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# WASTE UTILIZATION FOR DYEING OF COTTON AND SILK USING POMEGRANATE, PARIJAT AND MARIGOLD

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***Abstract:*** The fashion industry is known to be destructive to the environment. Unfair living wages to workers, poor working conditions, child labour, environmental destruction from hazardous chemicals, plastic-derived materials, and increasing amount of water pollution and textile waste are few disadvantages of fast fashion. To overcome these disadvantages, an ecofriendly and waste utilization approach was used via application of colorants extracted from *Punica granatum* rind (Pomegranate), *Tagetes erecta* (Marigold) dried petals and corolla of *Nyctanthes arbor-tristis* (Parijat) for multifunctional dyeing to cotton and silk. The dye has good scope in the commercial dyeing of cotton and silk. Dyeing was carried out by pre-mordanting method. The scoured cotton and degummed silk mordanted with different mordants for obtaining different shades. The dyed samples have shown very good to excellent colour and sunlight fastness properties. The obtained colours were measured and matched with the names of "Asian Paints World" shade cards. Study also suggests the different sources of natural dyes to add in the palette for kids wear, womens wear and home furnishing.

***Index Terms*– Natural Dyeing, *Punica granatum* (Pomegranate), *Tagetes erecta* (Marigold), *Nyctanthes arbor-tristis* (Parijat), Waste utiliation.**

## I. INTRODUCTION

Fast fashion is a boon for Textile business. It has made the global textile and fashion industry one of the resource-intensive industries in the world (Anchal, 2017). Despite the advantages for customers, fast fashion has also been criticized because it encourages a "throw-away" attitude. That's why it's also called disposable fashion (Adam Hayes, 2021). The increased demand for textile production and the use of synthetic dyes make the "fast fashion" as hazardous products. Dyeing is processed on textile through combination of water and dyes. Dyes are used to colour the original raw textile material and therefore product can be developed in that way. It can be synthetic (made with chemicals) or natural (found in nature) (Elisha Madison, 2021), resulting in toxic pollution, unethical labour practices, mounting waste. The textile industry is a # polluter of freshwater on the planet. Effluents are generally hot, alkaline, strong smelling and colored by chemicals used in dyeing processes. Some discharged chemicals are toxic (Anonymous, 1993). Some of them can pose risks to human being. The increasing complexity and difficulty in treating textile wastes has led to a constant search for new methods that are effective and economically viable. However upto the present moment, no efficient method put forward for removing both the colour and the toxic properties of the dyes released into the environment (Farah Maria, 2013).

Natural dyeing on textile involves the use of leaves, barks, woods, roots, flowers, fruits and nuts, minerals and insects, etc. Generally natural dyes do not cause health hazards, on the contrary they have antimicrobial, UV protection, insect repellent, etc. (Deepti Pargai, et. al., 2020). Natural dyes were the only source of colour for textiles, leather, basketry, and other materials until synthetic dyes were developed in the latter half of the nineteenth century (Sara J. Kadolph). Lately, there has been increasing interest in natural dyes, as the public becomes aware of ecological and environment friendly an approch. Use of natural dyes cuts down significantly on the amount of toxic effluent resulting from the synthetic dye process. Though natural dyes are more expensive than synthetic dyes and other few disadvantages (Uma Campbell, 2019), high cost can be replaced with the use of natural waste such as pomegranate rind marigold and night jasmine flowers which are used for social and religious reasons.

Rind of pomegranate fruit is rich in natural tannins. nGranatonine is the coloring molecule present in the pomegranate rind. It produced yellow dye and shades with different mordants. It can be used in dyeing of cotton, wool and silk (Virendra Kumar Gupta, 2019). The process of production of pomegranate peel dye was found to be cost-effective as compared to the cost of dyes in local market (Kulkarni S.S., 2011).

Marigold flower extract contains rich lutein esters. Flower extracts are used as antioxidant component in various food and pharmaceutical formulations. It has been used in the medicines, foods and in textile industry from ancient days. The marigold extracts are effective in protecting unsaturated fatty acids in the emulsion system and also used as a colouring agent (Sujata Harlapur and et. al., 2020). The extract of marigold flower can be used for colouration of 100 % cotton, silk, and wool fabrics (Harikrishnan and et. al., 2013)and can provide bright hues with good color fastness properties with metallic mordants (Mohd Shabbir, 2018). Printing paste is developed from marigold extract and guar gum has been used as paste ingredients. They are aluminum sulfate, ferrous sulfate, lead acetate, potassium dichromate, stannous chloride, zinc chloride and copper sulfate mordants used as fixer for printing paste on fabric varied with the weight of the printing paste (Redwanul Hasan, 2020).

