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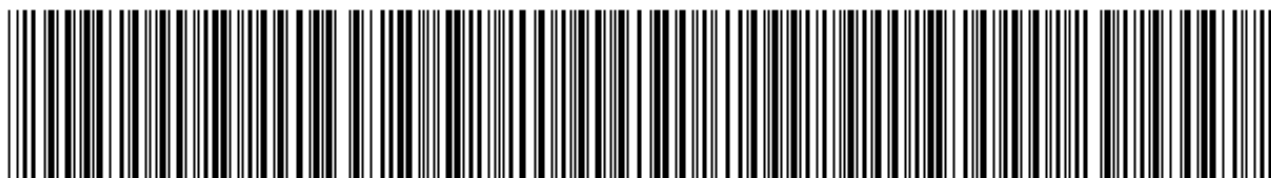


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## DYEING OF COTTON FABRIC WITH NATURAL DYES FROM FLOWER EXTRACT

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### ABSTRACT

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In this study cotton fabric was dyed with dyes extracted from natural resources. Marigold (*Tagetes erecta*) and Rose (*Rosa L.*) flowers were used for the extraction of natural dye. Vinegar, Sodium Carbonate ( $\text{Na}_2\text{CO}_3$ ), Tannic acid ( $\text{C}_{76}\text{H}_{52}\text{O}_{46}$ ), Copper Sulphate ( $\text{CuSO}_4$ ) were used as mordant in the dyeing with Marigold and Rose dyes on knitted cotton fabric. The experiments which were performed for cotton fabric dyeing with fresh Rose flower petals and dry Marigold flower petals. For fresh Rose flower petals Copper Sulphate & Vinegar were used as mordant and dyeing was carried out at room temperature for 24 hours. For dry Marigold flower petals Tannic acid and Sodium carbonate were used as mordant and dyeing was carried out at  $85^\circ\text{C}$ . After dyeing different fastness properties i.e. wash fastness, rubbing fastness of the dyed fabrics were evaluated. At the same time CIELAB values, Reflectance & Color Strength (K/S) of the dyed fabric samples were also evaluated.

**Key words:** marigold, rose, mordant

### INTRODUCTION

Dyeing of textiles has been practiced for thousands of years with the first written record of the use of dyestuff dated at 2600 BC in China. All dyes were natural substances obtained from plant, animal or mineral sources. In 1856, William Henry Perkin, while searching for a cure for malaria, discovered the first synthetic dye, Mauve. Since that time, a great number of synthetic dyes have been manufactured. Almost all garments purchased today are dyes with synthetic dyes. Manufacture and use of synthetic dyes for fabric dyeing has therefore become a massive industry today. However their toxic nature has become a cause of grave concern to environmentalists. Use of synthetic dyes has an adverse effect on all forms of life (Rita 2012).

The demand for eco-friendly products is always growing throughout the world. The use of natural dyes can play role in minimizing pollution and risk to human health (Shahnaz 2014). Textiles colored with natural dyes are preferred by environmentally conscious consumers. But the total share of natural dyes in the textile sector is approximately only 1% due to certain technical and sustainability issues involved in the production and application of these dyes such as non-availability in ready-to-use standard form, un-suitability for machine use, and limited and non re-producible shades. Nature provides a wealth of plants which will yield their color for the purpose of dyeing, many having been used since antiquity (Singh and Srivastava, 2015). Cotton is one of the most commonly used textile fibers in the world having any desirable characteristics such as comfort, soft hand, good absorbency, color retention, reasonable strength and machine wash ability. However, most natural dyes have little affinity for cotton and are required to be used in conjunction with mordants (Asif 2010).

*Tagetes erecta* (Marigold) belongs to the family Asteraceae. It is a small shrub and bears yellowish orange flowers in abundance during the flowering season which lasts for more than 6-8 months. It occurs in humid climate in different parts of Bangladesh, India and even in Sri Lanka (Padma 2009). *Rosa L.* (Rose) belongs to the family Rosaceae. It is a woody perennial and bears flowers vary in size and shape and are usually large and showy, in colors ranging from white through yellow and red. Most species are native to Asia, with smaller numbers native to Europe, North America, and northwest Africa. For successful commercial use of natural dyes, the appropriate and standardized dyeing techniques need to be adopted without scarifying required quality of dyed textiles materials (Gyanendra 2015). In the present work, it has been discussed about the dyeing of cotton fabric with natural dyes extracted flowers with different mordant to find out the comparable shades.

