

Effect of dyeing on physical properties of rayon-silk blend fabric

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■ **ABSTRACT :** The study focus on effect of dyeing on physical properties of rayon-silk blend fabric. Commercially available Rayon-silk blended (70% rayon and 30% silk) fabric was procured from market. The fabric was scoured to prepare for dyeing. The scoured fabric was pretreated with 3 per cent (o.w.f.) alfix and dyed with *Kachnar* bark (*Bauhinia variegata*) dye using two synthetic and two natural mordants. Synthetic mordants used were: copper sulphate and potassium permanganate and natural mordants were Indian gooseberry and eucalyptus. The mordants were applied by post mordanting technique. The dyed samples were tested for their colour fastness against washing, rubbing, perspiration and sunlight. The dyed and mordanted samples were also evaluated visually for appearance and lusture. Physical properties in terms of fabric thickness, weight and count, flexural rigidity, crease recovery angle and tensile strength and elongation were studied using standard test methods. *Kachnar* dye gave a colour series of rosy brown colour on rayon- silk blend using different mordants and mordanting methods with varying concentration levels. There was little variation in colour values produced with natural mordants. It was concluded from the overall fastness grades that fastness properties enhanced after post mordanting method and colour adherence to fabric was good. From the experiment it was found that the *kachnar* dyed silk samples mordanted with different mordants when evaluated visually showed improvement in appearance over the control sample. Sample mordanted with potassium pomegranate got highest score for lusture and texture. Fabric thickness, weight, fabric count, flexural rigidity and crease recovery of all the dyed samples increased when compared with original sample. Drape co-efficient of unmordanted, copper sulphate and pomegranate mordanted samples had no change. While in case of potassium permanganate and eucalyptus mordanted samples it increased slightly. Tensile strength of all the samples increased in both the directions except unmordanted samples which decreased in weft direction. Elongation in warp direction of potassium permanganate and eucalyptus mordanted samples increased while that of copper sulphate and pomegranate mordanted samples decreased. In weft direction it increased in all other samples except that of potassium permanganate mordanted samples. Studying the effect of dyes on physical properties of fabrics is very important as end use of different fabrics depend on these properties.

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Colour has always fascinated man and has played a dominant role in his life since time immemorial. In every civilization, from Stone Age to the 'silicon chip' age, it has played an important role in adding beauty to the world. The knowledge and use of colour on textile is one of the most important processes of fabric development and utilization. Earlier colours were derived from natural sources only and in India, dyes from natural sources have an ancient history. These dyes are oldest and generally referred as natural dyes.

Natural dyes are obtained from natural sources such as vegetable matter, minerals or insects. These are available in nature in the form of plant bark, root, flowers, leaves, fruit-covers, seeds etc. They are excellent for their endurance and soft lustrous coloring. Though the ancient art of natural dyeing withstood the ravages of time, with the discovery of the first synthetic dye in 1856, there was a rapid decline in the use of natural dyes.

Synthetic dyes were readily accepted because of their very distinct advantage in respect of application, colour range and availability. Some of the synthetic dyes consist of harmful amines and chemicals and create toxicological and harmful effects on skin during wearing. Production of synthetic dyes involves many violent chemical reactions which result in by-products and pollutants for the environment. On the other hand the environment friendly natural dyes are non-hazardous, biodegradable and have better compatibility with the environment.

Since the last one and a half decade, application of natural colourant on different fibres *viz.*, silk, wool, cotton, jute and some blends, etc. is gaining popularity all over the world in light of German ban on some of the synthetic azo dyes.

Although natural dyes are so significant yet the use of natural colour is still limited due to non-availability of precise and specific ways of application and standard norms and standard shade cards. It is also worthwhile to explore the more renewable sources for producing the natural dyes from abundantly occurring and easily available vegetative matters. The appropriate knowledge of colour extraction, standardization of dyeing techniques and their effect on colour fastness and physical properties of textile material is also of equal importance and require detailed investigation.

Keeping in view the above facts, the present

investigation was carried out to study the effect of dyeing on physical properties of rayon-silk blend fabric dyed with *Kachnar* (*Bauhinia variegata*) bark dye.

■ RESEARCH METHODS

Materials Used:

The material with the following specifications was taken for this study.

Fabric:

Unbleached/ Unscoured Rayon–Silk blend (70% rayon and 30% silk)

Chemicals:

Copper Sulphate and Potassium Permanganate

Natural Mordants:

Pomegranate and Eucalyptus

Dye:

Kachnar (*Bauhinia variegata*) bark

Testing of fabric :

For identification of blend ratio in the blended fabric, samples were got tested from SGS India, Pvt. Ltd., Gurgaon, Haryana.

