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Utilization of eucalyptus bark as natural dye: A review

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Abstract

Natural dyes have been used since antiquity until the 19th century when synthetic dyes were discovered. The harmful effects of synthetic dyes have drawn attention to natural dyes on a global scale. It was safe and biodegradable to extract dye from a natural source for use in textile materials. People are shifting towards environmentally friendly products. The present review paper provides an overview on potential of Dyeing with natural dye with special reference to Eucalyptus Bark Extract.

Keywords: Natural dyes, history, mordants, colourfastness, eucalyptus bark

Introduction

Beautiful colors abound in nature, drawing the attention of human being. Since ancient times, people have dyed food, cave walls, textiles, leather, and everyday items with natural dyes. There are several sources of plants, animals, insects, and minerals that can be used to extract pigments and dyes (Krizova, 2015) [7].

Since many nations have established strict environmental requirements in response to the harmful and allergic reactions linked to synthetic dyes, interest in the use of natural dyes has been developing significantly. With the world becoming more conscious towards ecology and environment, there is greater need today to revive the tradition of natural dye and dyeing techniques as an alternative of hazardous Synthetic dyes is extremely crude. The choice of dyes and dyeing methods for textiles depends upon the type of fabrics, their utilization, fastness to in-service requirements and type of preparatory and finishing processes (Jihad, 2014) [12].

The need for dyes and pigments has grown in conjunction with human civilization and population growth, driven by the desire for colors in necessary quantities at affordable prices that don't compromise durability. The use of natural dyes and pigments was uninterrupted until mid of 19th century, after synthesis of first synthetic dye mauve or aniline purple in 1856 by William Henry Perkin. Due to the great durability, wide color range, ease of application, and low cost of synthetic dyes, numerous synthetic dyes have been created, and their production industries have grown (Hagan and Poulin 2021) [3].

Natural dyes are becoming increasingly popular in the textile industry. The use of non-allergenic, non-toxic, and environmentally friendly natural dyes on textiles has taken significant importance as a result of growing environmental awareness of the need to avoid certain hazardous synthetic dyes (Jose, *et. al.*, 2017) [6]. With the world becoming more conscious towards ecology and environment, there is greater need today to revive the tradition of natural dye and dyeing techniques as an alternative of hazardous Synthetic dyes is extremely crude.

History of Natural Dye

In China, the first indications of the usage of natural dyes date back to 2600 BC. Later, colored pigments were discovered in King Tutankhamun's tomb in Egypt. In 541 BC, Alexander the Great made reference to purple attire. Some natural dyes were considering a luxury because of the difficulty of obtaining the material to produce them. For example, the shade of purple was derived from a mollusk and required a lot of work to achieve. It was calculated that one gram of dye required 8,500 molluscs to manufacture. The dye was more expensive than gold because of the intricate process for making it (http://www.quilthistory.com/dye.htm)

The use of colorants came in to existence from Stone Age and after the development of weaving technique; utilizations of dyes were extended to textiles in many ancient civilizations. Some of common ancient dyes comprise madder, blue indigo, and Yellow obtained from saffron or turmeric while ochre, limestone and charcoal were important pigments. The major source of natural colorants were animal, minerals and plants, almost all parts of plants like leaves, root, fruit, flower, bark, wood, seed etc. were used to produce different colors and their combinations. In ancient Stone Age, colored minerals were major utilized pigments while in Phoenicians, Ancient India, Ancient Roman, Ancient Egyptian and Ancient African were utilized minerals as well as bio-colorants (Yadav *et.al.* 2022) [17].

Mordant and mordanting methods

Chemicals known as mordants are needed by most natural dyes in order to improve fabric binding. Pre-, post-, and

simultaneous mordanting are the three categories of mordanting based on when the mordents are applied (Bisht and Goel 1999) [2] Mordants have an impact to enhance physical qualities including colourfastness, dye brightness, and rubbing fastness. Lack of mordant results in low color fastness and a narrow shade range (Ragab *et al*., 2022) [11].