### MATERIALS AND METHODS

#### Collection of samples

*Tagetes erecta* (Marigold) & *Rosa L.* (Rose) flowers were collected from the flower market of Agargaon, Dhaka, Bangladesh. 100% cotton knitted S/J grey fabric was collected from Micro Fiber Ltd. Located at Ramarbagh, Kutubpur, Fatullah, Narayanganj, Bangladesh.



a) Rose petals



b) Marigold petals

**Fig. 1.** a) Petals of Rose & b) Marigold flower petals collected from Agargaon flower market, Dhaka, Bangladesh

### Scouring and bleaching of grey fabric

Scouring is a process of removing natural impurities (waxes, oils, mineral matters) & process impurities from cellulose fabric to make it absorbent. Improper scouring results in uneven dyeing. Bleaching is a process by which natural colors of textile fibers are removed to achieve the whiteness for development of true color during coloration. Scouring & Bleaching of collected grey cotton fabric was done by using following recipe; The chemicals were laboratory grade.

Hydrogen Peroxide (H <sub>2</sub> O <sub>2</sub> )	→ 5 g/L
Caustic Soda (NaOH)	→ 3 g/L
Peroxide Stabilizer	→ 1 g/L
Wetting Agent	→ 1 g/L
Sequestering Agent	→ 1 g/L
Levelling Agent	→ 1 g/L
M:L	→ 1:20
pH	→ 10.5-11
Temperature	→ 90-100°C
Time	→ 60 min

### Extraction of dye

Extraction process was different for Rose & Marigold petals;

For Rose fresh petals; Extraction process was carried out by boiling at 85°C for 45 minutes with regular stirring.

For Marigold petals; Extraction process was carried out by boiling at 95°C for 25 minutes with regular stirring.

### Mordanting

Three chemical mordant namely Tannic acid and Copper Sulphate, Sodium Carbonate and Vinegar were used as a natural mordant. Mordanting was carried out in two stages: Pre-mordanting & Simultaneous mordanting.

#### Pre-Mordanting

In pre-mordanting firstly the scoured & bleached fabrics were treated with suitable mordant. For Rose petals (sample-2 & sample-3) pre-mordanting was carried out at 1:15 M:L for 20 minutes at 80°C. For Marigold petals (sample-4, sample-5 & sample-6) pre-mordanting was carried out at 1:15 M:L ratio for 45 minutes at 60°C. The amount of mordant used was 4% on the weight of the sample fabrics to be dyed. Then the mordanted fabric was used for dyeing.

#### Simultaneous Mordanting

In this method the fabrics were immersed in a mixture of the mordant (Vinegar) 25 mL and the fresh rose petals for 24 hours at room temperature followed by drying of the dyed fabrics (sample-1) at room temperature for 24 hours.

#### Application mode of different mordant

The use of different mordant for different samples was shown in below Table 1.

Table 1. Usage of Different Mordant & their application mode

Sample Number	Pre-Mordanting	Simultaneous Mordanting	Source of Dye-stuff
Sample-1	N/A	Vinegar	Rose Fresh Petals
Sample-2	CuSO <sub>4</sub>	N/A	Rose Fresh Petals
Sample-3	Na <sub>2</sub> CO <sub>3</sub>	Vinegar	Rose Fresh Petals
Sample-4	Tannic Acid	N/A	Marigold Fresh Petals
Sample-5	Na <sub>2</sub> CO <sub>3</sub>	N/A	Marigold Fresh Petals
Sample-6	Na <sub>2</sub> CO <sub>3</sub>	N/A	Marigold Dry Petals

### Dyeing

Dyeing process was different for Marigold petals & Rose petals. For Rose fresh petals (sample-1, sample-2, sample-3) dyeing was carried out at room temperature for 24 hours. For Marigold petals (both fresh & dry) dyeing was carried out at 80°C for 15 minutes. For each sample 3 trials were performed to ensure reproducibility. Dyeing was done manually (open bath method) at the wet processing laboratory of Southeast university.

