



Dyeability of silk Banana union fabric with natural Dyes

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Abstract: Silk banana union fabric woven with single banana filament fibre in the weft was used to study its dyeing behaviour towards two natural dyes viz. dye extract from curcuma longa(turmeric) and *Ocimum sanctum* (tulsi) leaf extract with mordants alum and lemon juice respectively. The scoured samples were dyed by the pre mordanting method and were evaluated for colour strength and fastness properties. The integrated colour strength K/S value obtained was higher for the fabric dyed with Turmeric and hence the dye uptake was also good as compared to the tulsi dyed fabric. The turmeric dyed sample gave brighter colour than the tulsi dyed sample as indicated by the higher chroma values. Silk Banana union fabric showed good dyeability with natural dyes with excellent rubbing fastness and good wash fastness, however the light fastness was low.

Keywords: filament fibre, natural dyes, pre mordanting, Tulsi, Turmeric, union fabric.

1. Introduction

Dyeing is an ancient art where the use of natural colours was explored by man. With the advent of synthetic dyes, natural dyes lost its popularity, latter being more tedious in application and limitations in colour. The emerging green consumerism and ban of azo dyes have brought the natural dyes and mordants back into the limelight. Researchers world over are exploring newer dyes from nature and experimenting with the array of colours produced by the use of different mordants on fabrics.

India, has an abundant source of natural dyes. Even temple waste such as marigold flowers, coconut, beetul leaves, etc are collected and used as dye extracts. Natural dyes, apart from contributing to sustainable development, many have health benefits relating to the rich ayurveda culture of India and are used for dyeing Ayurveda which has a huge demand in western countries. Turmeric and tulsi are two dyes found abundantly and have antibacterial properties which is good for the skin.

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Banana fibre is extracted from the pseudostem of the banana plant which otherwise goes waste after the bunch harvesting. The fibre is being experimented in making textiles which has been successful to a certain extent. The choice of dyes and dyeing methods for textiles depends upon the type of fabrics, their utilization, fastness properties and the type of preparatory and finishing processes [8]. Dyeing investigations were carried out on Banana fibre samples with dye extract from turmeric using ultrasonic and conventional methods. The ultrasonic method gave better dye uptake than the conventional method and the sample mordanted with ferrous sulphate gave good colour yield [5].

Banana fibers that were mechanically extracted were dyed with 4 different natural dyes viz. Marigold, Lac, Onion and Madder at 3 depths of shades (10%, 20% and 30%) using 10% Alum as a mordant. The dyes showed good affinity for the fibres as indicated by an increase in K/s values with increase in percent shade [13].

The dyeability of Jute Banana blended fabric was tested using sulphur and reactive dyes (15% owf). The colour strength was higher for Reactive green followed by Sulphur blue. The wash, perspiration and light fastness was excellent to good for both the dyes [3]. Cotton banana union fabrics were also dyed successfully with natural dyes [12].

As no literature was found on the dyeability of silk banana textiles, the researcher selected silk banana union fabric a combination of proteinic and cellulosic fibres to investigate its dyeing behaviour with natural dyes turmeric and tulsi in the conventional method.

2. Material and Methods

2.1 Selection of Materials

Silk banana union fabric woven on handloom in plain weave (66ends/inch, 26 picks/inch, 55gsm) with silk yarn in warp and single banana filament fibre in the weft was taken as the fabric sample. Sodium carbonate and Kleenox PF liquid were used for scouring. Alum and lemon juice were used as mordants.

2.2 Dye Extraction

The extract from the root of the **turmeric** plant (*Curcuma longa*) was one of the natural dye that was used. The turmeric was dried, powdered and stored in an air



tight container (Fig 2). Turmeric possesses yellow pigment of which curcumin is the main component (Fig 1).

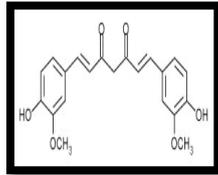


Fig.1 Structure of curcumin [Canbolat, 2015]



Fig. 2 Turmeric and the dye extract in powder form

The other natural dye was obtained by aqueous extraction of fresh Tulsi leaves (*Ocimum sanctum*). *Ocimum sanctum* commonly known as 'Tulsi' is a herb, which is branched annual plant found throughout India. *Ocimum sanctum* contains bright yellow coloured and volatile oil of which Urosolic acid is the chromophore (Fig3) [2].

