Cotton Dyeing with Natural Dye Extracted from Yellow Flowers of Caesalpinia pulcherima

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ABSTRACT

Flower waste is an easily available and replenishable source for natural dyes. The present study deals with the extraction of natural dye from flowers of Caesalpinia pulcherima using four different extraction methods. Various shades were obtained using four different mordents. The finding reveals that Caesalpinia pulcherima yellow flowers are a good source of natural dye which will be helpful in textile industry for dying Cotton fabrics.

Keywords: Natural dye, Mordent.

I. INTRODUCTION

India has a rich biodiversity. It has approximately 4,90,000 plant species of which about 17500 are Angiosperms. More than 400 are domesticated crop species and almost an equal number are their wild relatives1, 2. Hence plant is a huge source of natural product out of that natural dye is our product. The application of synthetic dye causes serious health hazards and influences adversely the eco-balance of nature3. On the other hand, natural dyes are eco-friendly; for example turmeric the brightest of naturally occurring yellow dyes is a powerful antiseptic which revitalizes the skin while indigo gives a cooling sensation4. Certain problems with the use of natural dyes in textile dying are color yield, complexity of dying process, limited shades, blending problem and inadequate fastness properties5, 6. But these problems can be overcome by using chemicals called Mordents. Mordents are the metal salts which produce an affinity between the fabric and the dye7, 8. Metal ions act as electron acceptor and form a complex with the dye molecule. Alum, Chrome, Stannous chloride, Copper sulphate, ferrous sulphate etc. is the commonly used mordants6, 8, 9.

In the present work, dyes were extracted from yellow colored flowers of Caesalpinia pulcherima using different extraction methods and applied on cotton cloth in presence of different mordents. Different shades of dye were observed. The color fastness of the dye materials were also studied in this work.

Caesalpinia pulcherima is a species of flowering plant in the pea family, Fabaceae that is native to the tropics and subtropics of the Americas. It could be native to the West India but its exact origin is unknown due to widespread cultivation. It is a shrub growing about 3 m tall. In climates with little to no frosts, this plant will grow larger and is semi-evergreen freezing; plant will die back to the ground depending on cold, but will rebound in mid to late spring. This species is more sensitive to cold than others; the leaves are bipinnate, 20-40 cm long, bearing 3-10 pairs of pinnae, each with 6-10 pairs of leaflets 15-25 mm long and 10-15 mm broad. The flowers are borne in racemes up to 20 cm long, each flower with five yellow, orange or red petals. The fruit is a 6-12 cm long. Caesalpinia pulcherima are common flowers in India [Figure 1]10. The flower themselves are edible.

In the present study, yellow color flowers of Caesalpinia pulcherima were used for extraction of natural dye using different solvents. The dye has low affinity towards cotton and hence attempts were made to dye cotton fabrics in presence of different mordents giving different shades. Thus it has wide scope to be used as dye in textile industry for dying specially the cotton fabrics.
II. MATERIALS

2.1 Plant Material
Fresh yellow color flowers of *Caesalpinia pulcherima* were collected in polythene bags from local area of Sangamner (District- Ahmednagar, Maharashtra, India).

2.2 Substrate
The 100% soft cotton fabric was used as substrate.

2.3 Chemicals
2% solutions of Alum (K₂SO₄·Al₂SO₄·24H₂O), Copper sulphate (CuSO₄·5H₂O), Ferrous sulphate (FeSO₄·7H₂O), Stannous chloride (SnCl₂) are used as Mordents and 95% Ethanol was used as solvent.

III. METHODS

3.1 Extraction of dye from flower
Extraction of color dye was done by following four different methods.

1. **Aqueous Extraction Method**
   5 gm of fresh yellow color flowers of *Caesalpinia pulcherima* were boiled in 100 ml distilled water at 80 °C for 30 minutes. The filtrate is used for further study.

2. **Acidic Extraction Method**
   In acidic extraction method, 5 gm of fresh yellow color flowers of *Caesalpinia pulcherima* were treated with 100 ml 1% Hydrochloric acid solution and boiled at 80 °C for 30 minutes. The filtrate is used for further study.

3. **Alkaline Extraction Method**
   5 gm of fresh yellow color flowers of *Caesalpinia pulcherima* were boiled in 100 ml 1% Sodium hydroxide at 80 °C for 30 minutes. The filtrate is used for further study.

4. **Alcoholic Extraction Method**
   5 gm of fresh yellow color flowers of *Caesalpinia pulcherima* were boiled in 50% Ethanol for 30 minutes in water bath. Finally the filtrate is used for further study.

