Wool Dyeing with Extracted Dye from Pomegranate (Punica granatum L.) Peel

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Abstract: The brown dry rind of the pomegranate (punica granatum L.) especially that of the wild plant has been used as a dyestuff from ancient times. In this study the dyeing substances present in the rind of Pomegranate were extracted by using the solvent extraction method. Woolen fabrics were dyed with both raw and extracted dyestuffs in a variety of concentrations. Spectrophotometric evaluations together with colorimetric studies were carried out in order to compare the color strength of the extracted dye on woolen fabrics with the raw dyestuff’s color strength. It was found that, the color strength of extracted dye from the rind of Pomegranate is more than that of its raw dyestuff.

Key words: Natural dye · Punica-granatum · Extraction · Color strength · Wool · Dyeing

INTRODUCTION

Since the prehistoric times, natural dyes have been used throughout the world. These dyes are generally environmental friendly and can provide a wide range of beautiful shades with acceptable levels of colorfastness [1-3]. Tied extraction of dyestuff from the raw material, low color value and long dyeing times make the cost of natural dyeing considerably higher than dyeing with synthetic dyes [4, 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 20th century. 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. However, with the worldwide concern over the use of eco-friendly and biodegradable materials, the use of natural dyes has once again gained interest [6, 7].

The pomegranate plant is originally a native of Persia and adjacent countries, but nowadays it can be found in all warm countries of the world [8, 9]. The brown dry rind of the pomegranate especially that of the wild plant has been used as a dye-stuff from ancient time’s. Forbes writes:” In Mesopotamia the yellow dye was extracted as early as 2000 B.C. from pomegranate by grinding the rinds and extracting them with water. In Egypt it was in use from 1500 B.C. onwards as finds in tombs proved; in Palestine it was used in dyes and inks” [10]. The main coloring agent in the rind of pomegranate is granatone, which is present in the alkaloid form N-methyl-garanatone, whose molecular structure is shown in Fig. 1. [11].

![Chemical structure of Punica-granatum](image)

Fig. 1: Chemical structure of Punica-granatum

In this work the solvent extraction method was used to extract the dye from pomegranate peels. The color strength of the extracted dye on woolen fabrics was compared with the raw pomegranate’s color strength. The intent of present study was to show the higher efficiency of dyeing with using the proposed extraction method in comparison with traditional dyeing procedures.

Experimental

Materials: Pomegranate plant, (punica granatum L.) was purchased from Iranian traditional natural dyers. Woolen fabrics (Iranian wool, construction: 82S/2 x 58S/1 3) Weight: 270 g/m), Ethanol.

Extraction: In extraction of punica granatum L. with soxhlet apparatus, ethanol was used as organic solvent. For evaporation of the solvent a rotary evaporator was used and the remained dry extract of dye was weighted. The total amount of extracted dye was found to be (22.5 %). For extraction in traditional method, powdered peels of punica granatum L. was mixed with 40 times as much water, boiled for 60 Minute and filtered while hot to obtain the extracted dyestuffs. The extracts left standing in a room until their temperature had dropped sufficiently and then filtered through a filter paper.

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**Dyeing Procedure:** The fabrics were mordanted prior to dyeing by treating with Potash-alum (potassium aluminum sulfate) \((\text{KAl(SO}_4)_2 \cdot 12\text{H}_2\text{O})\) at boil for 45 minutes. The liquor ratio was 1:40 and the mordant’s concentration was 5% on weight of the fabrics. Both methods extracted dyes at concentrations of 10%, 30% and 70% o.w.f. (on weight of fabric) were used for dyeing of the wool fabrics. The liquor-goods ratio was 40:1. Fabrics were introduced into the dyeing solutions at room temperature. Temperature was raised to the boil and dyeing continued at the boil for 45 minutes.

**Measurement of Color Strength:** The spectral reflectance of the dyed fabrics was measured using a (TextFlash spectrophotometer, D冢eCor Corp.). The K/S values were calculated by the Kubelka-Munk equation. (Eq.1)

\[
\frac{K}{S} = \frac{(1-R_s)^2}{2 \times R_s}
\]

Where R is the reflectance of dyed fabric at \(\varepsilon_{max}\), K is the absorption coefficient and S is the scattering coefficient. The relative color strengths (K/S values at \(\varepsilon_{max}\)) were determined using the following equation:

\[
\text{Relative Color Strength} = \frac{\left( \frac{K}{S} \right)_{\text{extracted}}}{\left( \frac{K}{S} \right)_{\text{raw}}}
\]

**Absorption Spectra:** Absorption spectra of the dye solutions were measured using a (Cintra 10 uv-visible) spectrometer.

**RESULTS AND DISCUSSION**

Figure (2) shows the absorption spectra of a 10 g/l raw pomegranate dye solution together with the spectra of a dye solution prepared by dissolving an equivalent amount of the extracted pomegranate in water (2.25 g/l). It was observed that the absorbance of raw pomegranate dye solution is considerably less than the absorption of its equal weight extracted pomegranate dye solution. Since the absorbance of solution is directly related to the concentration by Lambert -Beer’s Law, therefore the dye content of extracted pomegranate dye solution is more than its balance prepared dye solution of raw pomegranate.

The Reflectance spectra of the woolen fabrics, dyed with equivalent prepared dye solutions of raw (10 g/l) and extracted (2.25 g/l) pomegranate No.

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the lightness \((L^*)\) of raw pomegranate dyed samples is more than samples dyed with extracted pomegranate. The relative color strength of extracted and raw madder was also calculated by using the Equation (1). It was found that, the color strength of extracted pomegranate dye is more than raw pomegranate. The results are given in Table 1.

CONCLUSION

 Nowadays most of the natural dyers are interested to use natural dye materials in the same ways used for synthetic dyes. Therefore extraction of natural dyestuffs such as pomegranate peel irrespective of its positive effect on color strength of dyestuffs may help to optimize the technical aspects of natural dyeing procedures. On the other hand the proposed method of extraction can be discussed as a new approach to decrease the cost of natural dyeing via increasing the color strength of natural dyes.

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REFERENCES

4. Padmar, S., Vankar, 2000. Chemistry of natural dyes, Resonance, October,
9. John, Uri Lloyd, 1897. Punicca Granum The Western Druggist, Chicago, May,