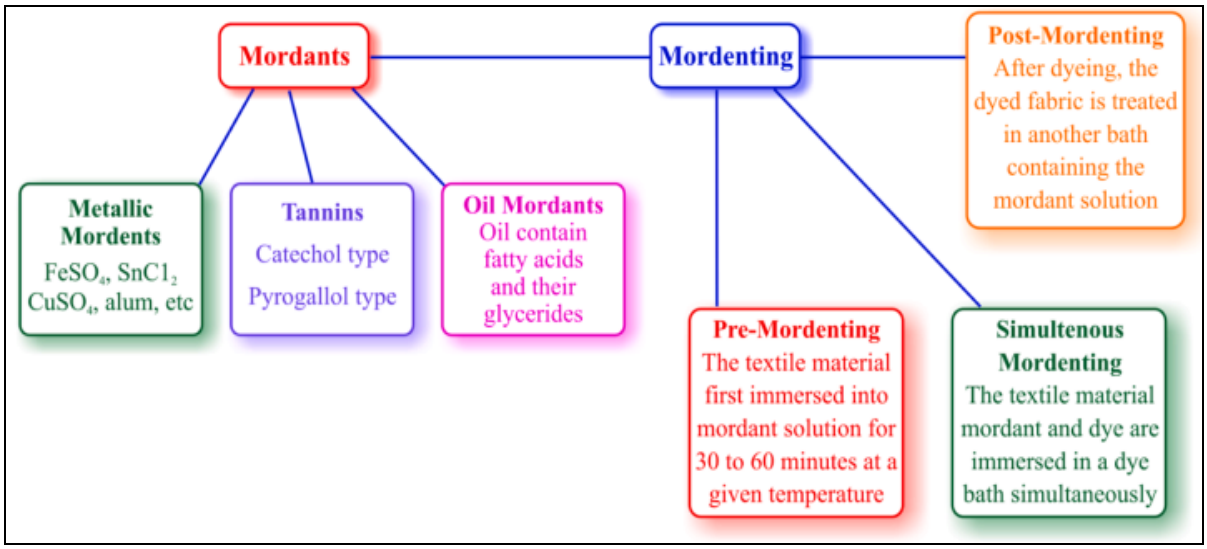

Fig 1: Mordant and Mordanting Methods (Source: Yadav., *et al.* 2022) [17]

In general, mordanting produces a wide range of colors with wide shade ranges, superior fastness qualities, and improved dye-exhaustion to the fibers. Not only are mordants made of metals like sulphates (magnesium, aluminium, zinc, copper, cobalt, nickel, manganese, or stannous sulphate), nitrates (aluminum nitrate), chlorides (stannic, ferric, copper, zinc, aluminium chloride and even rhenium, neodymium or zirconium trichloride or oxychloride), and various hydroxides (calcium hydroxide) and oxides (ferric or lanthanum oxide) can also be found in metal salts. Most commonly used mordants in natural dyeing are aluminium potassium sulphate (alum, KAl(SO4)2·12H2O), potassium dichromate (K2Cr2O7), stannous chloride (SnCl2·2H2O), ferrous sulphate (green vitriol, FeSO4·7H2O) and copper sulphate (blue vitriol, CuSO4·5H2O) (Shahid, 2013) [14].

Eucalyptus dye and its uses

Eucalyptus grows on swampland, valleys and mountains. Its trees are distinguished by their pale, leathery leaves that have an odd fragrance. One of the main sources of yellowish-brown coloring is eucalyptus bark. Plenty of naturally occurring tannins and polyphenols, ranging from 10% to 12%, are present in eucalyptus coloring matter. The important compounds found in the Eucalyptus bark are Eriodictyol, Naringenin, Quercetin, Rhamnazin, Rhamnetin and Toxifolin, apart from tannins of which some are colourants (Ali *et al*., 2007) [1]. According to Gajendra *et al*. (2019) [4] Eucalyptus (family: Myrtaceae) bark is a novel source for dyeing silk fabric and for manufacturing eco-textiles. It was discovered that eucalyptus bark had a high enough dye yield to colour fabric without the addition of a metallic mordant. However, a higher K/S value and excellent colorfastness properties of coloured silk fabric suggest that small-scale enterprises or cottage companies can commercialize bark dye for application in protein fabric dyeing.

