Biolife 3(3):710-716
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournal.com
BIOLIFE RESEARCH ARTICLE

Basella rubra Linn : A Dyeing study for Silk

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ABSTRACT

In the present study basella rubra berries of India origin was extracted for dyeing of silk as a natural dye. Extraction was carried out with two different methods. In method I, extraction was carried out at room temp. in cold tap water. In method II, extraction was carried out at boiling temp. pH of the colour extract was scanned and noted 6.5 as acidic pH. Citric acid treatment was given to samples of experimental group prior to dyeing. Samples of control and experimental group were dyed with both cold and hot dyeing method. 10% alum and alum in combination with other mordants imparted range of mauve, beige, pink and gold. Dyed silk samples exhibited moderate to very good wash and sunlight fastness. Citric acid treatment showed improved fastness properties.

Introduction

Basella rubra known as Malbar spinach is also known as cyclone spinach.Lomintski et al. 2003,spinach leaves contain several active components including flavonoids (Adhikari et al. 2012), *Basella rubra* is a succulent, branched, smooth, twining herbaceous vine, several meters in length stems are purplish or green. Fruit is fleshy, stalk less, ovoid or nearly spherical, 5 to 6 millimeters long, and purple when mature. Abundant carotene is showed in *Basellarubra*. Werner et al. (1993) reported anthocyanin extracted from *Basella rubra* berries produced stain comparable with synthetic stains like crystal violet & safranin, and can be used as an alternative microbiological stain. Sequeira Muriel and Nandita Burde (2005), dyed tussar and mulberry silk with sandalwood, Indian blackberry seed and marigold. Dyes used produced shades ranging from cream, yellow and brown. SrinathAmbat et.al (2010), studied that *Embeliaribes* berries contain several chemical constituents like embelia acid, volatile oil, fixed oil, resin, tannin, christembine (alkaloid), phenolic acids like caffeic acid, vanillic acid, chrorogenic acid. Cinnamic acid, o- cumaric acid. 4.33% of the embelin content is observed in the berries of *Embeliaribes* a quinone derivative embelin (2,5- dihydroxy-3- undecyl, 1,4- benzoquinone). Hee-Je Kim et al. (2013); Anjali Deshmukh and Sharda Dongre (2015) reported that natural dye, anthocyanin was extracted from the flowers of *Rhododendron* species with three different colors, pink, red and violet, using a simple extraction technique, and was used as the sensitizer in dye-sensitized solar cells. The dyes were treated with nitric and acetic acids to examine their effects on the power conversion efficiency. According to the experimental results, the performance was better with the acetic acid-treated anthocyanin.

How to Site This Article:
Anjali Deshmukh (2015). *Basella rubra* Linn : A Dyeing study for Silk. *Biolife*, 3(3), pp 710-716. doi:10.17812/blj.2015.3322

Published online: 16 August 2015

Material and Methods

Mulberry silk was used as a textile substrate which is the most superior quality of silk. Aqueous extract of *Basella rubra* Linn was used as a source of natural dye. Alum (Potash Alum), Stannous Chloride (Tin), Ferrous sulphate (Iron), Pomegranate rind (Punica Granatum) were used as mordants.

Experimental Methods:

Degumming of silk was carried out prior to dyeing. Ripen fruits of *Basella rubra* were collected during the month of November and December. Fruits were

washed during the extraction process to remove dust particles and antaminantsif seen any.

Aqueous extraction of *Basella rubra:*

Aqueous extraction of dye was carried out in cold water at room temperature. 50% fruits were weighed (owf) for extraction in required amount of water in a container. Fruits were crushed and colour was strained, concentrated colour (as a stock solution) diluted by making 1:50 M:L ratio.

Dyeing Study:

Prior to dyeing degummed silk samples were divided into control (not treated) and experimental group (Citric Acid treatment). Pretreatment of citric acid was given to 14 samples of degummed silk (experimental group) for 5 minutes.

Mordanting:

Mordanting was carried out for 10% alum as a single mordant and alum in combination with other mordants as A+T (Alum+Tin), A+I (Alum+Iron), and A+P (Alum+Pomegranate rind) as binary mordant combination. Mordanting was carried out for 45 minutes at 90^{o}c with M:L ratio as 1:50. (A) treated sample was entered into mordanting bath at 40^{o}c and slowly it was raised upto 90^{o}c with constant stirring of sample. Mordanting was carried out separately for each mordanted sample.