Preparation of fabric :

Scouring was done for removal of natural and added impurities like oils, fats, waxes and other adventitious dirt. The fabric was scoured in a solution containing 2g/lit. neutral soap at 7.0 pH on boiling temperature (100°C) for 45-60 minutes with material to liquid ratio 1:50. Material was rinsed thoroughly to remove any residues, if left and dried in shade.

Pretreatment of fabric :

Scoured fabric was pretreated with 3 per cent (o.w.f.) Alfix at 80°C and maintained for 30 minutes. The alfix treated samples were taken out and dried in shade without rinsing. These samples were used for dyeing (Rose, 2002).

Preparation of dye bath and dyeing :

Kachnar bark was collected from HUDA nursery, Hisar. The bark was dried in shade and ground to powder form. Eight per cent dye material was extracted in

alkaline medium at 10 pH for 60 minutes and strained. The fabric samples were dyed for 30 minutes at 7 pH and temperature of dye bath was 100°C.

Mordants used and mordanting Method:

Copper sulphate and Potassium permanganate, Indian gooseberry and Eucalyptus were used as mordants using post mordanting method.

Determination of Physical properties:

Physical properties of degummed, dyed and mordanted samples were determined using standard test methods and were assessed on the basis of per cent change.

Properties	Test Method
Fabric thickness	ASTM- D1777-60T
Weight per unit area	ASTM- D3776-90
Fabric count	ASTM- D123
Bending length and flexural rigidity	ASTM- DI388-64
Crease recovery angle	BS3086: 1972
Drape co-efficient	IS 8357: 1977
Tensile strength and elongation	ASTM- D1682-64

Appearance :

Five judges having experience of working with natural dyes evaluated the dyed samples visually. A tool for the subjective evaluation was prepared to assess the appearance in terms of lustre and texture of the dyed samples.

Lustre:

The term lustre refers to the gloss, sheen or shine

that a fabric has. It is the result of the amount of light reflected by a fabric and it determines the fabric's brightness or dullness. The lustre ratings given by the judges were assigned 3, 2 and 1 scores as high, moderate and low, respectively. These scores were summed up and weighted mean scores were obtained.

Texture:

Texture is the appearance of the surface of the fabric. It determines the hand or feel of a fabric. For the evaluation of texture of the dyed samples, the judges were asked to assign the scores 3, 2 and 1 as fine, medium and rough, respectively. The scores were summed up to obtain the weighted mean scores. The sample got highest score was ranked first.

RESEARCH FINDINGS AND DISCUSSION

The results are discussed in relation to the preliminary physical properties and appearance of the dyed fabrics.

Effect on preliminary properties :

The data on basic properties of controlled and dyed rayon- silk blend fabric *i.e.* fabric thickness, weight and count with *kachnar* bark dye is presented in Table 1. It is evident from table that an increasing trend was observed in almost all the properties of dyed fabric. The maximum increase in thickness was observed when dyed without mordant followed by mordanted with pomegranate and potassium permanganate. Maximum increase in weight was observed when in case of unmordanted sample followed by copper sulphate

Table 1 : Effect of dye on preliminary properties of fabric

Properties	Controlled	Dyed				
		Un mordanted	Mordanted			
			Copper sulphate	Potassium permanganate	Pomegranate	Eucalyptus
Thickness (mm)	0.248	0.259	0.261	0.262	0.266	0.261
% Change	--	+4.43	+0.77	+1.15	+2.70	+0.77
Weight (g/sq.m)	85.0	86.6	88.0	86.6	86.2	86.3
% Change	--	+1.88	+1.61	--	-0.46	-0.34
Fabric count (threads/ inch)						
Warp	78	81	82	82	80	80
% Change	--	+3.84	+1.23	+1.23	-1.23	-1.23
Weft	90	91	93	92	91	91
% Change	--	+1.11	-2.19	-1.09	--	--

(+) ve sign indicate increase in properties

(-) ve sign indicate decrease in properties

(--) no change in properties

mordanted sample. However the fabric count increased when compared with controlled sample but highest increase was observed in unmordanted sample followed by copper sulphate and potassium permanganate mordanted samples. However no specific trend was observed in change of physical properties of dyed and mordanted samples.