### Wash fastness

The fastness of a dyeing is a measure of its resistance to fading, or color change, on exposure to a given agency or treatment. For rose petals dyed fabric sample (sample-1, sample-2, sample-3) the method followed was [ISO 105 C03]. For marigold petals dyed fabric sample (sample-4, sample-5, sample-6) the method followed was [ISO 105 C01]. The marigold petals dyed samples were washed in ISO 105 C01 method. In this method soda ash is not present. In the presence of detergent and soda ash the light olive shade is changed.

### Rubbing fastness

Color fastness to rubbing means the resistance of color of dyed materials to rubbing. Rubbing fastness of Rose & Marigold dyed samples were measured by using ISO 105 × 12: 1993 method.

### Color strength & CIE lab values

Strength of any colorant (dyestuff / pigment) is related to absorption property. Kubelka – Munk theory gives us the following relation between reflectance and absorbance:  $K/S = [(1-R)^2 / 2R]$  Where R is the reflectance, K is absorbance and S is the scattering. By using the above equation color strength of different samples were measured. Color shades developed during the dyeing of the cotton fabrics were characterized from the reflectance measurements using the Datacolor 650® spectra flash reflectance spectrophotometer. The color values of the dyed fabrics with selected mordant were obtained in terms of CIE Lab co-ordinates with illuminant D65 with a 10 degree standard observer.

## RESULTS AND DISCUSSION

### Appearance of the dyed samples

Pink shades were obtained from Rose flowers. Mordant play very important role in imparting color to the fabric. With the use of Copper Sulphate a darker shade (sample-2) was obtained while Vinegar gives original pink color shade (sample-1 & 3) to the cotton fabric. The shades of color developed on the cotton fabrics from the fresh rose petals are shown in Figure 2. The shade of sample-3 looks uneven on the fabric surface due to the reason is that it was immersed in the dye bath in creased condition. The dye uptake on the fabric surface was not uniform.



Fig. 2. Dyed cotton fabric with Rose Petals

Light olive shades were obtained from Marigold flowers. The use of Tannic acid & Sodium Carbonate ( $\text{Na}_2\text{CO}_3$ ) as mordant with dye extracted from fresh Marigold petals a light olive shade (sample-4 & 5) was obtained on cotton fabric. The use of Sodium Carbonate ( $\text{Na}_2\text{CO}_3$ ) as mordant with dye extracted from dry Marigold petals a dark olive shade (sample-6) was obtained on cotton fabric. The shades of color developed on the cotton fabrics from the marigold petals both fresh (sample-4, 5) & dry (sample-6) are shown in below Figure 3.

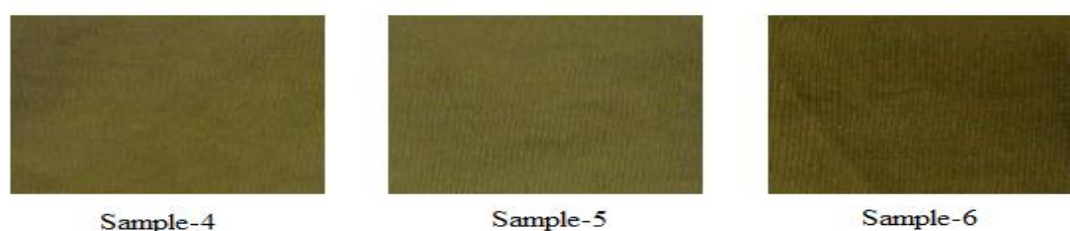


Fig. 3. Dyed cotton fabric with Marigold Petals

### Evaluation of rubbing fastness

The good rubbing fastness was observed for cotton fabric with the natural dye extracted from both Marigold and Rose flower petals. The rubbing fastness rating for both fading & staining of all samples are shown in below Table 2.

Table 2. Rubbing Fastness of different dyed samples

Sample Number	Color Fastness to Rubbing			
	Change in Shade		Staining	
	Dry Rubbing	Wet Rubbing	Dry Rubbing	Wet Rubbing
Sample-1	4-5	4	4-5	4
Sample-2	3-4	4	2-3	3
Sample-3	4-5	4	4-5	4-5
Sample-4	5	4-5	4-5	4-5
Sample-5	5	4-5	4-5	4-5
Sample-6	4-5	4	4-5	3-4

### Evaluation of wash fastness

The overall wash fastness of the dyed sample was not satisfactory. The fabric mordanted with Tannic acid (sample-4) and Sodium Carbonate ( $\text{Na}_2\text{CO}_3$ ) (sample-5 & 6) dyed with marigold flower petals shows comparatively better wash fastness properties than others. The wash fastness rating for both fading & staining of all samples are shown in below Table 3. For sample-2 and 3, the wash fastness rating was very poor as the samples were dyed with only dye solution and mordant without using heat or any other energy. The samples were only immersed in dye liquor.

