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GREEN COLORATION TECHNOLOGY: NATURAL DYES AND MORDANTS FOR COTTON FABRIC

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ABSTRACT

Present investigation deals with the extraction of natural dyes from flower of *Butea monosperma* (Palash) and its application on cotton fabrics using different concentrations (0.1 to 0.5%) of natural mordants. Natural mordants used in the study were almond shell, walnut shell, rinds of bahera fruits, rind of harad fruits, combination of almond shell + rinds of bahera fruits and combination of walnut shell + rinds of harad fruits. Dyeing was carried out by pre-mordanting method. Large range of colour shades was obtained because of varying mordant concentrations. Best dyed samples were selected on the basis of maximum colour strength and were evaluated for their colour fastness properties that is washing, rubbing, light and perspiration, showing fair to excellent fastness numerical ratings. The results showed the flowers as a good source of dyes.

Index Terms: **Natural dyes, Natural mordants, Advantages of natural dyes**

1. INTRODUCTION

The art of dyeing with natural dyes is as old as our civilization. Dyed textile remnants found during archaeological excavations at different places all over the world provide evidence to the practice of dyeing in ancient civilizations. Dyes derived from natural materials such as plant leaves, roots, bark, insect secretions, and minerals were the only dyes available to mankind for the colouring of textiles until the discovery of the first synthetic dye in 1856. The textile industry's shift towards sustainability is driven by consumer demand for natural dyes, which, although renewable and biodegradable, face production and application hurdles, limiting their market share. Natural dyes are sustainable, renewable and biodegradable.

Butea monosperma (Lam.) Kuntze (Family: Fabaceae), is commonly known as *'Palash'* or *'Tessu'* or *'flame of the forest'* and various other names in different parts of India and abundantly available in the forests of central India. It is one of the most beautiful tree and extensibly used in Ayurveda, Unani and Homeopathic medicine and has become a cynosure of modern medicine. Plants of this genus are well known for their colouring matters also (Sindhia and Bairwa, 2010). The flowers of plant are well known for its yellow or orange natural dye. Since, the leaves of this plant are abundantly available and most part of it goes waste only, it was planned to evaluate these leaves scientifically for their potential as natural dye. Therefore, the objectives of the study were to extract the natural dyes from the flower of *Butea monosperma* and its application on cotton fabrics using different types of chemical and natural mordants for development of various types of colour shades which were further planned to be evaluated for their colour fastness properties.

2. MATERIALS AND METHODS

2.1 MATERIALS

The flowers of *Butea monosperma* were collected from nearby forest & village areas of Jabalpur district of Madhya Pradesh. For the study, natural mordants like almond shell, walnut shell, Bahera fruit, and Harad fruit were procured from local markets and forests **(Figure 1)** and paired with 100% pure mill white cotton fabric. Distilled water was used for extraction and preparation of all solutions and dyeing fabrics.

Figure 1 Natural Mordants

2.2 METHODS

1. Preparation of samples for extraction of dye

The flowers were dried in shade and grinded to get the powder form. The dried powder of flowers was stored in polythene bags at room temperature (Bhuyan and Saikia, 2005).

2. Extraction & Isolation of dye from flowers

The dye was extracted by heating the powdered flowers in distilled water at 90-95°C for 1 hour by maintaining the material liquor ratio of 1:10. The dye solution was filtered and evaporated to get the concentrated form. It was further dried in sun to obtain the solid dye (6.8%) **(Figure 2)**.

Figure 2 Flower dye

3. Dyeing method

Dyeing on cotton fabric was carried out by pre-mordanting method which produced different shades in terms of hue and darkness.

4. Determination of optimum concentration of mordant

The different mordant solutions of 0.1 to 0.5% concentrations were prepared in distilled water and were used for mordanting to standardize the optimum concentration of each mordant. 1.24 gm of cotton fabric was directly immersed in the mordant bath and the bath was heated to a temperature of 90 - 95°C for 20 minutes. The bath was allowed to cool and fabric was directly transferred to dye bath for developing the colour.

5. Dyeing of fabric

1 gm of dye was dissolved in 100 ml distilled water. The dye bath was set and a temperature of 90 - 95°C was maintained by heating the solution for 30 minutes for dyeing. The dye bath was cooled to room temperature and the dyed fabrics were taken out, washed in tap water and dried in shade (Dayal et al., 2006). The developed colour was visually examined. Similar procedure was followed for dyeing cotton fabrics using all mordants taken for study.

6. Evaluation of Colour fastness: The dyed material was tested for washing fastness. The colour fastness is usually rated either by loss of depth of colour in original sample or is expressed by staining scale (Samanta and Agarwal 2009).

3. RESULT AND DISCUSSION

The above process of dyeing done with the combination of natural dyes and natural mordants. Dye extract was taken in dyeing process as *Butea monosperma* flower with six natural mordants as almond shell, walnut shell, rinds of bahera fruits, rind of harad fruits, combination of almond shell + rinds of bahera fruits and combination of walnut shell + rinds of harad fruits. Results shown the six shades of colour obtained on cotton fabric, after the pre mordanting and dyeing. Palash with almond shell showed Daffodil colour, walnut shell showed Biscotti, rinds of bahera showed Light lemon, rind of harad showed marigold, almond shell + rinds of bahera showed Blonde and walnut shell + rinds of harad showed Lemon colouration **(Figure 3)**. The evaluation of colour fastness to washing of dyed samples were tested by standard method. The sample treated with natural mordants showed excellent

washing fastness. Bahera, walnut, harad, treated samples exhibit good to excellent fastness whereas, washing fastness grades of almond and combinations ranged between moderately good to excellent (Table 1).

Figure 3 Colour shades of flowers dye

Table 1: Fastness Properties of dyed fabric

SNo	Fabric	Dye Extracted Material	Mordants	Washing Fastness
1	Cotton	Flower of Palash	Almond shell	3-4
2			Walnut shell	4-5
3			Rinds of bahera	4-5
4			Rind of harad	4-5
5			Almond shell + rinds of bahera	3-4
6			Walnut shell + rinds of harad	3-4

Fastness Grades: 1-Very Poor, 2- Poor, 3- Moderately Good, 4- Good, 5- Excellent

4. CONCLUSION

India's forests, particularly in central regions, are home to *Butea monosperma*, whose flowers are used for natural dyeing, promoting cultural heritage and job creation. It was found from the study that isolated dye from the *Butea monosperma* flower can be used for dyeing of cotton to obtained wide range of soft and light colours by using natural mordants. This environmentally friendly dyeing process produces minimal pollution and achieves impressive color fastness, ranging from moderate to excellent. Researchers also revealed that natural dye can be used with natural mordant successfully on cotton fabric. In contrast to chemical agents, natural dyes and mordants offer a healthier and more sustainable option, benefiting both human well-being and the environment. The studies further emphasized the effectiveness of natural dyes and mordants, which consistently delivered good to excellent results. Natural dyes offer a unique combination of benefits, including excellent color properties, fastness, and environmental sustainability, making them an ideal choice for responsible textile manufacturing.

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