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Effect of Perilla (Perilla Frutescens) Dye on Silk

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Abstract

Plants are the major source of natural colourants. Almost all their parts such as stem, leaves, fruits, seeds and pills are used for extracting natural color. They also have antimicrobial, antifungal and other medicinal value. It was found from the present study that perilla dye can be successfully used for dyeing of silk fabric. The dye gives a bright red color. Shades of red color is obtained when mordanted with natural and syenthetic mordants.

Keywords: Natural dyes | Natural Pigment | silk | Perilla plant

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Introduction

Consumer's demand for eco-friendly textiles and eco-friendly dyes led to the revival of natural dyes for textiles, with the newer energy efficient dyeing process and more reproducible shade developing processes. Perilla (PerillaFrutescens) dye, which is selected for the present study is a traditional crop of China, India, Japan, Korea, Thailand and other Asian countries. The seed oil of Perilla plant is used for cooking, as a drying oil and as a fuel. The foliage is used as a potherb, or medicine, and for food coloring. The foliage is also distilled to produce an essential oil for flavoring. The plants are grown as ornamentals. In Japan the foliage also provides a red food coloring and specialized red-leaved perilla varieties are used in the production of pickled plums. The Perilla pigment is most stable under cold, acidic condition.The acidic media exhibited maximum per cent absorption for jatropha, lantana, hamelia and euphorbia dye, while kilmora and walnut showed good results in alkaline medium. The result obtained from different experiments leads to the optimization of a standard recipe for a particular dye-mordant-fibre combination as stated by Dixit and Jahan (2005).

Srivastava (2006) studied the optimum dyeing technique for dyeing wool by determining the optimum wavelength, dye material concentration, extraction time, dyeing time, pH, concentration of mordant, *etc*. Das (2005) reported coloring of wool and silk textile with tea extract, which have highest affinity for both wool and silk at pH 2-4 in presence and absence of either of the ferrous sulphate and aluminium sulphate as mordants. Optimization of dyeing process variables for wool with natural dyes obtained from turmeric has been studied and reported by Agarwal (1992). Bansal and Sood (2001) studied the optimum conditions for development of vegetable dye of cotton from Eupatorium leaves. The optimization of dyeing of wool by Rhododendron arboretum as a natural dye source was reported by Sati (2003). Rose (2005), Siddiqui (2006) and Samanta (2006) studied the effect of variables on dyeing with selective natural dyes. The standardization and optimization of dyeing condition are essential for effectively coloring any textile in a particular shade in techno-economic way to produce maximum color yield.

The information will be useful to select a potential germplasm for large scale cultivation and will open an avenue for the synthesis and development of more effective and less toxic dye for dyeing of textiles. Commercial use of this eco-friendly dye extracted from Perilla plant will minimize environmental pollution due to reduction in use of synthetic dyes. Thus, the proposed study is designed to review the age old art of dyeing with perilla dye and its effect on silk.

Methodology

Perilla dye was collected from North-East region of India and dried in shade and grinded. Mulberry silk fabric with plain weave construction was scoured in 0.5% detergent solution to remove grease and other impurities which hinder dye takeup. The effects of dye extraction medium, optimum concentration of dye source material, extraction time, dyeing time, mordant concentration and methods of mordanting on silk dyed with natural dyes has been carried out as per Grover (2005) and Dixit and Jahan (2005) to prepare the final sample. After dyeing, the geometrical properties of the samples were tested. To determine the geometrical properties of the sample fabric count, thickness of the fabric, weight of the fabric and breaking strength and elongation was tested. Determination of fabric count was done with the help of pick glass. The average count of the silk fabric is given in Table 1. Thickness test was carried out to find weather the dye has affected the thickness of fabric. Heal's Thickness tester was used for the study. The average thickness of silk dyed with Perilla dye is given in Table 2. The fabric weight was determined by following the I.S. method and the average is presented in Table 3. To determine the breaking strength and elongation of sample, pendulum strength tester was used. Breaking strength was then converted to Newton and given in Table 4.

The results in the Table 1 show the effect of Perilla dye on fabric count. From Table 1 it is evident that all the samples have increased in ends and picks/inch compared with the original. The ends/inch of the stannous chloride and alum mordanted and dyed with

Perilla on silk sample was same by 115 for each. The picks per inch of Tannic acid mordanted sample were calculated maximum (116). Maximum percent change in warp direction was found in stannous chloride and alum (+4.5) which was followed by acetic acid(+2.7), ferrous sulphate (+2.7), and tannic acid (+1.8). While maximum percent change in weft direction was calculated for tannic acid (+3.5) which was followed by ferrous sulphate (+2.6), acetic acid (+1.7), alum (+1.7) and Stannous chloride (+0.9). Yadav, Rose and singh (2016) studied on the effect of dyeing on physical properties of rayon-silk blend fabric and stated that the samples dyed with kachnar dye, increases fabric thickness, weight, fabric count, and crease recovery when compared with original

Direction of fabric	Samples			
	Warp	Weft	%change in warp	%change in weft
Original	110	112		
Tannic acid	112	116	+1.8	+3.5
Ferrous sulphate	113	115	+2,7	+2.6
Stannous chloride	115	112	+4.5	+0.9
Acetic acid	113	114	+2.7	+1.7
Alum	115	114	+4.5	+1.7

Table 1: Effect of Perilla dye on thread count (thread/ inch) of silk

Samples	Aspect			
	Thickness	%Change in thickness	Weight	%Change in weight
Original	0.114		51.5	
Tannic acid	0.129	+13.1	54.5	+5.8
Ferrous sulphate	0.128	+12.2	53.5	+3.9
Stannous chloride	0.125	+09.6	53.9	+4.7
Acetic acid	0.124	+08.7	54.0	+4.8
Alum	0.120	+05.2	54.4	+5.6

Table 2: Effect of Perilla dye on thickness (mm) and weight on silk fabric

This indicated that all the fabrics had shrunk and rate of shrinkage was not equal for all the samples. It may be due to the consolidation taken place during dyeing. The increase in ends and picks per inch of the fabric does also increase thickness and weight.

