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Wool Dyeing Using Rose Flower Petal

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Abstract: Petal of rose has variety of applications such as medical, perfume and food industries. In the present study the petal of rose were used as a natural dyestuff for the dyeing of woolen fabrics. The boiling water was used in order to extract the dyeing substance. The woolen samples were mordanted with Potash-alum (potassium aluminum sulfate) ($KAl(SO_4)_2 \cdot 12H_2O$) and cooper sulfate and subsequently the dyeing processes was carried out. The obtained results from the fastness tests and also the resulted shades indicate that the rose-leafs have the potential of being a natural dyestuff.

Key words: Natural dye · Dying · Rosaceae · Wool · Mordant

INTRODUCTION

Until the introduction of the synthetic dyes in the nineteenth century, all dyeing materials were derived directly from natural sources such as the roots, leaves, flowers or stems of special plants, from insects for example cochineal and even a number of minerals. Natural dyes are generally environmental friendly and can provide a wide range of beautiful shades with acceptable levels of colorfastness [1-5]. The use of natural dyes for textile dyeing purposes, decreased to a large extent after the discovery of synthetic dyes in 1856. As a result with a distinct lowering in synthetic dyestuff costs, the natural dyes were virtually unused at the beginning of twenties century [6, 7]. Nowadays in most of the countries, natural dyeing is practiced only as a handcraft and synthetic dyes are being used in all commercial dyeing processes.

As the main problem in natural dyeing is the limited sources of natural coloring materials, in recent years a variety of projects have been developed in order to discover newer sources for natural coloring agents especially from by-products of farming and forestry e.g. bark or saw-dust from timber production as well as wastes from the food and beverage industry, e.g. pressed berries, onion peels and black tea residues [8-13].

In addition with the global concern over the use of eco-friendly and biodegradable materials, considerable research work is being undertaken around the world on the application of natural dyes in textile industry. The effluent problems of synthetic dyes occur not only during their application in the textile industry, but also during their manufacture and possibly during the synthesis of their intermediates and other raw materials. Application of the waste materials as sources of natural dyes can also assist in the preservation of the environment and also decrease the cost of natural dyeing.

Rose is a perennial plant of the genus Rosa, within the family Rosaceae. There are over 100 species. They form a group of erect shrubs and climbing or trailing plants, with stems that are often armed with sharp prickles. Flowers are large and showy, in a number of colors from white through yellows and reds. Most species are native to Asia, with smaller numbers native to Europe, North America and northwest Africa. Species, cultivars and hybrids are all widely grown for their beauty and fragrance. Rose plants range in size from compact, miniature roses, to climbers that can reach 7 meters in height. Species from different parts of the world easily hybridize, which has given rise to the many types of garden roses [14].

Roses are best known as ornamental plants grown for their flowers in the garden and sometimes indoors. The fruits of many species have significant levels of vitamins and have been used as a food supplement. Many roses have been used in herbal and folk medicines [15, 16]. The petal of Rose flower that usually has a purple to reddish shade is known to contain extractable water soluble natural dyes including antocianins derivatives. A representative structure of Cyaniding digluocosite presents in rose petal is shown below [17]:

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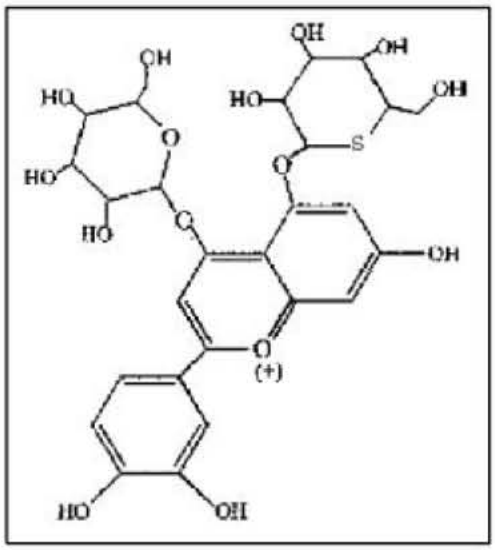

Fig. 1: Chemical structure of cyanidin diglucoside,

Because of lack of knowledge of the practice implicated in extracting, processing and dyeing by using the Rose flower petal; little utilization is done for this natural resource. The literature survey indicates that there is hardly any work reported on the reuse of rose flower petal as sources of natural dye for dyeing in textile applications. In the present study, petals of rose flower were used to be a source of natural dye.

Experimental

Materials: The rose flower petal sample was obtained from local herbal stores. Woolen fabrics (Iranian wool, construction: 82S/2 x 58S/1 3) Weight: 270 g/m).

