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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 thatCaesalpinia pulcherima yellow flowers are a good source of natural dye which will behelpful 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 aretheir wild relatives[1, 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 nature[3]. 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 sensation[4]. Certain problems with the use of natural dyes in textile dying are color yield, complexibility of dying process, limited shades, blending problem and inadequate fastness properties[5, 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 dye[7, 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 mordants[6, 8, 9].

In the present work,dyeswere extracted from yellow colored flowers of *Caesalpinia pulcherima* using different extraction methods andapplied 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 re-bound 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, yellowcolor 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.

Figure 1. Plant of Caesalpinia pulcherima

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($K_2SO_4.Al_2SO_4.24H_2O$), Copper sulphate ($CuSO_4.5H_2O$), Ferroussulphate ($FeSO_4.7H_2O$), Stannous chloride ($SnCl_2$) are used as Mordents and 95% Ethanol was used as solvent.

III. METHODS

3.1Extraction 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 ^{0}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 ^{0}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 ^{0}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.

3.2Exhausting 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, $CuSO_4$, $FeSO_4$ and $SnCl_2$ for 30 minutes. Then the above said pieces are allowed to drain and immediately soaked in different extracts.

3.4 Color Fastness to Washing[11-17]

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.

Table1. Result for the method of extraction.

Mordent Method	Alum	$CuSO_4$	$SnCl_2$	$FeSO_4$
Aqueous extraction	Pale Yellow (I)	Yellow (III)	Pale Yellow (IV)	Dark Brown (III)
Acidic extraction	Gray (II)	Pale Yellow (III)	Pale Yellow (II)	Red (IV)
Alkaline extraction	Yellow (III)	Pale Brown (II)	Light Yellow (III)	Brown Red (III)
Alcoholic Extraction	Dark Brown (II)	Pale Brown (II)	Pale Brown (III)	Dark Brown (IV)

( ) - 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[18]. The aqueous extract gave the pale yellow, yellow, pale yellow and dark brown color shades with mordent such Alum, $CuSO_4$, $SnCl_2$ and $FeSO_4$respectively. Various shades like gray, pale yellow, pale yellow and red on cotton fabrics were obtained using acidic extract with Alum, $CuSO_4$, $SnCl_2$ and $FeSO_4$. The alkaline extract with Alum, $CuSO_4$, $SnCl_2$ and $FeSO_4$ 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, $CuSO_4$, $SnCl_2$ and $FeSO_4$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.

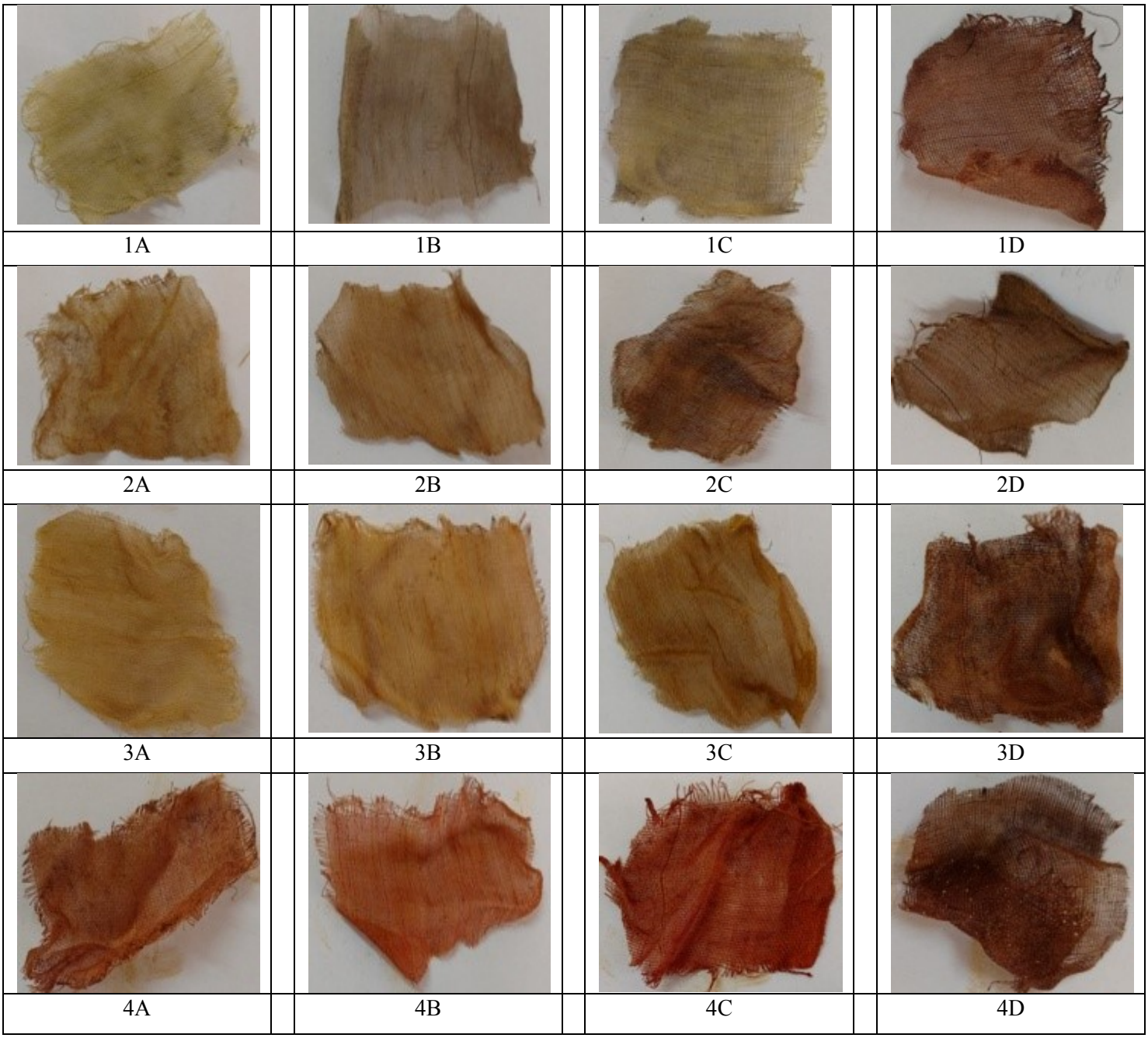

Figure 2. Color shades obtained on cotton fibersmordent with Alum (1), Copper sulphate (2), stannous chloride (3) and ferrous sulphate (4) using different extracts- Aqueous (A), Acidic (B), Alkaline (C) and Alcoholic (D)

V. CONCULSION

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 ($K_2SO_4.Al_2SO_4.24H_2O$), Copper sulphate ($CuSO_4.5H_2O$), Ferrous sulphate ($FeSO_4.7H_2O$), Stannous chloride ($SnCl_2$) with good fastness property to washing.

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VII. REFERENCES

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