

Dyeing of Cotton and Wool Fabric Using *Mirabilis Jalapa* Flower

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Abstract: Textiles, namely protein fibers, in continental part of central Europe have been traditionally dyed by natural dyes. Textile materials (natural and synthetic) used to be coloured for value addition, look and desire of the customers. Anciently, this purpose of coloring textile was initiated using colors of natural source, until synthetic colors/dyes were invented and commercialized. Hence, worldwide, growing consciousness about organic value of eco-friendly products as generated renewed interest of consumers towards use of textiles dyed with eco-friendly natural dyes. Natural dyes are known for their use in coloring of food substrate, leather as well as natural fibres like wool, silk and cotton as major areas of application since pre-historic times. A study was under taken to find out the effect of selected *Mirabilis Jalapa* Flower on cotton and wool fabric with different mordants Depth of shade and evenness of dye was also evaluated.

Keywords: Textile, Natural dyes, Eco-friendly, *Mirabilis Jalapa*.

1. Introduction

Dyeing is an ancient art which predates written records. It was practiced during the Bronze age in Europe. Primitive dyeing techniques included sticking plants to fabric or rubbing crushed pigments into cloth. The methods became more sophisticated with time and techniques using natural dyes from crushed fruits, berries and other plants, which were boiled into the fabric and gave light and water fastness (resistance), were developed.

Natural dyes can be used on most types of material or fibre but the level of success in terms of fastness and clarity of colour varies considerably. Users of natural dyes, however, tend to also use natural fibres, and so we will look in more detail at this group. Natural fibres come mainly from two distinct origins, animal origin or vegetable origin. Fibres from an animal origin include wool, silk, mohair and alpaca, as well as some others which are less known. All animal fibres are based on proteins.

Natural dyes have a strong affinity to fibres of animal origin, especially wool, silk and mohair and the results with these fibres are usually good. Fibres of plant origin include cotton, flax or linen, ramie, jute, hemp and many others. Plant fibres have cellulose as their basic ingredient. Natural dyeing of certain plant based textiles can be less successful than their animal equivalent. Different mordanting techniques are called for with each category. When a blend of fibre of both animal and plant origin is being dyed, then a recipe should be chosen which will accentuate the fibre which is required to be dominant.

Mirabilis Jalapa (The four o'clock flower or marvel of Peru) is the most commonly grown ornamental species of *Mirabilis*, and is available in a range of colors. *Mirabilis* in Latin means wonderful and Jalapa is a town in Mexico.

Mirabilis Jalapa is said to have been exported from the Peruvian Andes in 1540.

a Flowers and color

A curious aspect of this plant is that flowers of different colors can be found simultaneously on the same plant. Different color variation in the flower and different color flowers in same plant. Additionally, an individual flower can be splashed with different colors. Another interesting point is a color-changing phenomenon. For example, in the yellow variety, as the plant matures, it can display flowers that gradually change to a dark pink color. Similarly white flowers can change to light violet.

b. Reasons for selection of natural dyes (*Mirabilis Jalapa* flower)

The chemical screening of most of the plant material of the Indian forest show a good range of the dye yielding plant species. We have used particularly those plant part which do not disturb the plant growth particularly leaves, flowers or bark.

c Has the following advantages

- Extraction of dye is very simple while comparing to other natural dye.
- The colors obtained are very bright.
- It has very good color fastness properties to washing, perspiration and rubbing.
- The process is done at very short period of time.
- Easily degradable.

d Uses

The flowers are used in food coloring. The leaves may be eaten cooked as well, but only as an emergency food. An edible crimson dye is obtained from the flowers to colour cakes and jellies. In herbal medicine, parts of the plant may be used as a diuretic, purgative, and for vulnerary (wound healing) purposes. The root is believed an aphrodisiac as

well as diuretic and purgative. It is used in the treatment of dropsy. The leaves are used to reduce inflammation. A decoction of them (mashing and boiling) is used to treat abscesses. Leaf juice may be used to treat wounds. Powdered, the seed of some varieties is used as a cosmetic and a dye. Generally natural dyes have poor colour-fastness properties, thus to improve their colour-fastness some other additives like mordants are used for dyeing purpose. Mordants are considered as an integral part of natural dyes and govern the color obtained so that the same dye produces different color with different mordants. There are various types of mordants used for dyeing with natural dyes.