Cold Dyeing Method :

Degummed silk samples were grouped into experimental and control samples. Dye bath was set with. Previously extracted dye with 1:50 M:L ratio. Dyeing of mordanted silk sample was carried out for 60 min. at room temperature with constant handling of fabric in dye liquor. Sample was removed from the dye bath, washed thoroughly and shade dried. Procedure was repeated for both control and experimental group of silk samples.

Hot Dyeing Method :-

Dye bath was set with previously extracted dye with 1:50 M:L ratio. Mordantedsilk sample was entered into the dye bath. Initial temperature of the dye bath was 40^{o}C ; and slowly it was raised upto90^{o}c. Liquor ratio was maintained throughout the dyeing for 60 minutes with constant handling of

Table-1. Effect of Mordants on colour of silk Dyed with *Basellarubra Linn*using Cold Dyeing methods (control group)

Mordant & Combination	Mordant proportion & 10 (owf)	Coding	Colour obtained	
Alum	10%	MSNTSCA10	Crepe	
A+T	9:1	MSNTSCAT91	Hot Pink	
A+T	7:3	MSNTSCAT73	Lily Pink	
A+I	9:1	MSNTSCAI91	Taffy	
A+I	7:3	MSNTSCAI73	Pastel Pink	
A+P	9:1	MSNTSCAP91	Latte	
A+P	7:3	MSNTSCAP73	Dandelion	

fabric. pH was scanned and noted 6.5 as acidic pH. Dye bath was allowed to cool for 15 minutes. Dyed samples were then removed from the dye bath. Samples were rinsed and washed thoroughly and shade dried. Procedure was repeated for each sample of control and experimental group.

Assessment of fastness properties

All dyed silk samples of control & experimental group were assessed towards – washing fastness (ISO2 – IS : 3361-1971), Sunlight fastness (IS : 686-1985). The tested dyed sample were assessed for colour change &colour staining with Geometric Grey Scale.

Results and Discussion

Table-1 shows the names given to the colours obtained on silk dyed with *Basellarubra* using cold dyeing method for samples of controlgroup. Table-1 represents the colour name as**crepe** obtained when silk was mordanted with10% alum.

Alum+tinmordant combination and 9:1, 7:3 proportions imparted Hot Pink and Lily Pink respectively. Taffy and Pastel Pink are the colours exhibited using alum+iron combination with 9:1 and 7:3 mordant proportions. Alum+pomegranaterind ecofriendly mordant combination created**Latte**and Dandelionare the colours with 9:1,7:3 proportions.

Table-2, represents the names imparted on silk dyed with Basellarubra using hot dyeing method for control group of silk samples.

The use of 10% alum as a single mordant obtained Pink Pearl colour on silk dyed with Basellarubra. Little Piggy colour is obtained using alum+tin mordant combination with 9:1 proportion. Whereas Pink Eraser colour is seen on silk when 7:3 mordant proportion was used. Alum+iron 9:1 and 7:3 mordant combinations and proportion exhibited Powder Pink and Authentic Pink colours. Sepia and Sand castle colours are due to the use of alum+pome granate rind with 9:1 and 7:3 mordant combination and proportion.

Table-2. Effect of Mordants on colour of silkDyed with Basellarubra Linn using Hot Dyeing methods(control group)

Mordant & Combination	Mordant proportion & 10% (owf)	Coding	Colour Obtained	
Alum	10%	MSNTSHA10	Pink Pearl	
A+T	9:1	MSNTSHAT91	Little Piggy	
A+T	7:3	MSNTSHAT73	Pink Eraser	
A+I	9:1	MSNTSHAI91	Powder pink	
A+I	7:3	MSNTSHAI73	Authentic Pink	
A+P	9:1	MSNTSHAP91	Sepia	
A+P	7:3	MSNTSHAP73	Sandcastle	

Table-3, represents the colour names obtained on silk dyed with *Basella rubra* using cold dyeing method for experimental group of samples (treated with citric acid). Taffy colour is obtained using 10% alum as a single mordant. Alum+tin mordant combination with 9:1 and 7:3 proportions exhibited Bubble Gum and Light Pinkcolour on silk dyed with *Basella rubra* fruits. Alum+iron mordant combination with9:1 and 7:3 mordant proportions imparted Hot Pink and Supple Pink colours on silk dyed with *Basella rubra*. Goldenrod and Tuscan sun colour are obtained using alum+pomegranate rind as mordant combination with 9:1 and 7:3 mordant proportions. Oversaid discussion concludes that mordant proportions offers shade variation in colours.