The nonionic detergent used was obtained from the Shirley Development Ltd. Aqueous solutions containing 10 g/l of ferrous sulphate [$FeSo_4$], aluminium potassium sulphate (alum) ($KAl(SO_4)_2.12H_2O$), copper sulphate [$CuSO_4.2H_2O$], Stannous chloride ($SnCl_2.2H_2O$), silver nitrate ($Ag NO_3$) and Potassium Dichromate ($K_2Cr_2O_7$) were used as mordants that all the chemicals were supplied by Merck.

Extraction of Dye: For the purpose of extraction of natural dye, all samples of rose petals were stored at room temperature in an air-dried state. Subsequently the dried material was ground and a fine powder of dyestuff was obtained. To improve the extraction efficiency, the dried powder of rose petal was wetted 48 hours before the extraction. In extraction of natural dye, fine powdered rose petal, was mixed with water (L:R, 1:40), boiled for 60 Minute and filtered while hot to obtain the extracted dyestuff. Volume loss due to evaporation was compensated at the end of the extraction period. The extract left standing in a room until the temperature had dropped sufficiently and then filtered through a filter paper.

Dyeing Procedure: A pre-mordanting procedure was used in which the wool samples were mordanted prior to dyeing by treating with different mordants at boil for 45 min. The liquor ratio was 1:40 and the concentration of mordants was 5% on weight of the samples. Extracted dyes at concentrations of 50%, (o.w.s) were used for dyeing of the wool samples. The liquor-goods ratio was 40:1. Samples were introduced into the dyeing solutions at room temperature. Temperature was raised to the boil and dyeing continued at the boil for 1 hr. At the end of the dyeing period, the dye bath solution was removed and the rinsing procedure started. Excess dye was removed by rinsing three times with cold water.

Colorimetric Evaluation: The spectral reflectance of the dyed samples was measured using a (Texflash spectrophotometer, (Datacolor Corp.). The K/S values were calculated by the Kubelka-Munk equation. (Eq.l) [18, 19].

$$\left(\frac{K}{S}\right)_\lambda = \frac{(1-R_\lambda)^2}{2\times R_\lambda} \quad (1)$$

where R is the reflectance of dyed fabric at wavelength (λ), K is the absorption coefficient and S is the scattering coefficient. CIELAB coordinates [20,21] (L*, a*, b *, C*, where, L* defines lightness; a* denotes the red/green value; and b* the yellow/blue value and C* is the saturation) were calculated from the reflectance data for 10° observer and illuminant D_{65}.

Fastness Properties: The dyed samples were tested according to ISO standard methods. The specific tests were as follows: ISO 105-X12(1987), color fastness to rubbing; ISO 105-C02 (1989), color fastness to washing; and ISO 105-B02 (1988), color fastness to light (carbon arc).

RESULTS AND DISCUSSION

Most of the natural dyes have poor fastnesses properties on fibers and usually need the use of mineral salts, so called mordants. Mordanting agents are usually

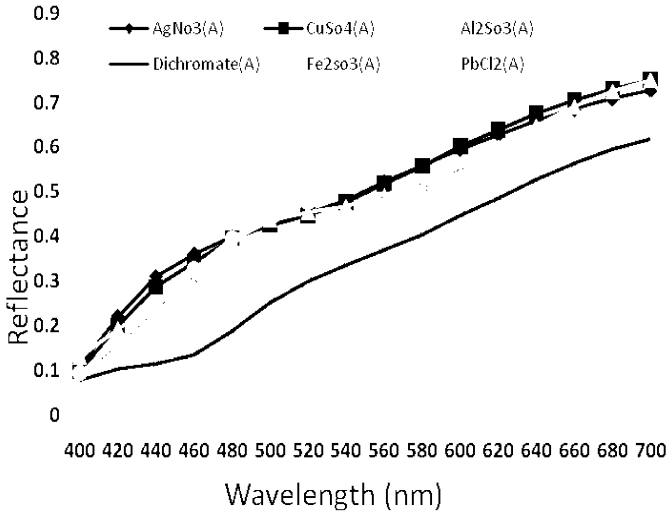

Fig. 2: Reflectance spectra of the wool samples dyed with Rose flower petals and different mordants

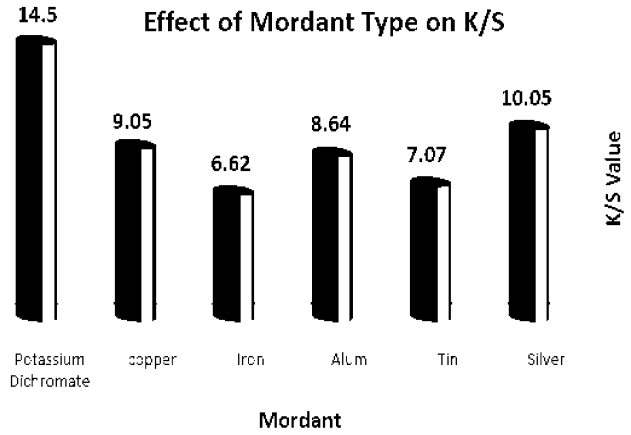

Fig. 3: Effect of mordants on color values of dyeing of wool with rose flower petal.