In recent years concern for environment has created an increasing interest in eco-friendly, biodegradable and non toxic rational products. Cotton belongs to natural cellulosic having good affinity towards color fastness properties. Wool is absorbent and healthy. Wool fibers naturally draw moisture away from the body and can absorb up to 30% of its weight in moisture without becoming clammy from perspiration, keeping you dry when sleeping. Various researches show that in case of dyeing with natural dyes, Cotton and wool fibers are generally used.

2. Methodology

The present study was conducted to dye cotton and wool fabric with natural dye extraction from *Mirabilis Jalapa* Flower. The different methodological procedures followed have been explained as under the following headings:

2.1 Collection of raw material

This selection includes the textile material, dye material and mordants used for the present study.

2.2 Textile material

Commercially available cotton and wool fabrics were selected for this experiment.

2.3 *Mirabilis Jalpa* Flower selected for dyeing

Table 1: *Mirabilis Jalapa* Flower used for dyeing cotton and wool fabric

S No	English Name	Common Name	Botanical Name	Part Used
1.	<i>Mirabilis Jalapa</i>	Four O' clock flower	<i>Mirabilis Jalapa</i>	Flower

The detail of *Mirabilis Jalapa* with its common name, botanical name and part used for dyeing are shown in above table.

2.4 Mordants

Synthetic and natural mordanting material was used with dye.

Table 2: Mordants used for dyeing cotton and wool fabric

S.No	Name	Molecular Formula
1	Alum	Al_2SO_4
2	Potassium- di-	$\text{K}_2\text{Cr}_2\text{O}_7$
3	Copper sulphate	CuSO_4
4	Ferrous sulphate	FeSO_4
5	Stannous Chloride	SnCl_2
6	Stannic Chloride	SnCl_4

Mordant selected for dyeing fabric along with its molecular formula are shown in above table.

2.5 Methods

2.5.1 Determination of preliminary data of the fabric

Yarn count, Weight per unit area, Thickness.

2.5.2 Preparatory process of the fabric

Scouring was done to prepare the fabric for dyeing.

2.5.3 Dye extraction

Dye was extracted by boiling 1 gm of mirabilis in 100ml water. The liquors were then strained through two layers of scoured muslin fabric. The clear filtrate was used as dye baths.

2.5.4 Mordanting Method

Mordanting is carried out using 15 to 30 gram/ liter concentration of mordants. Both Wool and Cotton fabric are treated with mordants before dyeing i.e., pre mordanting. The materials are treated with six mordants, such as Alum, Ferrous sulphate, Copper sulphate, Potassium dichromate, Stannic chloride, Stannous chloride.

2.5.5 Dyeing Method

General flow diagram for dyeing of wool and cotton sample is given below.

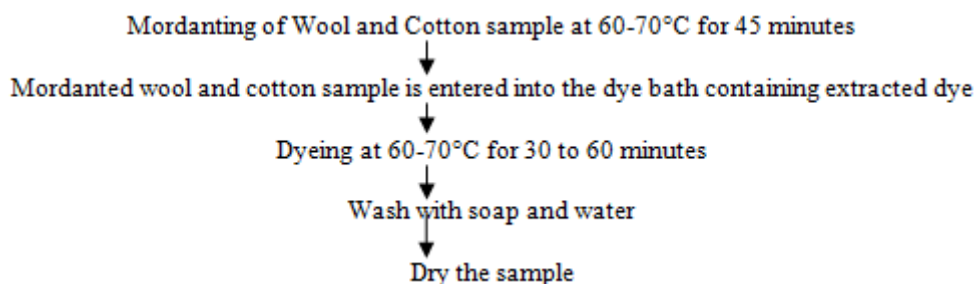


Figure 1: Dyeing Method

2.5.6 Determination of color fastness of the dyed samples

Color fastness is term used for the degree to which dye holds fast to the fiber or fabrics. A good or high fastness means that they do not bleed or rush in washings, crock or rub off in wear. Following colorfastness was assessed: - Colorfastness to Perspiration, Colorfastness to Laundering and Colorfastness to Crocking.

3. Results and discussion

Colors obtained after dyeing are given below.