Samples	Direction of fabric			
	Warp	weft	%change in warp	% change in weft
Original	311.4	183.63		
Tannic acid	321.20	190.00	+3.14	+3.46
Ferrous sulphate	316.88	195.30	+1.75	+6.35
Stannous chloride	313.46	178.50	+0.66	-2.79
Acetic acid	318.08	180.00	+2.11	-1.97
Alum	317.44	181.38	+1.93	-1.22

Table 3: Effect of Perilla dyes on Breaking strength (in Newton) of silk fabric

Samples	Direction of fabric			
	Warp	weft	%change in warp	% change in weft
Original	15	20		
Tannic acid	16	21	+6.6	+5.0
Ferrous sulphate	17	19	+13.3	-5.0
Stannous chloride	17	18.5	+13.3	-7.5
Acetic acid	16	18.5	+6.6	-7.5
Alum	16.5	21.5	+10.0	+7.5

Table 4: Effect of Parilla dyes on elongation (in %) of silk fabric

Table 2 represents the effect of Perilla dye on thickness (mm) and weight on silk fabric . As shown in the table that all the samples have increased their thickness and weight after dyeing and mordanting. The thickness of Tannic acid (0.129) was maximum which is followed by ferrous sulphate (0.128), stannous chloride (0.125), Acetic acid (0.124) and alum(0.120). Whereas, the per cent increase in thickness was recorded for the sample of Tannic acid (+31.1) was maximum which is followed by ferrous sulphate (+12.2), stannous chloride (+0.96), Acetic acid(+0.87) and alum(+0.52)Percent for silk. The increase in thickness may be due to the consolidation of yarn during dyeing which increase the count and also due to the absorption of dyes as stated by Chanchial (1996).

Determination of weight

The results on effect of Perilla dye on weight of silk fabric are presented in table no2. It is evident from the data that the weight of the entire mordanted sample differs from the original. The mordants used for each samples have increased their weight. The increased weight of all samples of Tannic acid, Alum, Acetic acid, stannous chloride, and ferrous sulphate were 54.5, 54.4, 54.0, 53.9 and 53.5 respectively. The percent increase in weight for Tannic acid (+5.8) was recorded maximum followed by Alum (+5.6), Acetic acid(+4.8), stannous chloride (+4.7), and ferrous sulphate(+3.9) mordanted samples on silk.

The increase in weight may be due to the absorption of dyes and also due to the consolidation taken place in the fabric during dyeing. Tayade and Adivarekar (2013) dyed the silk fabric with Cuminum cyminum L as a source of natural dye stated that the weight of fabric increases when dyed in optimum conditions.

The effect of Perilla dye on fabric strength both in warp and weft direction is shown in table no. 3. The above data shows that the entire sample showed maximum breaking strength in warp direction. All the samples shows an increased breaking strength in warp direction compared with the original, but the rate of increase was not similar. The breaking strength in warp direction for all dyed samples of Tannic acid, Acetic acid, alum, ferrous sulphate, stannous chloride, increased by 9.8,6.68,6.04,5.48 and 2.06 respectively. All the samples showed decrease in weft direction except the sample of ferrous sulphate and tannic acid. The per cent decrease in strength in weft direction for sample stannous chloride, Acetic acid and alum was -2.79,-1.97 and -1.22 respectively. The sample of Tannic acid and ferrous sulphate showed increase in strength both in warp and weft direction. The per cent increased in weft direction for sample Tannic acid and ferrous sulphate was 3.46% and 6.35% respectively. Rajendran and Selvi (2014) also stated that cotton fabric dyed with pigment extracted from *Roseomonas fauriae* noticed an increase in breaking strength

The results of the table 4 reveal the fabric elongation after dyeing with parilla dye. It was evident from the table that all the samples represented maximum elongation in warp direction then weft. The result of the data also indicated that all the sample have increased elongation in warp direction and decreased in weft except the sample dyed with alum and tannic acid mordant. The percent increased in elongation in warp direction was maximum for sample of ferrous sulphate and stannous chloride (13.3) followed by alum (+10.0), Tannic acid (+6.6) and Acetic acid (+6.6). In the weft direction the per cent decrease in elongation were similar for stannous chloride and Acetic acid (-7.5) followed by ferrous sulphate (-5.0).

The increase in elongation may be due to the increase in count of the fabric with the application of dyes and alsomay be due to the crimp percentage as noted by Pierce (1996)

Conclusion

Based on the findings it is evident that awide range of colors can be obtained from perilla dye .The geometrical properties like fabric count was calculated to be increased in picks/inch and ends/inch compared to the original. The thickness, weight and elongation of the sample also increased after dyeing. Allthe samples showed maximum breaking strength in warp direction. Commercial use of these eco-friendly dyes will minimize environmental pollution. Moreover, use of more natural dye will generate more employment for rural population.

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