Walnut Dye for Wool & Silk & Development of a Color Palette for a Product Line

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India was a fore – runner in art of natural dyeing, an art perfected during the era of the great Epics. It was known as a leading source of the earliest natural dyes and still continues to be one of the imminent producers of the same and enjoys its place as a land with a rich cultural heritage of traditional crafts. One such craft perfected in India is the fabric tie - dye technique known as *Bandhani and Leheriya*. *Bandhani* as it is popularly known in India comes from the Hindi word which means tying to give a dotted pattern and *Leheriya* means tying of fabric diagonally to produce a stripe pattern and is mostly done in the Western states of Rajasthan and Gujarat.

Traditionally tie and dye was done employing natural dyes. But with the advent of synthetic dyes, tie and dye with natural dyes were found to be losing their grounds. However, with the present trend being "back to nature", natural dyes are now in vogue. Persian or English Walnut (Juglone Regia) is native to the Himalayan belt and the Kumaon hills of Uttaranchal – a northern state of India. Dye from walnut tree is an area that has not been explored very well though it carries a very strong potential with it for being a significant natural coloring agent.

Thus for the present study, the natural dye studied was walnut and extracts were taken from bark, leaf and fruit of walnut tree. In natural dyes, an interesting aspect is obtaining an array of colors which can be easily done by varying different mordants and with change of pH. Thus the concept of utilizing the color palette of walnut on silk and wool (as this dye was found to be appropriate for protein fabrics) and developing a product line to show its just one of the applications employing tie and dye makes a very interesting and beneficial project to work on, both in terms of ecology and economy.

Thus the main objectives of the present study was to obtain a color palette, evaluation of the color yield and fastness properties of the colors obtained, and application of these colors to produce a product line (bags and stoles) using the hand technique of tie - dye

Methods and Materials

For the present study, 100% seri silk and 100% wool was employed as the main substrate. Three dye sources under study-**bark, leaf and fruit** were collected, dried and powdered for easy handling. The M: L ratios, temperature and time for extraction, mordanting and dyeing were as follows-

- Extraction-20g/l, 80^{o}C, 1 hr
- Mordanting- 1:40, 50^{o}C- 60^{o}C, 1 hr
- Dyeing- 1:80, 50^{o}C- 60^{o}C, 1 hr

Samples were pre- mordanted and then dyed with the dye extract at three different pH i.e. self pH (6, slightly acidic), alkaline pH (8) and acidic pH (5). After dyeing was complete samples were washed and dried in shade. Seven mordants were used, four metallic and three natural, their concentrations are given in Table 1.

Sr. No.	Name of the mordant	Concentration of the mordant
1	Alum	10% on the weight of the fabric
2	Copper sulphate($CuSO_4$)	4% on the weight of the fabric
3	Ferrous sulphate($FeSO_4$)	4% on the weight of the fabric
4	Tannic acid	By calculation of m:l of 1:20 from 1% solution
5	Tea	20 g/lit
6	Coffee	20 g/lit
7	Pomegranate	20 g/lit

Table 1: *Name and concentration of mordant's*

The dyed samples were tested for color yield and for CIELAB value, for which Spectrophotometer 5100 was employed. They were also tested for their wash, rub and light fastness properties using AATCC standards. The samples were experimented with tie and dye and then a product line of fashion accessories was prepared. (Fig. 1 Research design)

