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A Review on Sources and Application of Natural Dyes in Textiles

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Abstract Textile industries are very useful for human being but these are destroying eco system because of generation of huge wastewater containing toxic substances. Prime reason of toxicity is use of synthetic dyes. To save our environment there is no alternative of natural dye. There are many sources of natural dyes in the Universe. In this article possible sources of natural dyes are discussed (2008-2018). Prominent sources of natural dyes are onion, carrot, marigold, orange peel, rose etc. have been discussed gradually. Isolation techniques, dyeing methods and fastness properties have been discussed in this article.

Keywords Synthetic dyes, Environmental pollution, Natural dye, Textiles

1. Introduction

Textile industries consume huge quantity of synthetic dyes such as reactive dyes for different type of fabric dyeing specially cotton fabric. It requires huge amount of water resulting large quantity of effluent which creates serious environmental pollution. In many cases it was found that synthetic dyes have hazardous characteristics. To get rid of this environmental as well as health hazards it is essential to think about alternative of synthetic dyes which can make safe environment and human health. To this view point natural dyes could be a good solution for textile sector. There are many natural dyes available in different plants and vegetables in the Universe which may be used as supplementary of synthetic dyes. Sources of natural dyes are onion skin [1], *Butea monosperma* [2], *Cassia singueana* [3], black carrot [4], barberry bark [5], orange & lemon peels [6], *Senegalia catechu* [7], rose [8], jengkol (*Archidendron jiringa)* [9], corn poppy [10], sindoor [11], marigold flower [12], turmeric [13], tea [14], neem herb [15], *Hibiscus Rosa Sinensis* [16] etc. In this article research papers published from 2008-2018 have been considered. The summary of published articles discussed gradually in following section.

2. Discussion

Onion is very useful and available source of natural dye. Its skin can be used for the dyeing purpose. Zubairu et al. [1a] reported that, onion's skin can be used successfully for cotton fabric dyeing, dyes from onion may be isolated by using mordanting techniques. Both of synthetic and natural mordnats can be used in this case. Among two types of mordants, synthetic one produces better result than natural mordant. Authors studied three cases, pre-mordanting, simultaneous mordanting and post mordating. They concluded that ferrous sulphate produced the best color fastness when pre-mordanting technique was used in case of dyeing of fabric by onion skin.

In another report, Nurunnesa and co-workers [1b] explained their experimental results for dyeing of silk fabric by using outer skin of onion. Authors clearly explained that, a variety shades produced after dyeing of silk fabrics by the outer onion skin. Authors used various mordants to assess the changes of shades with variation of mordanting techniques with same mordant and concentration. Authors found that color fastness to rubbing was very good in every samples but color fastness to wash was not good in every samples.

Recently flower of *Butea Monosperma* (locally known as PALASH) successfully used for cotton fabric dyeing [2]. Daberao et al. [2] reported that they have extracted dye from flower of *Butea Monosperma* by boiling method. Authors found yellow color after extraction and used for cotton fabric dyeing using alum as mordant. They analyzed different fastness properties to characterize dyed fabrics.

Cassia singueana plant can be used as a source of natural dye. Teklemedhin et al. [3] reported eco-friendly dyeing of silk fabric by natural dye extracted from bark of *Cassia singueana* plant. As per the report, authors mentioned that bark of *Cassia singueana* plant was collected manually from Northern Ethiopia (Tigray). Natural mordant was used in this

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experiment. It was extracted from Aloevera leaf so that the method became completely eco-friendly. Author described that, the color fastness of dyed silk fabrics were tested according to the standard ISO methods. According to the paper, 3-5 rating was found in fastness property. It was found that the mordant concentration increases the fastness properties of the dyed silk fabric samples increase when the mordant concentration is increased in all mordants and mordanting techniques.

Shukla et al. [4] reported that black carrot could be used as source of natural dye. Authors mentioned that black carrot was a newer source for newer shades on silk. According to the report, it could be stated that, the color depth and dye ability by black carrot extract on silk fabric were enhanced with pre-mordanting process because of its color compatibility. Black carrort can produce earthy shades of green on silk fabric because it has substantial amount of primary colorant, anthocyanin.

Barberry bark was used to dye degummed pure silk yarn [5]. Four selected mordants: alum, chrome, copper sulphate and ferrous sulphate in different ratios were used. Fastness properties were very good to excellent. Brightness was improved when the samples were exposed to sunlight.