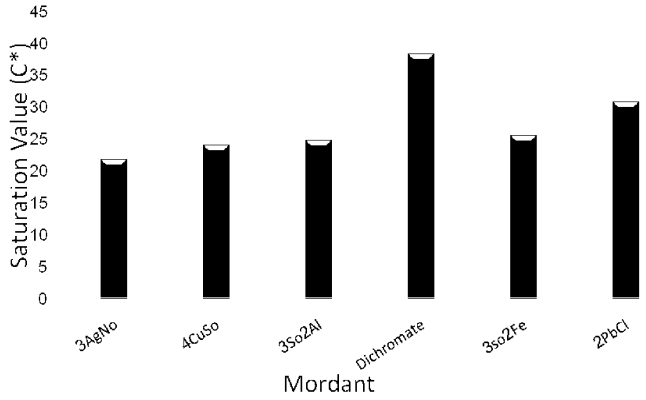

Fig. 4: Effect of mordants on saturation value (C*) of dyeing of wool with rose flower petal.

used in order to increase the absorption and fixing efficiency and prevent fading against washing and exposure to light. Figure1 shows the reflectance spectra of different samples dyed with rose flower petal and by using different mordanting agents. The effect of mordants used in this study on colorimetric coordinates L*, a*, b* and obtained color of wool samples dyed with the rose flower petal are also given in the Table (1). Generally the colors obtained through application of various mordants ranged from beige to pink. The darkest color (dull brown)

Table 1: Color and CIELAB values for dyeing of wool with Rose flower petals

No.	Mordant	L*	a*	b*	Color
1	(Alum) ($KAl(SO_4)_2.12H_2O$)	76.53	6.32	19.18	Beige
2	(Ferrous sulphate) ($FeSO_4.7H_2O$)	73.79	3.38	25.37	Brown
3	(Copper sulphate) ($CuSO_4.2H_2O$)	76.41	13.12	11.44	Pink
4	(Silver nitrate) ($AgNO_3$)	76.53	3.81	22.31	Brown
5	(Stannous chloride) ($SnCl_2.2H_2O$)	78.45	3.65	29.56	Light brown
6	(Potassium Dichromate) ($K_2Cr_2O_7$)	65.74	10.92	27.67	Dull Brown

Table 2: Fastness properties of silk samples dyed with rose flower petal and different mordants

No.	Fastness Mordant	Alum	Iron	copper	Silver	Tin	Potash
1	Washing Fastness	4	4-5	4-5	4	4	4
2	Light Fastness	4	4	4-5	4-5	4	4
3	Rubbing Fastness	4-5	4	4-5	4	4-5	5

was obtained by using potassium dichromate as mordant (L*=65.74) and the lightest color, beige (L*=78.45) was achieved by mordanting with Stannous chloride.

The effect of mordants on color values of wool dyed with rose flower petal is shown in Figure 3. Among the mordants used, potash showed the highest color value (K/S =14.5) followed by silver (K/S=10.05), while in dyeing with iron as mordant the lowest amount of (K/S) was achieved (6.62). From the figure (4) it can be noted that dyeing with silver as mordant resulted the lowest saturation value (C*) while using of potash as mordant resulted the highest amount of saturation.

Fastness Evaluation: Results for fastness properties of dyeing with petals of rose flower and by using different mordants are given in Table 2.

When all the samples were subjected to wash and rubbing fastness evaluation, it was observed that almost all showed good washing fastness (4) and good-to-excellent rubbing fastness (4-5). The samples mordanted with potash showed the best rubbing fastness and the samples mordanted with copper and iron had the best wash fastness (4-5) among all. Light fastness of the samples was found to reach the fair values of 4 according to the blue scale standard.

CONCLUSION

This research was aimed to show how some type of waste materials such as petals of rose flower can serve as inexpensive raw materials for the extraction of natural dye-forming substances. The rose flower petal as a natural dye gave a variety of shades by mordanting with different mordants used in this study. The shades produced differed from mordant to mordant. Mordanting with tin and alum gave bright shades silver alum and iron gave dull shades. The fastness properties of the studied natural dye on wool fiber were also acceptable (4-5) for textile applications.

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