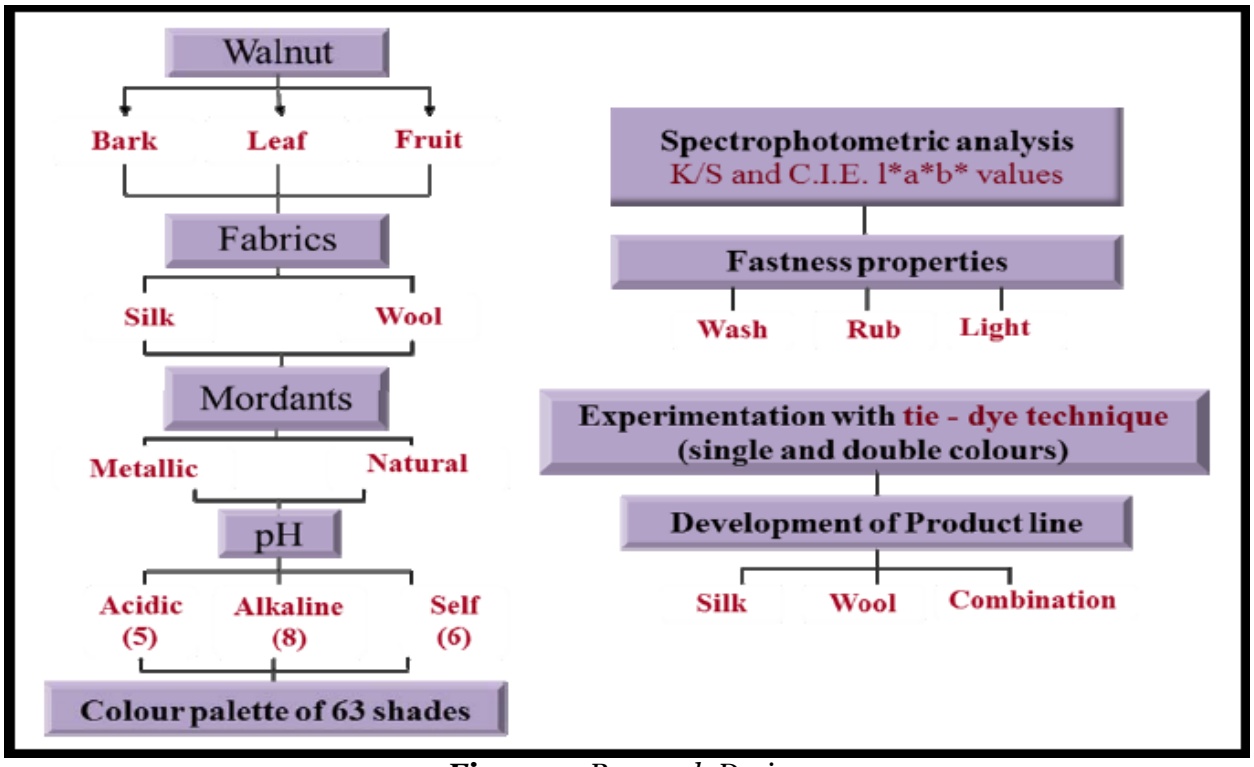

Figure 1: *Research Design*

Results

Color yield

The main objective of the study was to obtain a colour palette and for this three dye sources, seven mordant's and three pH were exploited and a colour palette of 63 shades was obtained. (Fig.2-4). It was evident from the results that in the samples treated with bark in self and acidic pH the shades obtained were a mixture of yellow and green and similar for alkaline medium leaving alum and pomegranate treated that had green and yellow. (Fig.2). The shades obtained with leaf at self and alkaline pH were mostly green and yellow while samples dyed with leaf extract in an acidic pH gave colors in the red-yellow quadrant except $FeSO_4$ mordanted sample (Fig.3). Observing the values obtained from fruit, it could be stated that, red – yellow was the dominant color quadrant. (Fig.4)

