting method were good to excellent in colour change (cc) grade and good to excellent in wash staining ratings, ranging from 4 to 5 on the grey scale, with no staining on adjacent fabric as compared to unmordanted samples, and exhibit good to excellent fading when tested for light fastness (5-7), as shown in Table no.1. *Punica grantum* mordant was chosen for further testing of anti-UV properties on fabric based on ratings. And supported by Nayak (2014) a study of jute-cotton and jute-wool union fabrics dyed with *Rheum emodi* colorant, thickened with

guar gum and albumin, and dyed with aluminum, copper, and iron sulfates as mordants. The different shades produced by printing with *Rheum emodi* colorant and various mordants ranged from yellowish brown, deep brown, reddish brown, and gray shades to olive black and all printed samples have good to excellent wash, rubbing, and light fastness properties.

**Effect of dyeing on UV protection property**

The unmordanted dyed samples have a low UPF value then the mordanted treated samples and show a greatest improvement in the UV protection categories are presented in Table no.2. This study can be supported by Saleh (2012) conducted a

banana peel study on cotton substrate. The data obtained demonstrated that, when compared to the control and unmercerized cotton fabrics, the mercerized fabrics have superior antibacterial activity, high dye uptake, and high UV protection properties.

In conclusion, *Terminalia arjuna* dyed fabrics demonstrated very good colour fastness to wash and light fastness, while the presence of *Punica grantum* increased UV protection from very good to excellent levels. In short, the Baco fabric blend of organic cotton and banana produced great results in terms of improvement in colour fastness and UV protection characteristics and has a good scope of its use in textile sector for various applications.

**Table.1** Wash fastness and light fastness ratings of Baco fabric dyed with *Terminalia arjuna* dye

Mordants concentration	Wash fastness				Light fastness	
	CS		CC		Control	Experimental
	Control	Experimental	Control	Experimental		
<i>T.Chebula</i> (10%)	2/3	4	2/3	3/4	4	8
<i>P.Alum</i> (10%)	2/3	4	2/3	4/5	4	7
<i>P.grantum</i> (10%)	2/3	5	2/3	5	4	8
<b>Ferrous Sulphate</b> (2%)	2/3	4	2/3	4	4	7
<b>Stanous Chloride</b> (2%)	2/3	4/5	2/3	4	4	7

\*Control-unmordanted fabric sample, Experimental-mordant treated fabric sample, CS-colour staining and CC-colour change

**Table.2** UPF ratings of *Terminalia arjuna* dyed samples

Fabric	Mordant	UPF	UV-A (Transmission %)	UV-B (Transmission %)	Blocking (UV-A %)	Blocking (UV-B %)	Protection Category
<b>BACO (Control)</b>	<i>P.grantum</i>	48.21	2.01	2.08	97.89	97.80	Very good
<b>BACO(Exp.)</b>	<i>P.grantum</i>	75.01	1.20	1.28	98.99	98.97	Excellent

\*Control-unmordanted fabric sample, Experimental-mordant treated fabric sample and *P.grantum-Punica grantum*

**Fig.1** Colour shades of dyed fabric with different mordants



## References

- Ashrafi, N., Gharanjig, K., Hosseinezhad, M., Khajeh Mehrizi, M., Imani, H., & Razani, N. (2018). Dyeing properties and color fabrics using natural dye and mordant. *Progress in Color, Colorants and Coatings*, 11(2), 79-83.
- Balda, S., Sharma, A., Capalash, N., & Sharma, P. (2021). Banana fibre: A natural and sustainable bioresource for eco-friendly applications. *Clean Technologies and Environmental Policy*, 23, 1389-1401. <https://doi.org/10.1007/s10098-021-02041-y>
- Bhatnagar, R., Gupta, G., & Yadav, S. (2015). A review on composition and properties of banana fibers. *Cellulose*, 60, 65.
- Kanchana, R., Fernandes, A., Bhat, B., Budkule, S., Dessai, S., & Mohan, R. (2013). Dyeing of textiles with natural dyes-an eco-friendly approach. *International Journal of ChemTech Research*, 5(5), 2102-2109.
- Mongkhohrattanasit, R., Punrattanasin, N., Rungruang kitkrai, N., Somboon, B., Narumol, N., & Nakpathom, M. (2016). Dyeing, fastness and UV protection properties of cotton fabric dyed with mangrove bark extract. *Cellulose Chemistry and Technology*, 50(1), 163-171.
- Nayak, L. 2014. A Study on Coloring Properties of *Rheum emodi* on Jute Union Fabrics. *Journal of Textiles*. 8: 4 <https://doi.org/10.1155/2014/593782>
- Patil, K. P. (2020, February). *Organic Cotton-Benefits, Uses & Production*. Organic Facts. Retrieved May 27, 2023, from <https://www.organicfacts.net/organic-cotton.html>
- Saleh, S. M. 2012. Antibacterial Activity and UV Protection Property of Some Egyptian Cotton Fabrics Treated with Aqueous Extract from Banana Peel. *International Journal of Clothing Science*. 1(1): 1-6. <https://doi.org/10.5923/j.clothing.20120101.01>
- Sangeetha, K., Gomathi, R., & Bhuvaneshwari, M. (2015). Dyeing of silk fabric using lemon leaves extract with the effect of different mordants. *International Journal of Innovative Research in Science, Engineering and Technology*, 4(6), 4692-97. <https://doi.org/10.15680/IJRSET.2015.0406129>
- Tiwari, A., & Srivastava, M. (2019). Colouration and UV protection properties of cotton khadi fabric dyed with galls of *Quercus infectoria* dye extract. *Man-Made Textiles in India*, 47(2).

## How to cite this article:

Daksha and Meenu Srivastava. 2023. Anti-UV Properties of Baco (Organic Cotton+Banana) Fabric Dyed with *Terminalia arjuna* As Dye and Selected Mordants. *Int.J.Curr.Microbiol.App.Sci*. 12(06): 58-61. doi: <https://doi.org/10.20546/ijcmas.2023.1206.008>