Night blooming jasmine is a fragrant plant with multifaceted medicinal properties such as antioxidant, antibacterial, antifungal, anticancer, hypoglycemic, antimalarial, antiepileptic, cytotoxic, analgesic, anti-inflammatory, anti-HIV, and hepatoprotective, antipyretic and wound healing effect (Anshuman Singh, 2018). It produces a very colour fast natural dye in golden yellow shade. It gave bright shade on cotton and vibrant golden yellow shade on cotton silk (Anonymous, 2017). Cotton and silk can be printed with dye obtained from *Nyctanthes arbor-tristis's* using block technique (Renu Jain and et. al., 2016). *Nyctanthes arbor-tristis Linn* is very good option for range of yellow and yellow-orange colour as a value addition to fashion fabric and ultimately in eco-friendly clothing (Anjali Deshmukh and et. al., 2015).

## II. MATERIALS AND METHODS

### 2.1 Materials

#### 2.1.1 Sources

Pomegranate rind *(Punica granatum)*, Parijat (*Nyctanthes Arbor-tristis* Linn), Marigold (*Tagetes erecta* L.) were used as a source of natural dye.

#### 2.1.2 Substrates

100% Gray Cotton and Gray Mulberry Silk were used.

#### 2.1.3 Mordants

Harda Fruit (*Terminalia chebula linn*), Babool bark were used as natural mordants and Alum (Aluminium potassium sulphate), Stannous chloride (Tin) and Ferrous Sulphate (Iron) were used as metal mordants.

### 2.2 Methods

#### 2.2.1 Scouring and Degumming

The pure cotton/Silk fabric were washed in bath containing 5% non-ionic soap (Ezee) for 45 minutes at room temperature. The scoured cotton/ degummed silk rinsed thoroughly in 10-12 warm water and dried at room temperature.

#### 2.2.2 Mordanting

Accurately weighed and wetted cloth was treated with 10% mordant or mordant combinations (owf). Alum(10), Alum+Ferrous (7:3), Alum+Stanous (7:3) proportions were used to fixation of dye. The sample was entered into mordanting bath initially at 40°C and raised up to 90°C for 45 minutes. 1:50 (M:L) ratio was maintained throughout the mordanting procedure. Pre-mordanting method was used.

#### 2.2.3 Dye Extraction

Fresh Pomegranate rind/dried corolla of Parijat/dried marigold petals were used for dye extraction and carried out with 1:50 M:L ratio for 1hr at boiling temperature. The water level was maintained during the extraction time.

#### 2.2.4 Dyeing Procedure

Pre mordanted cotton was dyed in previously prepared dye bath. 90°c during dyeing time. Dyeing was carried out for 1 hour with adequate movement of the dye liquor. Initially the temperature of the dye bath was 50±1 and raised up to 90°c during dyeing time. The bath was allowed to cool at room temperature for 15 minutes and material was removed, squeezed gently and rinsed thoroughly in the cold water. Dried under shade.

#### 2.2.5Assessment of fastness properties

Dyed cotton and silk were assessed towards wash fastness using ISO test and Sunlight fastness was assessed using (IS:686-1985), on Paramount Launder-O-meter (IS:3361-1979).

## III. RESULTS AND DISCUSSION:

Table-1 Wash and sunlight fastness of dyed Cotton

| No. of random sample | Mordant /mordant proportion | Dyed Cotton | | |
|---|---|---|---|---|
| | | Wash | | Sunlight |
| | | C. C. | C. S. | |
| 1 | A 10 SD | 4.5 | 5 | 5 |
| 2 | | 4 | 5 | 5 |
| 3 | | 4 | 5 | 5 |
| n=3 | | ∑x1=12.5 | $\sum (x1-x)^2=0$ | **5** |
| | | | | |
| 1 | (TT) A 10 SD | 5 | 5 | 5 |
| 2 | | 5 | 5 | 5 |
| 3 | | 5 | 5 | 5 |
| n=3 | | ∑ x1=15 | $\sum(x1-x)^2= 0$ | **5** |
| | | | | |
| 1 | (TT) A+F 7:3 SD | 4 | 5 | 5 |
| 2 | | 4 | 5 | 5 |
| 3 | | 4 | 5 | 5 |
| n=3 | | ∑x1=12 | $\sum(x1-x)^2= 0$ | **5** |

n=Number of Random Sample; CC=Color Change; CS=Color Staining; SD=Standard Deviation; B=Babool bark; BL=Black.