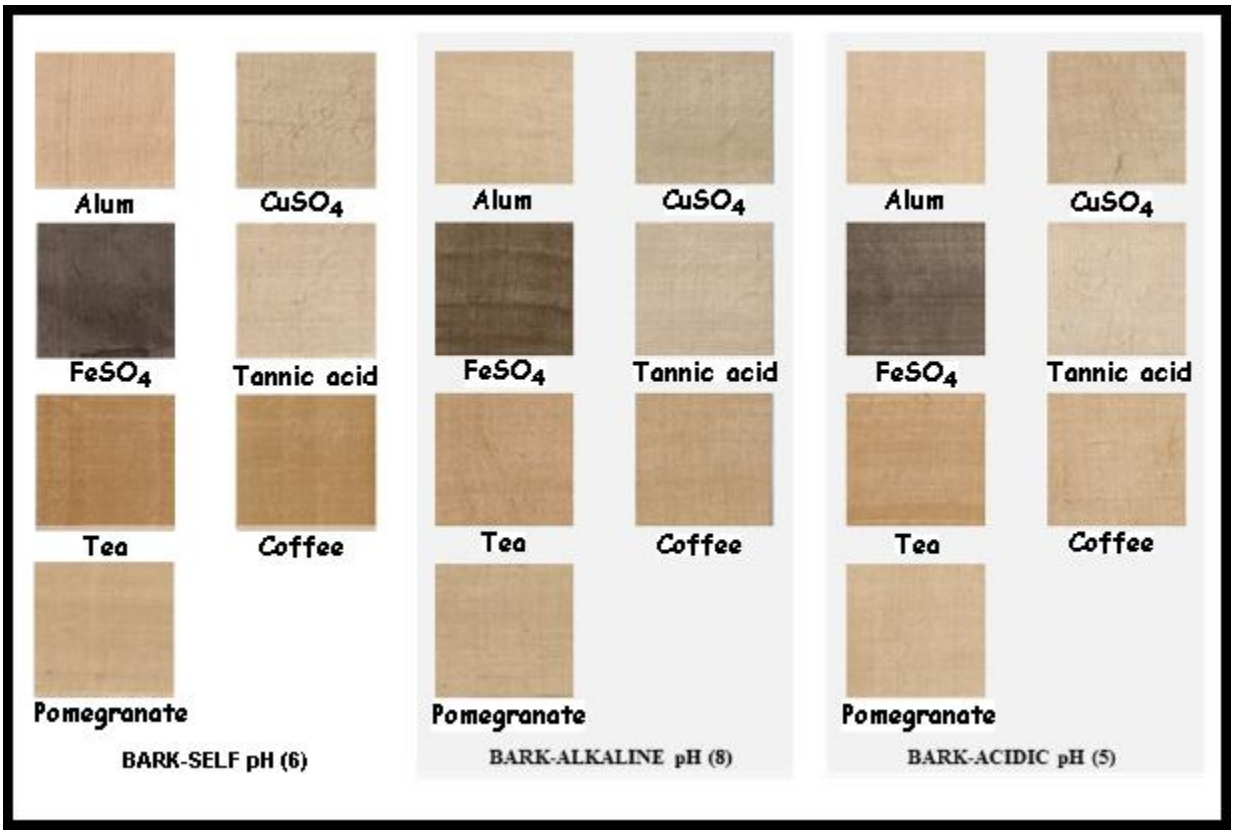

Figure 2: *Color palette from Walnut Bark*

Figure 3: *Color palette from Walnut Leaf*

Figure 4: *Color palette from Walnut Fruit*

Fastness properties

In the case of wash fastness it was observed that all the samples showed good to excellent fastness, ranging between 4 – 5 except the samples treated with CuSO4, which showed fair fastness- rated 3. Light fastness for samples dyed with all the three dye sources gave good to excellent (4 – 5) results except for samples mordanted with pomegranate rind which gave fair results. Samples mordanted with tea and dyed with bark and leaf at self and alkaline pH darkened with exposure to light.

In terms of rub fastness, samples were subjected to two types of rubbing action and it was seen that the samples had fastness ranging between 3 and 5, fair to excellent.

