



## Review

### Dyeing textiles with eco-friendly natural dyes: A brief review

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**Abstract:** The current review articles deal with the data on the natural colors. Because they are safe and good for the environment, colors that come from plants play an important role in human life. Biodegradability is good with natural dyes. They are non-poisonous, non-susceptible to skin and non cancer-causing, effectively accessible and inexhaustible. The natural color enjoys a few upper hands over manufactured colors according to the perspective of wellbeing, security and nature. The investigations on natural colors and their feasible use for multifunctional clothing are acquiring pace now. Additionally, the advancements and opportunities of using natural dyes will be emphasized in the reviews. The information presented in this review article focuses on Indian dye-producing plants.

**Keywords:** Natural dyes, synthetic dyes, dye-yielding plants, extraction techniques, mordants, indigenous use.

### Introduction:

Dyeing with natural dyes has been done since ancient times and has many developments in the present time. However, the development of synthetic dyes in the nineteenth century significantly curtailed the availability of these dyes. This condition is made worse by the complexity of the stages involved in the utilization of natural dyes and the lack of readily available dye materials as a result of unorganized manufacturing, raw material characteristics, and unstandardized manufacturing procedures (Prusty et al. 2010; Singh et al. 2005; Ramya et al. 2011; Singh and Jain, 2012; Selvam et al. 2015). The prevalence of synthetic dyes, which first emerged in the 19th century, is due to this condition. Since then, synthetic dyes have dominated due to their wide range of shades and abundance of raw materials. In its development, synthetic dyes are known to be unbreakable, can cause skin and lung disease (Ayoola et al. 2008; Edeoga et al. 2005; Karc et al. 2009) and are carcinogenic (causing cancer) (Kusumawati

et al. 2025; Sheeja et.al 2019). Because of this, many developed nations are reluctant to use, sell, or import dye products from other nations that are harmful to the environment (Kasih et al. 2019). As a result, the worldwide fashion trend is gradually returning to the use of natural dyes in textile manufacturing. Today, natural dyes with abundant raw material availability in the surrounding environment, its biocompatibility, low toxicity, and eco-friendly properties, gained worldwide popularity for textile applications (Joshi et al. 2009; Samanta and Agarwal 2009; Kusumawati et al. 2017).

Light fastness, wash fastness, and rub fastness are all considered for textile fibers. Fastness is the material's resistance to change in any of its characteristics. It also measures the extent of colorant transfer to adjacent materials (Kulkarni et al. 2011). When synthetic dyes are used, a lot of waste and unfixed material are released. It causes health hazards pollution and disturb eco – balance. So now a day's trend of using natural s is drawing production (Deshmukh 2012). All over the world in the formation of different cultures of human being has played an important role. Our lives, our clothes, and the furniture in our homes are all heavily influenced by. Previously, painters had utilized normal colors separated from plants, bugs, mollusks and minerals for their works of art. The use of various mixtures of dyes and mordents as varnishes and lacquers responsible for the cohesion of the pigments and protection of the layers destroyed by environmental effects gave their works their distinctive character (Yusuf et al. 2017). Natural dyes are found to be environmentally friendly and do not cause cancer or allergic reactions in humans, particularly dyers, when compared to synthetic dyes. They are able to acquire these inexpensive natural dyes, which are

primarily utilized in our sector for the dyeing of silk fabric (Jihad 2014). Natural dyes are frequently used in a variety of industries, including the production of confections, other food products, textiles, cosmetics, pharmaceuticals, leather, paper, paint, ink, and other products (Krizova 2015). Natural colors are supportable those cover the area of green science. Because they are made from a renewable resource, natural dyes never pollute like synthetic dyes do. Some natural dyes have very good color fastness properties although people consider synthetic dyes have much more better color fastness properties than that of natural dyes. Natural dyes were severely restricted by the introduction of synthetic dyes, such as the difficulty of gathering or the absence of organized cultivation of dye-making materials. There are a lot of plant resources, but very little has been used up so far. It has not achieved the same level of commercial success as synthetic dyes as a result of the lack of precise technical knowledge regarding the extraction and dyeing process. Lawsone is the name of henna. A red-orange color has been utilized for the coloration of skin and hair as well as material materials. Due to its seamless coordination with nature, henna has garnered a lot of scientific interest in the dyeing of textiles in recent years. Henna has no negative effects on the environment and has a low chemical reactivity (Rahman Bhuiyan 2017). Annatto, a natural dye, is typically referred to as *Bixa orellana*. It is an orange-yellow dye made from this plant's seeds. It has high biodegradability, low poisonousness, and similarity with the climate (Shahid-ul-Islam 2016).