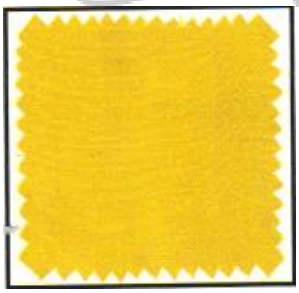
Table-1 reveals the wash and sunlight fastness of dyed cotton.Cotton was mordanted with alum of 10% proportion and dyed with Pomegranate rind. Good wash fastness was noted which rated 4 for accuracy and precision of the values of 3 samples were tested randomly for wash fastness and standard deviation was calculated with average rating towards fastness. Value of standard deviation is also found to be around 0.17, hence from the results wash fastness of 10% alum mordanted sample has deviated which confirm the accuracy of the wash fastness rating. Tannin treated cotton with 10% alum and dyed with Pomegranate rind. Excellent wash fastness was noted which rated 5 for change in color and 5 for color staining with absolutely negligible staining of adjacent dyed fabric which value of standard deviation is found 0 with more accuracy and precision in fastness. Tannin treated cotton was dyed with Parijat and mordanted with Alum+Ferrous in 7:3 proportion. Good wash fastness was noted and rated as 4 for color change and 5 for color staining. 0 value of standard deviation was noted with more accuracy and precision. Excellent sunlight fastness was showed and rated 5 for all mordants used with pomegranate and parijat on cotton substrate.

Table-2 Wash and sunlight fastness of dyed Silk

| No. of random sample | Mordant /mordant proportion | Dyed Silk | | |
|---|---|---|---|---|
| | | Wash | | Sunlight |
| | | C. C. | C. S. | |
| 1 | A+S 7:3 SD | 5 | 5 | 5 |
| 2 | | 5 | 5 | 5 |
| 3 | | 5 | 5 | 5 |
| n=3 | | x1=15 | $\sum(x1-x)^2= 0$ | **5** |
| | | | | |
| 1 | A+F 7:3 SD | 4 | 5 | 5 |
| 2 | | 4.5 | 5 | 5 |
| 3 | | 4.5 | 5 | 5 |
| n=3 | | x1=13 | $\sum(x1-x)^2= 0$ | **5** |

When silk sample was dyed with dried petals of Marigold and mordanted withAlum+Stannous chloride of proportion 7:3 was used, excellent fastness in terms of color change and color staining rated as 5. The sample was mordanted with Alum+Ferrous of 7:3 ratio, very good wash fastness was noted which rated 4. For accuracy Standard deviation was calculated with average rating towards fastness, value of standard deviation has also derived to be around 0.17. Hence from the results wash fastness of the sample has deviated which confirm the accuracy of the wash fastness rating as very good and rated as 4/5 for color change and 5 for color staining. Sunlight was excellent with 0 value of standard of deviation. Excellent sunlight fastness was observed and noted 5 for both mordants used with marigold on silk substrate.

Table-3 Color developed on Cotton and Silk

| | | | |
|---|---|---|---|
| **Substrate** | Cotton |  | **SAMPLE 1** |
| **Dye Source** | Pomegranate rind | | |
| **Mordants** | Alum | | |
| **Shades** | Sun Shadow | | |
| **Substrate** | Cotton |  | **SAMPLE 2** |
| **Dye Source** | Pomegranate rind | | |
| **Mordants** | Tannin + Alum | | |
| **Shade** | Ochre Shadow | | |
| **Substrate** | Cotton |  | **SAMPLE 3** |
| **Dye Source** | Parijat | | |
| **Mordants** | Tannin + Alum + Ferrous | | |
| **Shades** | Rare Herbs | | |
| **Substrate** | Silk |  | **SAMPLE 4** |
| **Dye Source** | Marigold | | |
| **Mordants** | Alum + Stannous Chloride | | |
| **Shades** | Mustard | | |
| **Substrate** | Silk |  | **SAMPLE 5** |
| **Dye Source** | Marigold | | |
| **Mordants** | Alum + Ferrous | | |
| **Shades** | Gold Mine | | |

## IV. CONCLUSION

After consumption of Pomegranate, rind is usally thrown in dustbins. Marigold flowers used in almost every Indian rituals. These are grown throughout India and so are easily available. There is ample scope for application of these extracts in the process of dyeing. In the present work, it can be concluded that Cotton and Silk dyed with Pomegranate, Parijat and Marigold exhibits the scale- very good to excellent in the event of wash and sunlight fastness. Different shades of colour can be obtained from different mordants and combinations. Study also suggests the different sources of natural dyes to add in the palette for kids wear, womens wear and home furnishing. The outcome of this dye development has good scope in the commercial dyeing of cotton and silk industry.

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