Experimentation with fabric tie and dye using color palette

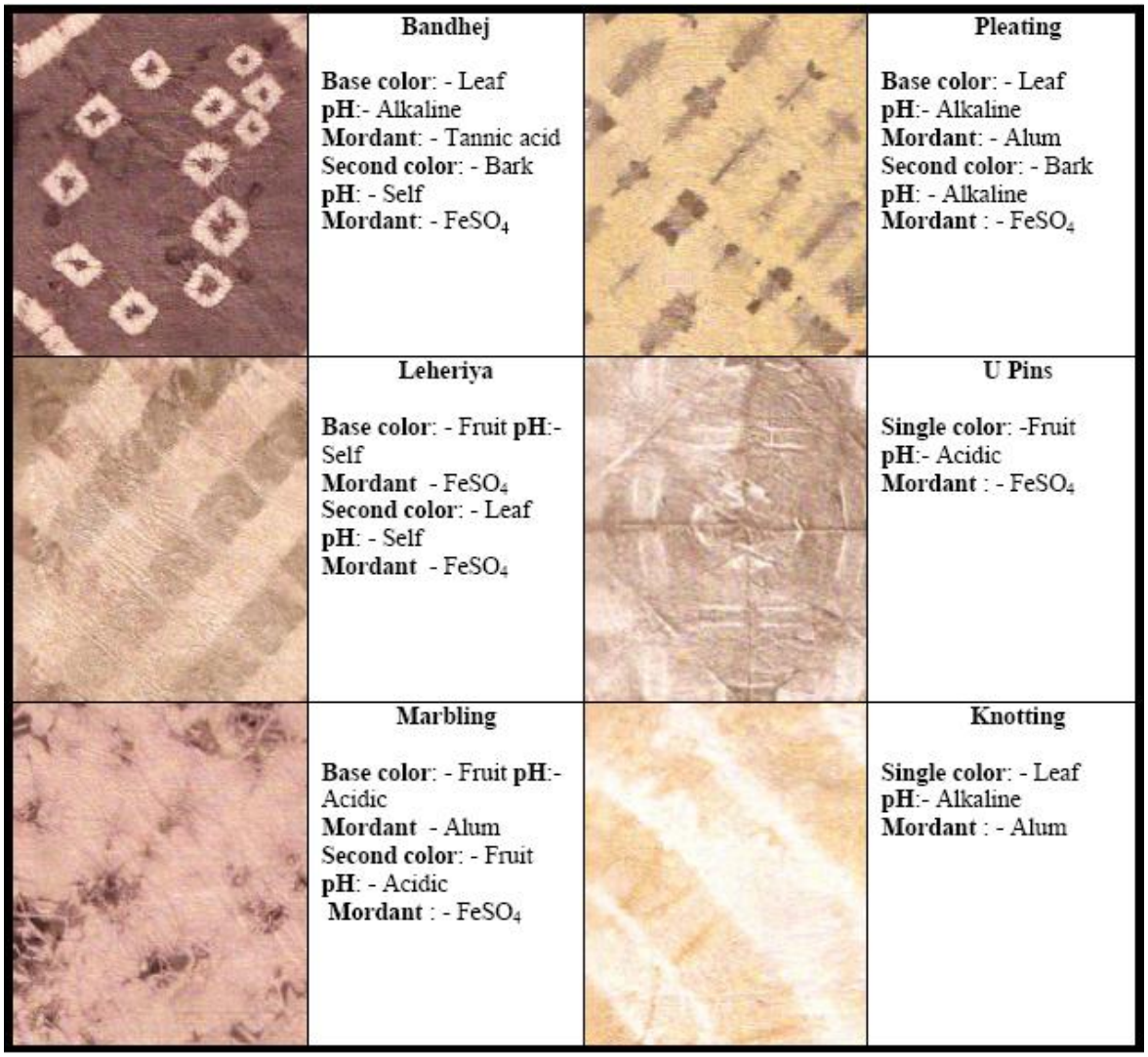

Figure 5: *Experimentation with tie -dye techniques*

After the color yield test, the shade obtained were experimented with tie and dye technique. For this purpose, the most striking and appealing color combinations were tried for their feasibility. Different traditional and contemporary techniques of tie and dye in single color with different mordant's and two colors with combination of mordant's were tried out and some samples are shown in Fig. 5. Tie dye techniques used were knotting, marbling, leheriya, pleating, bandhej, u-pins, hand tritik, cording etc...

Dyes - Fruit
Mordant - Alum and $FeSO_4$
Tie & Dye - Marbling

Dyes - Fruit
Mordant – Tannic acid and $FeSO_4$
Tie & Dye - Bandhej

Category I - Silk Stole and Bag

Dyes - Leaf
Mordant – Tea and alum
Tie & Dye - Knotting

Dyes - Leaf
Mordant – $FeSO_4$
Tie & Dye - Cording

Category II - Wool Stole and Bag

Figure 6: *Product line of Bags and Stoles in Wool and Silk using walnut dye and tie and dye technique*

Product line using Walnut dye and tie and dye technique

Using these various combinations a product line was envisaged. One of the simplest applications of naturally dyed silk could be developing bags and stole and so these products were finalized. For the dyeing of products, simultaneous mordanting was employed as pre – mordanting was not effective. These products were divided into three categories; Category I – Silk, Category II – Wool, Category – III Combination of silk and wool (Fig 6).

All the constructed bags, illustrated in Fig.6 were divided into three categories according to the fabric used. For Category I, the bag was made up of silk and the tie and dye technique used was bandhej. For dyeing the upper lighter part of the dye, tannic acid was used as a mordant and for the rest of the parts, $FeSO_4$ was used as mordant. Fruit extract was used for dyeing the complete bag at self pH for the upper light part and lower dark was dyed at alkaline pH, as the shade obtained from fruit extract is usually light thus a dye concentration of 30 gm/lit was used. The stole was made up of silk and employed marbling as a technique of tie and dye. Mordant's used were alum for the center panel and $FeSO_4$ for side panels and for marbling effect and fruit extract (30 gm/lit) as the dye at alkaline pH for the center panel and acidic for side panels and marbling effect. In this first, the complete stole is dyed at alkaline pH with alum being used in simultaneous mordanting. Once this is done the center panel is crumpled and tied while the side panels remain open and are dyed again at acidic pH with $FeSO_4$. The center panel is marbled and the side panels get one solid color.