The *Eucalyptus globulus* bark extract contains a total of 29 polyphenolic compounds. Due to their exceptional oxidant and anticancer capabilities, these chemical compounds are biologically active. According to Vankar *et al*. (2000) [16], the phytochemicals present in *Eucalyptus globulus* support its therapeutic use. A pigment can be found in the crude extract of eucalyptus bark, which is a plant waste that peels off and can be used as a natural dye for cotton fabric. According to Naseer *et al*. (2019) [10], an aqueous extraction of the completely pulverized eucalyptus bark resulted in a brown, fine powder. It contained tannins, reducing sugars, alkaloids, glycosides, saponins, several antioxidants, antibacterial agents, and an antiradical component. Tesfaye *et al*. (2015) [15], the dye extract from eucalyptus bark produced deeper colour shades than the other dye extracts regardless of the type of mordant used. Dye from Eucalyptus bark showed tints of pale yellow. It was found that silk dyed in a eucalyptus bark extract solution with a mordant compound exhibited a yellow to brown colour (Mongkholrattanasit *et al*. 2007) [9].

Colour fastness properties of dyed yarn

Fastness is the resistance of fabric against colour fading from various colour fastness methods like washing, rubbing crocking etc. According to Gajendra *et al*. (2019) [4], tannin, contains phenolic chemicals capable of forming hydrogen bonds with the carboxyl group of protein fibres, which gives coloured fabrics their darker shades of eucalyptus bark. The findings of the colour fastness analysis of coloured fabrics showed a rating of 4-5 on the grey scale (4-5) when washing materials, rubbing silk dry (4-5), and in damp conditions. The silk fabric had an exceptional 5 on the grey scale colour fastness to light. This indicates that eucalyptus bark is a novel source of dye for colouring silk fabric and producing eco-textile.

Samanta and Konar (2011) [13] stated that an important factor in determining an item's suitability is its ability to retain its colour over time, which is an incredibly important characteristic of a dyed material. It relates to how resistant a

colour is to fading or altering as a result of treatments like washing, rubbing, dry cleaning, exposure to various light sources, heat sources, or other situations, etc. (Ali *et al.* 2007) [1] investigated that the dye extracted from eucalyptus has good fastness properties. Washing and light fastness properties are better than many of the commonly used direct and sulphur dyes. However, these may not be acceptable for high-quality articles requiring very good fastness properties. Dry rubbing fastness is quite good. However, the wet rubbing fastness is poor. Many commonly used direct and sulphur dyes have excellent washing and light fastness qualities. Excellent dry rubbing fastness is attained. However, the wet rubbing fastness is good.

Conclusion

Utilizing modern science and technology for the application of natural dyes not only revitalizes the age-old method but also enhances its rate of production, cost-effectiveness, and consistency in hues. As a result, additional measures must be taken to ensure dye evenness. When using natural dyes, a lot of considerations need to be made. They are: nature of Material to be dyed, measurements of mordants and dyestuffs, temperature, agitation, natural dyes are unpredictable, wet fibers look darker and rinsing. People are now more conscious about their health, safety, environmental issues, sustainability and ecological benefits of natural dyes. As natural dyes are non-toxic, biodegradable, and non-allergic with antimicrobial properties. So, people are shifting towards natural dyes due to the hazardous nature of synthetic dyes. The dyeing of mulberry silk yarns with different dyestuffs enhances the dye affinity of the fiber and improved its aesthetic appearance and intrinsic value of the product.

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