Table-4, represents the colour names for silk dyed with hot dyeing method treated with citric acid prior to mordanting. It can be observed that Pink Fairy colour is exhibited towards 10% alum as a single mordant in dyeing with *Basella rubra* fruits. Alum+tin mordant combination with 9:1 and 7:3 mordant proportion imparted touch of Pink and Little Piggy colours. Powder Pink and Pink Fairy colours are created due to the use of alum+iron mordant combination and 9:1 and 7:3 mordant proportions. Peachy and Warm Camel colours are seen when alum+pomegranate rind as natural mordant with9:1 and 7:3 mordant proportions were used.

It can be said that range of Pink can be imparted using citric acid treatment and hot dyeing method with alum as a single mordant and alum in binary combination with other mordants.

From **Table-5 and Figure-1**, it can be said that silk sample of control group mordanted with 10% alum as a single mordant when dyed with cold dyeing method, fair wash fastness was rated with rating of 2/3. It was seen extremely poor when sample was mordanted with alum + tin 9:1 proportion and dyed with cold dyeing method. Poor wash fastness was rated when sample of control group was dyed with cold dyeing method and mordanted with alum + Iron mordant combination with 9:1 and 7:3 modant proportions. Alum + pomegranate rind combination rated as 2/3 with fair wash fastness when dyed with cold dyeing method. Absolutely no staining was noted on adjacent fabric for all the samples of control group with cold dyeing method.

Table-3. Effect of Mordants oncolour of silk Dyed with Basellarubra Linn using cold Dyeing methods (experimental group)

Mordant & Combination	Mordant proportion & 10% (owf)	Coding	Colour obtained	
Alum	10	MSTTSCACA10	Taffy	
A+T	9:1	MSTTSCACAT91	Babble Gum	
A+T	7:3	MSTTSCACAT73	Light Pink	
A+I	9:1	MSTTSCACAI91	Hot Pink	
A+I	7:3	MSTTSCACAI73	Supple Pink	
A+P	9:1	MSTTSCACAP91	Goldenrod	
A+P	7:3	MSTTSCACAP73	Tuscan Sun	

Wang et al. 2014, extracted nine anthocyanins from *L. platyphylla* fruits. The colour of the solution is red under acidic condition with pH values above 7.0. The dye extracts applied to silk fabric with mordant free dyeing show different color under different pH conditions, changing between purple, blue green and yellow. However, the dyed colors are light and the dyeing rate is low. Metal mordant such as Sn in chelation enhances the dye depth and improves the fastness of the dyed silk fabrics, especially in silk fabrics dyed by pre-mordanting and meta-mordanting fairly good to good wash and sunlight fastness was noted.

Table-6 and Figure-2, reveals that sample of control group mordanted with 10% alum and dyed with cold dyeing method exhibited moderate sunlight fastness. Alum+tin combination with 9:1 and 7:3 ratio also exhibited moderate fastness, further it was noted that when samples of control group dyed with hot dyeing method showed improvement in sunlight fastness which was rated 3/4 as fairly good. Alum+iron combination with 9:1 and 7:3 proportion exhibited fair sunlight fastness in terms of cold dyeing and hot dyeing method. Alum+pomegranate rind 9:1, 7:3 combination and proportion showed comparatively better results with fairly good (3/4) to very good (4/5) sunlight fastness. Gumrukcu et al. 2008, extracted anthocyanin pigments from red onion (*Alliumcepa L.*) and dyed woolen fabrics. Dyeing processes were carried out according to pre, together and last-mordanting methods by using buffer solutions at the pH = 2-8 interval for 1 hr. at 98-100^{o}c. Some metals salts such as $Al(OH)_3$, $Cu(NO_3)_2$, $Fe(NO_3)_2$, $Zn(NO_3)_2$, $NiCl_2$, $SnCl_2$,Pb $(CH_3COOH)_2$ were used as mordanation agents. Dyeing conditions and other characteristics showed that mordant was more important than dye in predicting light fastness which was between 2 and 4 values were obtained.