Category II had a bag and a stole made up of wool, for the bag dye used was leaf extract was used with $FeSO_4$ as mordant at self pH. The technique employed was cord dyeing with cord being held at the center of the sample. For the stole it was a woollen stole dyed employing knotting technique. It was dyed in two colors yellow base and brown in top of it. First for the base color, alum was used as the mordant and was dyed with bark extract at self pH without any fold or knots for one single solid color. After the fabric was dried up, it was knotted at equal spaces and its ends were secured by wrapping a poly sheet around it, so that no dye seeps in. To get the brown color, leaf extract was used at self pH with tea (30 gm/lit) as a mordant.

Category III had a bag and a stole made by combining the two fabrics, wool and silk. For development of bag fruit extract was used to dye wool with $CuSO_4$ as the mordant at self pH and leaf extract was used to dye silk with tea, alum and $FeSO_4$ as the mordant's at self pH. The bag had different panels of fabrics attached together, right and left most side having silk dyed in two colors, for base color alum as mordant and leaf extract at self pH was used. For the second color, the fabric was pleated lengthwise and tied and dyed at self pH of leaf extract, $FeSO_4$ as the mordant. Then after silk, next two panels on either side were of wool, dyed in single color. In this too, lengthwise pleating was employed with $CuSO_4$ being the mordant, at self pH of fruit extract. The center panel of silk was again dyed with leaf extract at self pH employing tea as the mordant and dyed in one solid color. These panels were then joined together and the back side of the back was of undyed white wool. For the stole, the fruit extract was used to dye wool in single color and leaf extract to dye silk. For wool, the technique employed was hand tritik with simultaneously mordanted with CuSO4 at alkaline pH. For silk, a single panel was dyed in one solid color with leaf extract using tannic acid as the mordant at self pH.

Opinion regarding the environmental awareness and product line

These products were displayed to a number of respondents and they were asked to fill an opinion schedule. The respondents were basically students, teachers and people dealing with natural dyes. The schedule comprised of closed ended questions to judge the environmental awareness, purchase behaviours and opinion about the constructed line. A total no of 40 responses were analyzed.

The respondents were asked their view about the environmental degradation that has taken place in recent years. All the 40 respondents (100 %) of them agreed that there has been degradation in the environmental condition due to various reasons like pollution, population and technological advances. The respondents were asked the tick mark the environmental terms they were familiar with from the given options. It was see that 95 % of the respondents were familiar with the term eco – friendly and the least known term was bio – prospecting. The respondents were asked questions to observe their purchase behaviours and the results showed that 70% of the respondents agreed that their attention is drawn to the naturally dyed of eco – friendly products and 75% said that they possessed products with eco – labels. 60% of the respondents said that

sometimes while making a purchase environmental concern becomes their first priority while only 5% said that they rarely thought about environmental concern while making a purchase. 37.5 % of the respondents said that if available they would always buy more naturally dyed products and 30% of them agreed to the fact that if available they would always opt for naturally dyed products over the synthetic ones.

The respondents were asked questions about the designed products regarding the color combinations used; price range, aesthetic value etc, and the responses scrutinized were as follows. 95 % of the respondents thought the displayed products were novel and unique. Most of them appreciated the effects created by the tie and dye, the muted color palette of walnut dye and the designing aspect of the product line. Out of all the respondents, 72.5 % agreed that tie and dye technique had added value to the constructed products

Conclusions

From the study, it was concluded that the colors produced by natural dyes- Walnut are interesting and attractive due to tonal effects created by them. Bark dyed samples had mixture of yellow and green. Strong presence in the red and yellow quadrant was observed in acidic and self pH. In leaf dyed samples the shades obtained in self, alkaline pH were mostly green and yellow. In fruit dye, red – yellow was the dominant color quadrant. All the three pH gave mild shades and a strong presence of brown, showing the more of red being present. All colors showed fair to excellent wash, rub and light fastness properties.

The products were appreciated for its different color palette and the variety of tie and dye techniques used. Respondents showed eagerness to possess these products indicating a positive trend to eco-fashions. There were suggestions to use these beautiful, earthy, muted and mellow colors for home décor too and if available they would always opt for naturally dyed products over the synthetic ones.

The concept of using tie and dye with walnut natural dye on silk and wool and visualizing a product line of fashion accessories was thought to be novel and splendid. A variety of shades can be produced for today's ever evolving pot of competitive market by varying the mordant's, pH and dye sources. It could also be concluded that natural mordant's could replace metallic mordant's and thus making the whole process eco – friendly or environmental friendly in true sense. Standardization of recipes and quantitatively analysis is needed to commercialize these colours. Products can be value added by use of natural dyes with traditional techniques. These studies would be beneficial in terms of both ecology and economy and also, help in preservation of traditional crafts.

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This article was originally published in the 12th Benniel Symposium, Textile Society of America, 2010