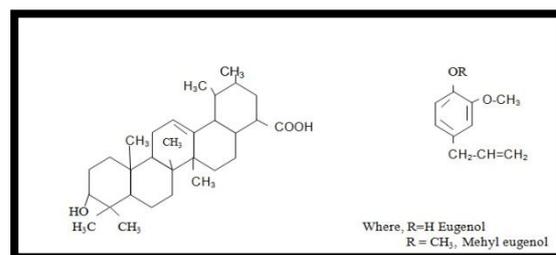


Fig. 3 Structure of Urosolic acid (www.textiletoday.com.bd, 2013)



Fig. 4 Tulsi leaves and the dye extract in aqueous form

Fresh leaves of Tulsi were picked in the morning from a local garden. The leaves were weighed and 10gms were put in 100ml boiling water. This was kept in the waterbath at 60°C for one hour so as to extract the full colour from them (Fig 4).

2.3 Fabric pre treatment

The silk banana union fabric samples weighing an average of 5.7 gm were scoured with Sodium carbonate 2gm/l and a wetting agent Kleenox PF liquid 5gm/l at 50°C for 30 minutes in a water bath by the exhaust method with a material to liquor ratio of 1:20. After the process, the fabric samples were washed in cold water and dried in room temperature.

2.4 Premordanting dyeing

The pre mordanting method by the exhaust process was carried out with one of the scoured fabric sample with 15% Alum (owf) at boil for 60 minutes with a material to liquor ratio of 1:20. After mordanting the fabric sample was squeezed and dried. The turmeric dye was used in 20% depth of shade (owf) with 1:20 material to liquor ratio. The dye bath was prepared accordingly and heated in the open boil dye bath vessel. The premordanted fabric was entered into the dye bath when the temperature reached 40°C. The temperature of the dye bath was gradually raised to boil i.e. 95°C -98°C for 60 minutes. After the completion of dyeing the fabric sample was allowed to cool in the dye bath itself after which it was washed in cold water and dried.

The pre mordanting method by the exhaust process was carried out with the other scoured fabric sample at boil (100°C) for 30 minutes with a material to liquor ratio of 1:20. The mordant bath was prepared by calculating 15% of lemon juice (owf) from 1% stock. After mordanting the fabric sample was squeezed and dried. The dyebath was prepared with 100ml of tulsi leaf extract solution. When the temperature of the dyebath reached 40°C, the mordanted fabric sample was



immersed in the dyebath and the temperature was raised to 95°C. Dyeing was carried out for 60 minutes, after which the sample was allowed to cool in the dye liquor. The cooled fabric sample was washed in running water and dried.

2.5 Evaluation of colour

The colour strength of the silk banana union fabric samples dyed with Turmeric and Tulsi dye extracts were measured for their colour strength under illuminant D65 daylight for the 10⁰ standard observer on Spectrophotometer Gretag Macbeth over the range of 400-700 nm. The instrument was standardized by a white tile for reference.

The K/S is the ratio of the Absorption coefficient (K) versus the scattering coefficient (S) for reflectance which is given by the Kubelka Munk equation as

$$K/S = (1-R)^2/2R$$

where R is the reflectance (Eq. 1)

The colour measurement depends on the wavelength of the colour. The wavelength of visible light ranges from 400nm to 700nm

The results were also recorded in terms of CIELAB coordinates L, a*, b*, C* and h*

2.6 Evaluation of Fastness properties

The colour fastness of the dyed fabric using natural dye turmeric and tulsi to rubbing was carried out according to Indian Standard IS: 766-1986-88.

The colour fastness to washing was done in a launderometer according to IS: 3361-1979, test method IS02 washing test. The sample specimen in contact with the given fabric piece is mechanically agitated in soap solution at 50°C for 45 minutes rinsed and dried. The change in the colour of the specimen and the staining of the adjacent fabric are assessed with the help of the standard gray scale for staining.