Plate: 1 *Mirabilis jalapa* flower

3.1 Color obtained for Cotton

- Alum : Pale Khaki
- Copper Sulphate : Olive
- Ferrous Sulphate : Khaki
- Potassium Dichromate : Pale Khaki
- Stannous Chloride : Brown
- Stannic Chloride : Light Brown

3.2 Color obtained for Wool

- Alum : Brown
- Copper Sulphate : Olive Green
- Ferrous Sulphate : Olive Green
- Potassium Dichromate : Khaki
- Stannous Chloride : Brown
- Stannic Chloride : Brown

3.3 Dyed fabric swatch

Plates 2: Colors obtained after dyeing

Dyes	Alum + <i>Mirabilis Jalapa</i>	Copper Sulphate + <i>Mirabilis Jalapa</i>	Ferrous Sulphate + <i>Mirabilis Jalapa</i>	Potassium Dichromate + <i>Mirabilis Jalapa</i>	Stannous Chloride + <i>Mirabilis Jalapa</i>	Stannic Chloride + <i>Mirabilis Jalapa</i>
Cotton						
Wool						

3.4 Colorfastness to perspiration, laundering and crocking

Table 3: Colorfastness to perspiration, laundering and crocking

S.NO	DYE NAME	Change In Colour			Staining	
		Perspiration		Laundering	Crocking	
		Acid	Alkaline		Dry	Wet
1	Alum + <i>Mirabilis Jalapa</i> (Cotton)	3	2	3	4/5	3/4
2	Alum + <i>Mirabilis Jalapa</i> (Wool)	3	3	3	4/5	3/4
3	Copper Sulphate + <i>Mirabilis Jalapa</i> (Cotton)	4	3	3	3/4	3
4	Copper Sulphate + <i>Mirabilis Jalapa</i> (Wool)	4	4	4	3	2/3
5	Ferrous Sulphate <i>Mirabilis Jalapa</i> (Cotton)	2	2	3	4/5	2/3
6	Ferrous Sulphate <i>Mirabilis Jalapa</i> (wool)	4	3	5	4/5	3
7	Potassium Dichromate + <i>Mirabilis Jalapa</i> (Cotton)	2	2	3	3/4	3
8	Potassium Dichromate + <i>Mirabilis Jalapa</i> (Wool)	3	3	2	4/5	3/4
9	Stannous Chloride + <i>Mirabilis Jalapa</i> (Cotton)	3	3	3	4/5	3
10	Stannous Chloride + <i>Mirabilis Jalapa</i> (Wool)	3	2	4	4/5	3
11	Stannic Chloride + <i>Mirabilis Jalapa</i> (Cotton)	2	2	3	4	3
12	Stannic Chloride <i>Mirabilis Jalapa</i> (Wool)	3	2	3	4/5	3

It is clear from the table the results are very encouraging. It is for the first time that mirabilis has been used as a dye source. Result of the preliminary test carried out to standardize the dye extraction and dyeing procedure with the mirabilis flower showed that copper sulphate and ferrous

mordanting gave good colour with concentration of 30 gram / liter.

Our own experience with this flower (*Mirabilis Jalapa*) shows good fastness properties. The findings of color

fastness test of wool and cotton samples to rubbing under dry condition showed that the sample have fair to good fastness as compared to wet rubbing.

- Fastness towards perspiration has fair to good fastness to wool when compared to cotton.
- Washing Fastness test showed fair to excellent fastness to wool when compared to cotton.
- However wool shows good color fastness and bright color ranges while compared to cotton.
- Dyeing absorbency of wool without mordants is good while in cotton dyeing absorbency is poor.

4. Conclusions

A detail study on the mirabilis was carried out for the dye material concentration for wool and cotton. *Mirabilis Jalapa* flower, which is abundantly available in the season, can be exploited can be exploited as a good source of natural dye for the wool and cotton dyeing range from olive green to brown depending upon the choice of mordant. The efficiency of various mordants is correlated with possible chemical interactions on the dyeing of wool and cotton. We were able to get good ranges of colors.

5. Future Scope

The future scope of textile processing industry is good in India. Nowadays, fortunately, there is increasing awareness among people towards natural dyes. Natural dyes are preferred in developed countries, because they are non-allergic, non-carcinogenic and have lower toxicity and better biodegradability than the synthetic dyes. The whole process of extraction and dyeing is ecologically safe. The obtained results have shown that the *Mirabilis Jalapa* as source for cotton and wool fabric dyeing. Good fastness exhibited by the dyed clothes is because of the mordants used. There is need for proper knowledge, documentation and assessment of dye- yielding plants as well as the dyeing techniques so as to increase the use of natural dyes. There is a lot of scope to use the *Mirabilis Jalapa* dye for obtaining various color shades using safe mordant's under eco-friendly textile dyeing. The process of production of *Mirabilis Jalapa* dye was found to be cost-effective as compared to the cost of dyes in local market. . Many of the dyes & dye intermediates plants are operating with obsolete technologies and below economic scale of operations. A Technology up-gradation and development fund needs to be established for up-gradation of such plants.

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