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ORIGINAL ARTICLE

Dyeing studies with henna and madder: A research on effect of tin (II) chloride mordant

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Candida glabrata

Abstract The present paper deals with the application of natural dyes extracted from powdered henna (*Lawsonia inermis*) leaves and madder (*Rubia cordifolia*) roots on woolen yarn and assessment of effect of stannous chloride mordant on dyeability, color characteristics, fastness properties and antifungal activity of dyed woolen yarn. Sixteen shades have been developed for the characterization of their color characteristics and fastness properties. The color strength (K/S value) has been found to be very good in all dyed woolen yarn samples. The color fastness with respect to light exposure, washing and rubbing was quite satisfactory for both henna as well as madder dyed samples. Henna leaves extract was found very effective against *Candida glabrata* both in solution as well as after application on wool substrate but no antifungal activity is reported in case of madder both in solution as well as on wool substrate.

1. Introduction

Natural dyes are comprised of those colorants (dyes and pigments) that are obtained from animal (insect) or vegetable source without chemical processing. They are mainly mordant dyes, although some vat, solvent, pigment, direct and acid types are also known. People have used natural dyes since ancient times for dyeing carpets, rugs and clothings by using roots, stems, barks, leaves, berries and flowers of various dye plants (Gulrajani, 1992). Uses of synthetic dyes are involved with the release of some hazardous chemicals into the environment during their processing and production (Dutta, 1996). In the present context of eco-preservation, the use of natural dyes has been revived in the coloration of textiles and food materials (MacDougall, 2002). Considerable research work has been undertaken on the application of natural dyes in the coloration of textiles around the globe in the recent past

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(Ali and El-Mohamedy, 2010; Kamel et al., 2005; Khan et al., 2010b, Moiz et al., 2010; Vankar et al., 2007).

Textiles composed of proteinous materials such as wool and silk as well as cellulosic materials such as cotton, jute, flax and other fibers come in contact with the body, which provide an ideal environment for the growth and multiplication of pathogenic microbes leading to objectionable odor, dermal infection, product deterioration, allergies, and other related diseases (Khan et al., 2011). These factors necessitate the development of methods to impart microbial resistance to textiles with all usual desirable characteristics of textiles, as these textile materials find extensive use in different sectors related to a hygienic and healthy life style apart from the conventional apparel usage (Sathianarayanan et al., 2010; Velmurugan et al., 2009). Dyeing of textile materials with natural colorants is a promising area which needs to be explored systematically and scientifically for producing diversified value-added products.

Natural vegetable fibers such as cotton fiber are probably used for the first time for spinning and weaving into cloth; animal fibers in the form of furs, and skins were undoubtedly the earliest forms of clothings used by primitive people. Wool has specific physical and chemical properties such as high water absorption, high elasticity and flexibility, bulkiness, comfort, easy dry-cleaning and good dyeability. It is undoubtedly the first natural protein fiber of dyers' choice for dyeing. These properties enabled the use of wool fibers in various textile products (Cook, 1984; Knecht et al., 1941).

Lawsonia inermis, commonly known as Mehdi/Mehandi is a shrub or small tree frequently cultivated in India, Pakistan, Egypt, Yemen, Iran and Afghanistan. Henna is an ancient dye, evidence being the Egyptian mummies found in the tombs that had their nails dyed with henna. It is also used in many countries for dyeing hair, eyebrows and fingernails during religious festivals and marriages etc. the powdered leaves of this plant (aqueous paste) are used as a cosmetic for staining hands, palms, hairs and other body parts. The dyeing property of henna is attributed to the presence of a colorant, lawsone; 2-hydroxy-1, 4-naphthoquinone component shown in Fig. 1 with Color Index Number 75480; Natural Orange 6 (Color Index, 1971a; John and Cannon, 1994a; Mayer and Cook, 1943a). Antibacterial properties of henna dyed wool fabrics against *E. coli* and *S. aureus* are also reported (Dev et al., 2009).

Rubia cordifolia belongs to the family *Rubiaceae,* also known as majith or manjista, is a perennial herbaceous climbing plant with very long roots; cylindrical, flexuous, with a thin red bark. Stems often have a long, rough, grooved, woody base. Plants belonging to this family are known to contain substantial amounts of anthraquinones, especially in the roots.

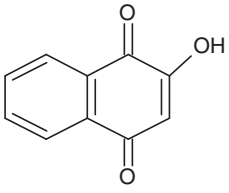

Figure 1 Coloring component of henna (*L. inermis*) leaves – Lawsone.

The coloring pigments present in the root of *R. cordifolia* are pupurin (I), munjistin (II) in major amount, and xanthopurpurin (III), pseudopurpurin (IV) in little amounts shown in Fig. 2 (Anonymous, 1972; Color Index, 1971b; John and Cannon, 1994b; Mayer and Cook, 1943b; Perkin and Everest, 1918).

The present study is focused on the effect of tin mordant on color, fastness and antifungal properties of woolen yarn dyed with henna leaves and madder roots extracts. This will help to make natural dye as an alternative co-partner of synthetic dyes in an era of environmental awareness and eco-preservation.

2. Experimental

An experimental study was planned keeping in view the objective of the study.

2.1. Materials

2.1.1. Woolen yarn, mordant and natural dyes

Woolen yarn was purchased from MAMB Woollens Ltd., Bhadohi, S R Nagar Bhadohi (UP), India. A commercial sample of powdered henna leaves was obtained from New Kirana Store, Khari Baoli, Delhi-110006, India. Powdered madder roots were obtained from SAM Vegetables, Moradabad-244001 (UP), India. All other chemicals including the mordant (stannous chloride) used were of Laboratory grade.

2.2. Methods

2.2.1. Extraction of dye from powdered henna leaves

In the view of reported (Ali et al., 2009) better color yield in case of alkaline extraction of colorant from henna leaves than aqueous extraction, colorants from henna leaves were extracted in alkaline medium. Required quantities (1%, 5%, 10% and 20% on weight of fiber) of powdered henna leaves were taken in an aqueous solution of Na_2CO_3 main-

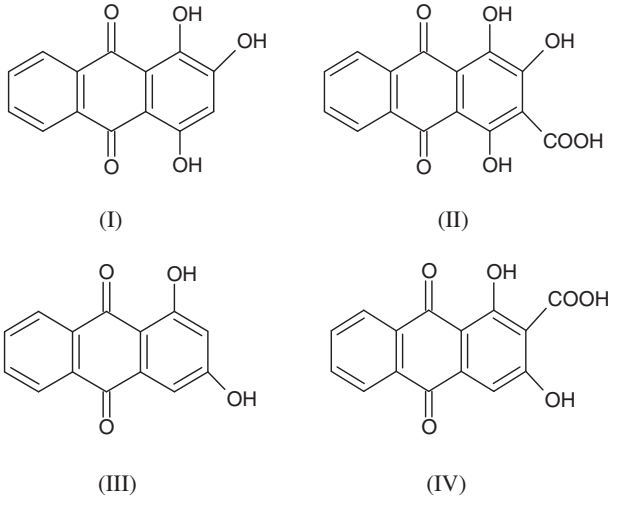

Figure 2 Coloring components of madder (*R. cordifolia*) root-Purpurin (II) Munjistin (III) Xanthopurpurin (IV) Pseudopurpurin.