The light fastness of the dyed fabric samples were tested according to IS: 2454-1985. The fabric samples and the Blue Wool standards having ratings from 1 to 8 were exposed to artificial light source whose wavelength is similar to that of sunlight. The change in colour of the dyed fabric samples were compared with the change in the Blue Wool standards.



3 Results and Discussion

3.1 Colour measurements

The fabric dyed with turmeric produced a bright yellow colour whereas the tulsi dyed fabric produced an ochre colour. The integrated colour strength K/S value obtained was higher for the fabric dyed with Turmeric and hence the dye uptake was also good as compared to the tulsi dyed fabric. However, ΔE^* or colour difference values for both the dyed samples were a little higher than the acceptable value of 1.0 as per commercial standards and the positive value indicated that the colour was lighter than the standard.

The CIElab coordinates as revealed from table 1 show that for the turmeric dyed sample, both a^* is negative and b^* is positive so the colour falls in quadrant II. The tulsi dyed fabric sample showed both positive values for a^* and b^* hence the colour falls in quadrant I. The turmeric dyed sample gave brighter colour than the tulsi dyed sample as indicated by the higher chroma values. The hue angle was also higher for the turmeric dyed fabric sample 91.10° and for tulsi dyed sample it was 71.81°

Table 1 Colour measurements of the Silk Banana union dyed fabric

Parameter s	Fabric dyed with turmeri c	Fabric dyed with tulsi
K/S	88.3	42.6
ΔE	1.42	1.86
L*	73.77	64.78
a*	-1.13	7.36
b*	58.77	22.39
C	58.78	23.56
h°	91.10	71.81



Fig. 5 Fabric dyed with turmeric



Fig. 6 Fabric dyed with tulsi

3.2 Colour fastness properties of the dyed fabric

3.2.1 Rub fastness

Table 2 gives the rub fastness of the dyed fabric to dry and wet rubbing. The rub fastness to dry rubbing and wet rubbing was tested for both the dyed fabric samples on a crockmeter and the results were excellent to very good with no colour change.

Table 2 Rub fastness of silk banana dyed fabric samples

Fabric	Dry rubbing	Wet rubbing
Turmeric dyed fabric	5	4-5
Tulsi dyed fabric	5	5

The ratings shown in the above table prove that the fabric samples had good dye uptake and the mordant and dye formed a stable complex and that it is fast to rubbing.



3.1.2 Wash fastness

The dyed fabric samples showed no stain but the colour of the dyed sample changed considerably for turmeric dyed fabric and noticeably for tulsi dyed sample. The ratings for wash fastness are given in Table 3. Hence the staining was excellent for both the samples but the colour change was poor for turmeric dyed sample and fair for tulsi dyed sample. Colour bleeding can be attributed to lower stability of the mordant – dye complex in the fabric when in aqueous medium..

Table 3 Wash fastness of the Silk Banana union fabric

Fabric	Colour change	Change in stain
Turmeric dyed fabric	2	5
Tulsi dyed fabric	3	5

8.5.3 Light fastness

The dyed fabric samples were not stable to light and showed a low light fastness. The light fastness of most natural dyes are low and similar results were obtained by previous studies for turmeric [5]. From Table 4 it is seen that the light fastness of the turmeric dyed sample is poor and the tulsi dyed sample gave fairly good fastness to light.

Table 4 Light fastness of Silk Banana union fabric

Fabric	Light fastness
Turmeric dyed fabric	2
Tulsi dyed fabric	2-3



4 Conclusion

Silk banana union fabric is a combination of proteinic and cellulosic fibres. It showed good dyeing behaviour with natural dyes turmeric and tulsi. Both turmeric and tulsi are known for its antibacterial properties contributing to health benefits. Apart from this use of natural mordant like lemon juice makes it ecofriendly.

The fabric showed excellent rubbing fastness and good wash fastness and low light fastness. The colour yield and dye uptake were also good. Use of different mordants and dyeing methods can improve the dyeing behaviour of the fabric.

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