Natural dye can be used for wool dying from a long time. Now days some new sources also used for pure wool dying. The studies on application of dye from flowers of *Erythrina suberosa*, seed coat of *Juglans*

*regia*, bark of *Pinus roxburghii*, flowers of *Butea monosperma*, root and stem of *Berberis aristata*, bark of *Myrica esculenta* on wool fibers using combination of mordants (Kundal et al. 2014; Joshi 2013; Joshi 2014; Joshi 2016). Celosia, Nerium, Hollyhock, Hibiscus, Caryatia, Tegetus, Rambutan, and Curcuma, are utilized for the dying of wool. Animal proteins, similar to wool dye best in acidic circumstances and are debilitated by alkalines. The natural dyes that are utilized primarily impart color to wool in an acid dye bath typically (Shukla and Vankar 2017).

### Natural Dyeing Methods- The Basics

#### Scouring

The first step in the dyeing process is scouring. Fabrics and yarns purchased at stores carry residue (dirt, wax, dust, and coatings) from manufacturing and transit. If the fibers aren't scoured thoroughly enough, instead of adhering to the fiber itself, the dye will stick to the residue coating. As a result, fabric will dye unevenly and the colors will not fully penetrate.

Scouring is the process of immersing fibers and a scouring agent in water. The type of fiber that is being worked with affects the water temperatures and scouring agents. Protein fibers are more delicate and must be handled with greater care than plant fibers, which can simmer for several hours in a bath.

#### Extraction Methods

Since natural dye ingredients contain only small amounts of color or dye, as well as some other plant and animal ingredients such as water-insoluble fiber, carbohydrates, proteins, chlorophyll, and tannins, Therefore, extraction is necessary for the preparation of dyes. Pure natural dyes and the use of raw materials containing

dyes. Natural dye extraction is a complex process because natural coloring materials are not a single chemical entity and the plant matrix also contains a variety of non-dye plant constituents. Before using an extraction method, the nature of the coloring materials and their solubility properties must be determined. In preparation for extraction, the plant parts were ground into a fine powder and shaded to dry. The specific portion of the plant resource determines the dye extraction methods. The extraction techniques rely essentially upon medium in which the color is removed (Geetha and Judia 2013). Natural dyes can be extracted in primarily four ways.

Aqueous Method: The powdered mass is soaked in water for several hours and then gently heated. After pressing and filtering, heating is repeated as necessary, and the entire amount is boiled and concentrated.

Alkaline Method: Prepare 1% alkaline solution (sodium carbonate/sodium hydroxide) and pour dye material into it and boil then filter.

Acidic Method: Prepare 1% alkaline solution with sodium carbonate or sodium hydroxide and pour in the dye material, boil and then filter.

Alcoholic Method: Prepare the solution of dye material in alcohol and boil it then filter.

#### Dyeing

Remove the fabric from the mordant solution. Discard the mordant. In a large pot, add the extract dye solution. Add enough water to the dye solution so that the fabric or yarn can move freely in the dye solution. Add the fabric and heat for an hour or until the color. The color gets darker when wet and lighter when washed and dried. If the color is too light, use more dye extract in the bath. Allow the fabric to cool sufficiently before rinsing. It is recommended to gently squeeze the fabric

through several water changes until the water is clear. The fabric can also be washed in the washing machine without detergent. The thread should be shaken in an up and down motion to help untangle and smooth (Joshi 2013; Kumaresan 2011).

### Mordanting

There are some plant dyes that can change color significantly with iron stains. This step in the dyeing process is important because the mordant acts as a bond between the fiber and the dye (Joshi 2014; Naveed et al. 2020). Scouring allows the fabric to absorb color better and improves the light fastness and wash fastness of most dyes. Three pickling methods were used, depending on plant characteristics.

Premordanting- In this method the fabric/yarn mordanted in the first stage and then dyed in the second stage.

Simultaneous mordanting-In this method the mordant and the dye are applied simultaneously in the same bath.

Post mordanting- In this process the fabric is first dyed and then mordanted.

Mordanting is the process of wetting and soaking the yarn in hot water with a diluted mordant for at least an hour. Many dyers let the yarn cool in the solution overnight to ensure maximum color fastness. Common mordants include alum for bright colors, copper for green and brown tones, tannins for deep tones, and iron for darker, darker tones. The choice of mordant will vary depending on the yarn and the desired end result.