Conclusion

From the present work it can be said that *Basella rubra* Linn (fruit dye) can be explored as a source of natural dye. Mordant combinations and proportions imparted range of mauve, beige pink and gold colour. Dyed silk samples imparted moderate to very good wash and sunlight fastness.

Conflict of Interests:

The authors declare that there is no conflict of interests regarding the publication of this paper.

Table-4. Effect of Mordants oncolour of silk Dyed with Basellarubra Linn using Hot Dyeing methods (experimental group)

Mordant & Combination	Mordant proportion & 10% (owf)	Coding	Colour obtained	
Alum	10	MSTTSCAHA10	Pink Fairy	
A+T	9:1	MSTTSCAHAT91	Touch of Pink	
A+T	7:3	MSTTSCAHAT73	Little Piggy	
A+I	9:1	MSTTSCAHAI91	Powder Pink	
A+I	7:3	MSTTSCAHAI73	Pink Fairy	
A+P	9:1	MSTTSCAHAP91	Peachy	
A+P	7:3	MSTTSCAHAP73	Warm Camel	

Table-5. Washing Fastness of Malbar Spinach Dyed Silk

Mordant & Combination	Mordant Proportion & 10% (owf)	Control				Experimental			
		Cold Dye Method		Hot Dye Method		Cold Dye Method		Hot Dye Method	
		CC	CS	CC	CS	CC	CS	CC	CS
Alum	10	2/3	5	2/3	5	2/3	5	3/4	5
A+T	9:1	1	5	2/3	5	2/3	5	3/4	5
A+T	7:3	1	5	2/3	5	2/3	5	3/4	5
A+I	9:1	2	5	2/3	5	2/3	5	3/4	5
A+I	7:3	2	5	2/3	5	2/3	5	3/4	5
A+P	9:1	2/3	5	2/3	5	2/3	5	3/4	5
A+P	7:3	2/3	5	2/3	5	3	5	3/4	5

Table-6. Sunlight Fastness of Malbar Spinach Dyed Silk

Mordant & Combination	Mordant proportion & 10% (owf)	Control		Experimental	
		Cold Dye Method	Hot Dye Method	Cold Dye Method	Hot Dye Method
Alum	10	3	3/4	3/4	3
A+T	9:1	3	3/4	3/4	3
A+T	7:3	3	3	3.4	3
A+I	9:1	2/3	2/3	3/4	3
A+I	7:3	2/3	2/3	3/4	3
A+P	9:1	3/4	3/4	3/4	4
A+P	7:3	4/5	4/5	3/4	4

Figure-1.Washing Fastness of Malbar Spinach Dyed Silk. (CC – Colour Change, CS – Colour Staining)

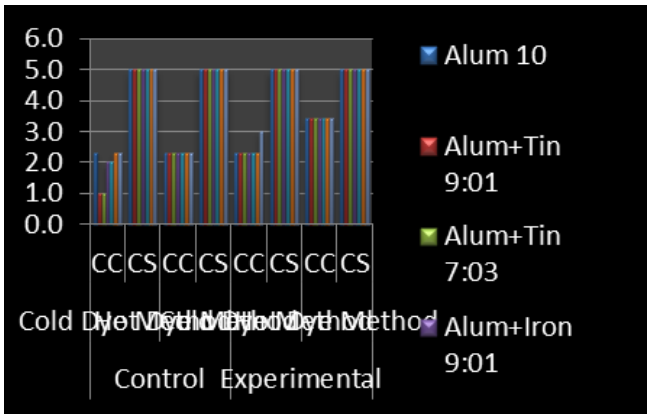
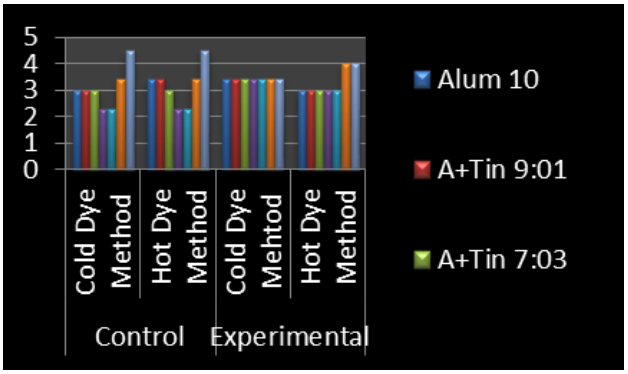


Figure-2. Sunlight Fastness of Malbar Spinach Dyed Silk



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