Table 3. Wash Fastness of different dyed samples

Color Fastness to Wash		
Sample Number	Change in Shade	Staining
Sample-1	2-3	3-4
Sample-2	1-2	3
Sample-3	2	3
Sample-4	3-4	4
Sample-5	3-4	3-4
Sample-6	3	4

### Evaluation of reflectance (%) & color strength (K/S)

Reflectances (%) of different samples were measured. It is known to us that when reflectance is more, absorbance is less and when reflectance is less, absorbance is more. Reflectance (%) of sample-1 was found 65.07 while the reflectance (%) sample-2 & sample-3 was 22.10 and 63.04 respectively. The absorbance of dye in sample-6 was more with a reflectance (%) of 54.13 compared to sample-4 (62.10%) & sample-5 (62.49%).

The color strength of a dyed fabric also depends on its reflectance value. Color strength is high when reflectance value is high at the same time color strength is poor when reflectance value is low. Sample-1 showed maximum color strength (31.54%) among all the dyed samples. Dyed samples with marigold petals showed good color strength than rose dyed samples. Among all of the samples sample-2 showed poor color strength (10.07%).

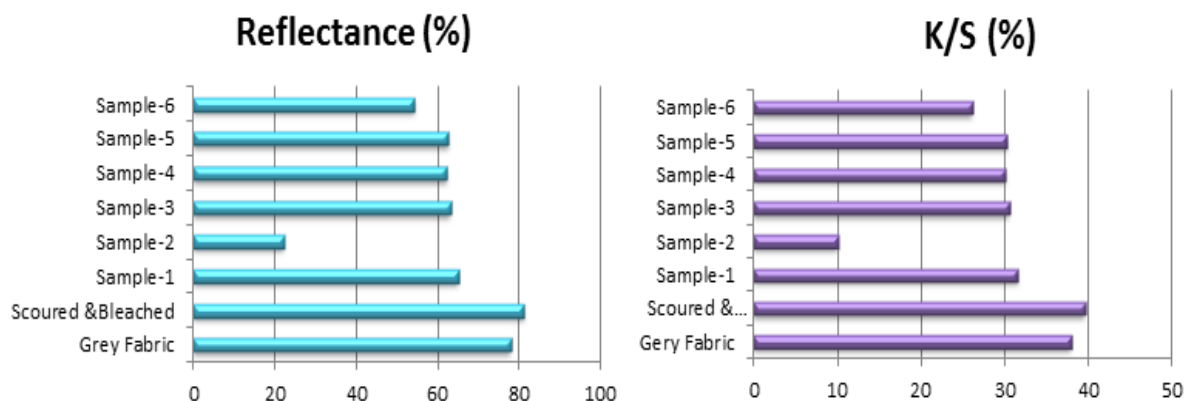


Fig. 4. Reflectance (%) & Color Strength (K/S) values of different samples

### CONCLUSION

A Global awareness is already in place favoring the use of natural resources for protecting the environment and earth from pollution and ecological imbalances. Hence, the presented work shows different flowers can be used as dye. Different shades can be obtained by using different mordant with flowers. Waste marigold and rose flowers are available in flower markets in every season. In this work, waste marigold and rose flower petals were collected from market in low price and used for dye extraction. The total cost for dyeing was not calculated. Bleached cotton fabric was successfully dyed with natural dye extracted from *Tegetes erecta* (Marigold) & *Rose L.* (Rose), with Pre-mordanting and simultaneous mordanting, achieving reasonably good overall rubbing fastness properties while wash fastness properties was not satisfactory. Mordanting results not only improve the color depth and brightness in some cases but also leads to improvement in color fastness properties. While mordanting with Copper Sulphate enhances the color depth the most, mordanting with Sodium Carbonate best results in the improvement of color fastness properties. Although the bleached fabric samples were dyed with the extracted dye liquor from flowers, the dye fiber interaction and probable dye structure was not evaluated through NMR/FTIR instrument. It can be recommended for the future work.

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