Orange and lemon are very common and popular food items. People eat huge quantity of orange and lemon as a result huge peels wastes are generated. These peels are good sources of natural dye [6a]. Authors mentioned that both extracts from orange and lemon peels could be used for cotton fabric dyeing. According to the report, cotton fabric dyeing with 30% pre-mordanting and 1:1 liquor ratio have shown better fastness to rubbing and washing fastness in both of dry and wet conditions. In another report, Edeen [6b] reported dyeing procedure and results of cotton fabrics with orange peel using padding technique. Tensile strength and elongation % of treated and untreated Giza 93 Egyptian cotton fabric were tested. Color parameter (K/S, L, a, b and ΔE), and fastness properties (wash, and light) were studied. High tensile strength and poor fastness properties were achieved.

The flowers of *Senegalia catechu* have been used for wool dyeing with banana pseudostem sap biomordant [7]. Light color was obtained. Simultaneous mordanting technique has produced higher color strength than both of pre and post mordanting techniques. Excellent fastness to light and washing were achieved.

Rose is another suitable and easily obtainable natural dye source globally. Patil reported extraction of natural dye from rose flower for dyeing cotton fabrics recently [8]. Rose is designated as ornamental plant and rich in red & pink pigments. In this paper authors used four different solvent extraction methods. Three different mordants were used for cotton fabric dyeing by coordination complex formation. The dye extracted from rose could be used also for silk and wool fabrics.

Sofyan used jengkol *(Archidendron jiringa)* pod waste for cotton fabric dyeing [9]. Jengkol pod is waste from jengkol (dogfruit). It grows well in Malaysia, Singapore, Brunei Darussalam, and Indonesia. It has different names in respective “jering” in Malaysia, “krakos” in Cambodia, and “niang-yai” in Thailand. 56% Jengkol seed is consumed and produces jengkol pod. Approximately 44% jengkol pod is wasted and unused.

Avinch et al. reported natural dyeing with petals of corn poppy (*Papaver rhoeas*) flower [10]. Corn poppy can yield green, brown, lead and tan colors on cotton fibres. Cationizing process of dyeing produces increased color yield than non-cationizing process. Wash fastness result shows excellent for cotton dyeing with poppy corn. Perspiration fastness value was acceptable. Rubbing fastness under dry condition was acceptable but it was not acceptable under wet condition. Authors tested antibacterial effect of poppy corn flower. But no antibacterial effect was detected.

Sindoor is an important cosmetic item for married hindu married women. Kapoor reported use of sindoor as natural dye [11]. Eco-friendly natural dye-based herbal sindoor was used in this work.

Marigold petals were used as natural dye [12] using aloe vera juce as natural mordant. Natural dye extracted from marigold petals showed good dyeing effect on the animal fibre compared to plant or synthetic fiber at 10:10 ratio with aloe vera juice.

Turmeric was used to compare between dyeing properties on cotton and silk fabrics. Mazumder et al. [13] reported that comparative results using different mordants. As per the report, alum, ferrous sulphate and mixture of alum & ferrous saulphate were used in this study. Better color fastness was found on silk than cotton. Mixture of two mordants produced better result compared to individual use on silk fabric. But in cotton fabric reverse result was found.

Green tea could be used as a source of natural dye [14]. Using three different mordants dyeing process was carried out. The optical density, washing fastness, light fastness, K/S and reflectance values were determined. Wash fastness was excellent but light fastness was moderate to good.

Bukhari reported extraction and standardization of natural dye from neem herb [15]. Solvent polarity was key factor for measurement of absorption maxima of neem dye extract. May be salvation of dye molecules occurs via dipole-dipole interactions in non-hydrogen bond containing solvents but in hydrogen bond containing solvents more hydrogen bonding nature was found. pH 9 of extraction increased solubility and diffusion coefficients.

Hibiscus Rosa Sinensis flower locally known as Joba in Bangladesh could be a good source of natural dye [16]. Ramprasath et al. reported isolation and dyeing properties of natural dye on cotton fabric from *Hibiscus Rosa Sinensis*. Authors isolated dye from *Hibiscus Rosa Sinensis* and analyzed by GC-MS, UV-Visible and IR Spectroscopy. In this work, commonly used mordants such as, alum, potassium dichromate, copper chloride and stannous chloride were used to increase the color strength. Authors concluded that the strength of color was increased by using the stannous chloride as mordant for cotton fabric dyeing with extracted dye from the *Hibiscus rosa sinensis*.

3. Conclusions

Textile industries are polluting environment because of use of synthetic dyes. Synthetic dyes are synthesized from petroleum source causing harm to human health and aquatic biodiversity. So natural dyes will be good solution for these problems. Possible natural dye sources are discussed in this article.

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