The increase in weight may be due to the absorption of mordant and dye during dyeing and increase in fabric count due to the consolidation of yarn during dyeing which increased the count and also due to the absorption of dye. Rose (2002) also observed improvement in overall appearance and physical properties of cotton samples dyed with natural dyes as compared to original sample. Gogoi and Kalita (1999) also reported that silk samples treated with mordants and dyed using natural dyes showed increasing trend in their fabric count,

thickness, weight, breaking strength and elongation.

Effect on physical properties:

The data related to effect of dye on physical properties *i.e.* flexural rigidity, crease recovery angle, drape co-efficient, tensile strength and elongation is presented in Table 2. In case of unmordanted, copper sulphate and pomegranate mordanted samples slight increase in crease recovery angle was found, while potassium permanganate and eucalyptus mordanted samples no change was observed. Drape co-efficient of potassium permanganate and eucalyptus mordanted samples increased, whereas no change in drapability was found in unmordanted, copper sulphate and pomegranate mordanted samples. From the data it is clear that the tensile strength of all the mordanted specimens showed increase in both the directions *i.e.* warp and weft when

Table 2 : Effect of dye on physical properties of fabric

Properties	Controlled	Dyed				
		Un mordanted	Mordanted			
			Copper sulphate	Potassium permanganate	Pomegranate	Eucalyptus
Flexural rigidity (mg-cm)	0.116	0.118	0.118	0.123	0.123	0.119
% Change	--	+1.72	--	+4.23	+4.23	+0.84
Crease recovery ($^{\circ}$)	116.3	116.6	116.3	116.3	116.0	116.3
% Change	--	+0.25	-0.25	-0.25	-0.51	-0.25
Drape co-efficient (%)	33.17	33.17	33.17	33.19	33.17	33.18
% Change	--	--	--	+0.06	--	+0.30
Tensile strength (kg/cm)						
Warp	17.45	17.35	17.95	17.40	17.85	18.10
% Change	--	+0.57	+3.45	+0.28	+2.88	+4.32
Weft	28.25	28.15	29.15	28.95	29.65	30.00
% Change	--	-0.35	+3.55	+2.47	+4.95	+6.20
Elongation (%)						
Warp	13.22	13.12	13.05	13.27	13.00	13.27
% Change	--	--	-0.53	+1.14	-0.91	+1.14
Weft	11.97	12.05	12.11	11.91	12.06	12.05
% Change	--	+0.66	+1.16	-0.50	+0.75	+0.66

(+) ve sign indicate increase in properties

(-) ve sign indicate decrease in properties

(--) no change in properties

Table 3 : Visual assessments of *Kachnar* bark dyed silk for appearance

Sr. No.	Type of treatment	Weighted mean score	
		Lusture	Texture
1.	Without mordant (control)	2.4	2.0
2.	Copper sulphate	2.6	2.4
3.	Potassium permanganate	2.8	2.4
4.	Pomegranate	2.4	2.2
5.	Eucalyptus	2.4	2.4

compared with the original, while the unmordanted sample had decreased strength in both the directions.

The results revealed that the fabric elongation of only potassium permanganate and eucalyptus mordanted samples increased in warp direction, while of others it decreased. Increase in elongation was also visible in weft direction for all the samples except potassium permanganate mordanted sample which decreased in weft direction.

The *kachnar* bark dyed silk samples mordanted with different mordants when evaluated visually showed improvement in appearance over the control sample. It became clear from the Table 3 that potassium permanganate mordanted sample got highest scores *i.e.* 2.8 for lusture followed by copper sulphate mordanted sample (2.6). Pomegranate and eucalyptus samples scored 2.4 for its lusture. For texture copper sulphate, potassium permanganate and eucalyptus mordanted samples scored highest (2.4) whereas controlled sample scored lowest (2.0). It was concluded that sample mordanted with potassium permanganate got highest score for lusture and texture. Devi *et al.* (1999) reported that ratings for general appearance (lusture and texture) of cotton dyed with natural dyes varied with the use of mordants. Similar work related to the present investigation was also carried out by Kaur and Kola (2012); Kale and Naik (2015); Kalsy and Srivastava (2015) and Phukan (2014).

Conclusion :

It is thus concluded that the fabrics dyed with *Kachnar* bark dye and mordanted with natural as well synthetic mordants showed positive enhancement in all the properties. Hence, *Kachnar* bark can be effectively

and efficiently used for dyeing of rayon- silk blended fabric for commercial purpose as an eco-friendly dye.

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