3.2 Exhausting of cotton cloth
Cotton cloth used for dyeing were boiled in 10% NaOH solution for 20 minutes to remove starch and impurities in the cloths and then thoroughly washed with cold water.

3.3 Mordenting and Dyeing
Rectangular pieces of cotton cloth measuring 3 cm x 2 cm were treated with 25 ml 2% solutions of different mordents namely Alum, CuSO₄, FeSO₄ and SnCl₂ for 30 minutes. Then the above said pieces are allowed to drain and immediately soaked in different extracts.

3.4 Color Fastness to Washing
Color fastness to washing is the ability to retain its color after washing. The rating of 1 to 5 was adopted to define fastness for I to V washing respectively Table 1.

<table>
<thead>
<tr>
<th>Mordent Method</th>
<th>Alum</th>
<th>CuSO₄</th>
<th>SnCl₂</th>
<th>FeSO₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous extraction</td>
<td>Pale Yellow (I)</td>
<td>Yellow (III)</td>
<td>Pale Yellow (IV)</td>
<td>Dark Brown (III)</td>
</tr>
<tr>
<td>Acidic extraction</td>
<td>Gray (II)</td>
<td>Pale Yellow (III)</td>
<td>Pale Yellow (II)</td>
<td>Red (IV)</td>
</tr>
<tr>
<td>Alkaline extraction</td>
<td>Yellow (III)</td>
<td>Pale Brown (II)</td>
<td>Light Yellow (III)</td>
<td>Brown Red (III)</td>
</tr>
</tbody>
</table>

( ) - Indicates fastness to washing in the rating scale I to V

IV. RESULT AND DISCUSSION

Different color shades were observed from various extracts of *Caesalpinia pulcherima* red color flowers and the color intensities are showcased in Figure 2. The present work successfully produced the red, brown and yellow color shades. The color strength also depends
upon use of mordent. Mordents are the metal salts having tendency to coordinate with dye and fibre\textsuperscript{18}. The aqueous extract gave the pale yellow, yellow, pale yellow and dark brown color shades with mordent such Alum, CuSO\textsubscript{4}, SnCl\textsubscript{2} and FeSO\textsubscript{4} respectively. Various shades like gray, pale yellow, pale yellow and red on cotton fabrics were obtained using acidic extract with Alum, CuSO\textsubscript{4}, SnCl\textsubscript{2} and FeSO\textsubscript{4}. The alkaline extract with Alum, CuSO\textsubscript{4}, SnCl\textsubscript{2} and FeSO\textsubscript{4} give yellow, pale brown, light yellow and brown red color shades respectively. While the alcoholic extract gave dark brown, pale brown, pale brown and dark brown color shades in combination with mordents such as Alum, CuSO\textsubscript{4}, SnCl\textsubscript{2} and FeSO\textsubscript{4} respectively. The study revealed that the production of various natural color shades is possible from plant pigments. The present work suggests that utilization of flowers waste for isolation of natural color is an example of value addition to waste leading to an impact on the economic growth of the rural communities. This work is also helpful for small scale dyeing and printing industries in locality.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image.png}
\caption{Color shades obtained on cotton fibers mordent with Alum (1), Copper sulphate (2), stannous chloride (3) and ferrous sulphate (4) using different extracts- Aqueous (A), Acidic (B), Alkaline (C) and Alcoholic (D)}
\end{figure}
V. CONCLUSION

The natural dyes extracted from yellow flowers of *Caesalpinia pulcherima* are safe because these are non-toxic and biodegradable in nature. Thus results obtained from the present investigation rebuild that the extracts of flowers of *Caesalpinia pulcherima* show four different color shades like pale yellow, yellow, gray, dark brown, brown red, pale brown and red on cotton in presence of mordents like Alum (K₂SO₄. Al₂SO₄.24H₂O), Copper sulphate (CuSO₄.5H₂O), Ferrous sulphate (FeSO₄.7H₂O), Stannous chloride (SnCl₂) with good fastness property to washing.

VI. ACKNOWLEDGMENT

We are thankful to Principal Dr K.K.Deshmukh for providing the facilities and motivation.

VII. REFERENCES


[10]. http://en.m.wikipedia.org/wiki/Caesalpinia_pulcherima


[15]. David Kirkland, Daniel Marzin, 'An assessment of the genotoxicity of 2-hydroxy-1, 4-naphthoquinone, the natural dye ingradient of Henna', Mutation Research, 2003; 537, pp183-199.