### Eco-friendly characteristics of Natural Dyes

Natural dyes are compounds that are abundant in nature with their ecological properties. These dyes are recyclable, biodegradable or degradable in nature. Here

are some eco-friendly characteristics of natural dyes-

- **Environment Friendly:** Because these dyes are derived from natural sources. They are very attractive to customers because they do not harm the environment. Natural dyes are environmentally friendly. They are biodegradable and do not cause environmental pollution when discarded (Kumar and Gunasundari 2018).
- **Viability or survival rate:** Natural dyes are renewable, naturally derived, and sustainable. These dyes are environmentally friendly and do not harm human health (Rather et al. 2018).
- **Inexpensive or cheap:** Natural dyes are affordable, readily available in nature, and safe to use. Some natural dyes are cheaper than synthetic dyes (Prabavathy et al. 2017).
- **Sustainable:** Natural dyes are obtained from inexhaustible resources that can be used without undue impact on the environment. It is also recyclable (Arora et al 2017).
- **Gentle or soft shades:** Natural dyes are materials that give soft shades to fabrics, threads, fibers and other materials. They create an impressive layering to the human eye (Jaafar et al. 2017).
- **Non-hazardous:** Natural dyes are obtained from normal sources, are harmless, and do not cause harm to the skin of the body (Yoshanti and Dowaki. 2017).
- **Accessibility:** Natural dyes are readily available in nature. It is possible to collect them effectively from the environment when needed (Feng et al. 2017).

- Vibrant or refreshing: Natural dyes are lively. They are recyclable and harmless. They are much healthier for the environment and for use throughout the organism. It is not difficult to remove natural colors from plants, vegetables, fruits, flowers, etc. (Al-Alwani et al. 2016; Shalini et al 2016).
- Antimicrobial Properties: Natural dyes have antibacterial properties and are generally safe for children. Dyeing the fabric with natural dyes has good antibacterial properties, so it can be used in medical hospital beds (Yazie et al. 2016).
- Safety: Natural dyes are non-toxic, non-allergenic and harmless. They are less harmful to humans than synthetic dyes (Arputharaj et al. 2016).
- Harmless Ingredients: Natural dyes do not contain the unsafe plastic and carcinogenic ingredients that synthetic dyes do (Carvalh and Santos 2015).
- Safe Production: The production of natural dyes is protected, environmentally friendly, economical and degradable. They are practically degradable if they are destroyed after use (Chattopadhyay et al. 2015).
- Waste free: A synthetic dye production system that could safely produce natural dyes is undesirable. These dyes contain no toxic synthetic compounds or waste products. (Isah et al. 2015).
- Smiles of Nature: Using natural dyes is one approach to getting in touch with nature, whereas synthetic dyes do not have these emotional properties. ready to feel (Kanagaraj et al. 2015).
- UV Protection: Dyeing fabrics with some natural dyes, with or without mordants, shows excellent UV protection properties (Baliarsingh et al. 2015).
- Sunburn Protection: By using of clothing dyed with natural dyes is a safer way to protect individuals from sun burning (Saxena and Raja 2014).
- Amicable: Natural dyestuffs make some outstanding shading thoughts, and these shades are constantly agreeable. (Ludin et al. 2014).
- Decomposable: Natural dyes are effortlessly formed by the earth after endues. Destroying these colors after the end use does not cause harm to human health. These dyes are easily decomposed in nature (Haddar et al. 2014).
- Antifungal and antibacterial: Natural dyes are fungus resistance, and they have good protection against antibacterial germs (Rosana et al. 2014).
- Less allergic: Fabrics with synthetic colors that contain chemicals that may cause allergies or harm your health. Naturally colored fabrics help reduce exposure to allergens and other irritants and provide comfort (Mishra and Gautam 2020).

### Conclusion:

Products made with natural ingredients are becoming more popular as people become more aware of the hazards of synthetic dyes. Natural dyes are attracting attention in the field of textile dyeing research because they are non-toxic, non-allergenic, and have little environmental pollution and side effects. It is endowed with diverse flora and fauna



treasures, but only a few are used to meet the needs of textile dyeing. Natural dyes are considered an environmentally impacting, cheap, non-toxic, renewable and sustainable resource, and their use in a variety of traditional and emerging applications has attracted the attention of the scientific community.

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