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Does Natural Dyes from Selected Medicinal Plants Used in Jordan Suitable for Dyeing Different Types of Cloth after Chemical Treatment

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Abstract

The study was conducted on different medicinal plants that grow in Jordan after air-dried and mechanically powdered them. Weights of 50 g of each powder were percolated. Alum used as mordent to fix color on fabric preventing it from fading with exposure to light or washing. The results were amazing that the extraction of these plants are suitable for dying different colors on different types of cloths such as, cotton, wool, and raw cloth. These results may be useful for cloth and textile factories to use these different pigments as coloring agents.

Keywords: medicinal plants, natural dyes, percolation, extraction, mordents

1. Introduction

Medicinal plants are very important as drugs since 60% of substances that enter in the pharmaceutical industry are plant origin (Rates, 2001); World Health Organization (WHO) reported that about 70-80% of the world populations rely on non-conventional medicinal in their primary health care (Bannerman et al., 1983). Moreover, plants exhibit a wide range of colors where some of these pigments can be used as dyes. These natural dyes are environment friendly and safer compared with synthetic dyes which are detrimental to human health due to harmful chemicals that cause allergic and carcinogenic.

Many medicinal plants were used as dyes for different types of cloth. The discovery of cloth dyes is related to a few hundred years ago. Natural dyes were used in coloring of textiles, drugs, cosmetics, etc. Moreover, owing to non-toxic effects, they are used for coloring various food products (Siva, 2007).

The human civilizations knew how to extract these dyes from natural resources such as metals, plants, and sometimes insects such as Lac Coccus lacca Kerr. Dyes do not interact directly with the materials they are intended to color, thus natural dyes are substantive and require mordant such as Alum, Stannic chloride, iron and acid, where alum, iron and ferrous sulphate are used to fix to the fabric and prevent the color from fading with exposure to light or washing out (Vanker, 2000). So far there is a great concern on the developing different types of dyes. Natural dyes are less toxic, less polluting, less health hazardous, non-carcinogenic and non-poisonous, harmonizing colors, gentle, soft and subtle, environment friendly, can create a restful effect and above that can be recycled after use.

The dye solution can be defined as the specific quantity of dye that dissolved in a specific volume of water, with the addition of auxiliaries and fixing substances. Nature has gifted us more than 500 dye-yielding plant species. Some of plant species are colorants having several applications in textile, inks, cosmetics, etc (Debajit, Mahanta, & Tiwari, 2005).

In this study, natural dyes of *Crocus Sativus* (saffron), *Quercus aegilops* L. (oaks), *Punica granatum* L. (Pomegranate), *Pistacia palastina* L. (wild pistachio) dye, *Carthamus tinctorius* L. (Safflower) and *Rhus coriaria* (sumach) were used for dyeing cloth as shown in Table 1.

Table 1. Some medicinal plants that contain dyes

Scientific name	Part used	Family	Local name	English name
Pistacia palaestina L.	Fruits	Anacardiaceae	Butm	Mastic, lentisk
Rhus coriaria L.	Fruits	Anacardiaceae	Summach	Siliclain sumach
Carthamus tinctorius L.	Fruits	Asteraceae/ Compositae	Ossfor	Safflower
Quercus aegilops L.	Shell	Fagaceae	Baloot	Oaks
Crocus sativas L.	Stigma	Iridaceae	Zafaran	Saffron
Punica granatum L.	Fruit peel	Punicaceae	Roman	Pomegranate

Saffron contains coricin that considered as yellow dye substance and gives with sulfuric acid a dark blue color. Saffron contains some volatile oils, picrociene, red dye substance called policrobit The ancient yellowish-orange dye saffron is produced from the crushed stigmas of a crocus blossoms (*Crocus sativus*). The coloring principle is coricin, a tetraterpene carotenoid pigment related to vitamin A. So far saffron used as popular food coloring and flavoring. It is also used in pharmaceuticals and perfumes. The highest coloring strength was obtained when saffron submitted to higher temperatures (83°C) and lower times (28 min) (Carmona et al., 2005). The part used of safflower is the dry root, flowers and volatile oils. After washing and drying of root, its color became yellow, and it has a hot taste. It contains a pigment substance called carthamine. This substance is insoluble in water, but it is dissolved in alcohol and ether and its color became purple red.

The main object of this study was to investigate the ability of natural dye-yielding plant species that grow and used in Jordan in order to provide employments and yield economic and ecological benefits.

2. Materials and Methods

All chemicals used are analytical grade, where different chemical solutions including 2.5 M NaOH, 0.6 M $NaHCO_3$, 0.5 M NH_2SO_4 and 2.5 M HCl prepared to test the solubility of some medicinal plants.

The process used in this study went through three steps after taking 50 g of each dried natural dye-yielding medicinal plant species, and grinded them mechanically. Firstly the weight of 50 g of each crashed part of the plant boiled in water for long period in iron pot to get thick liquid. Then the liquid allowed cooling and the extract is filtered through a piece of thin cloth, where the natural dye solution used to dye coarse cotton fabrics in which alum used as a mordant. Sometimes we used acetone and salt instead of water, and the color obtained of the dyes thus extracted and prepared through this process depends upon the plant species and part used which are as follows.

2.1 Saffron

The dye in Saffron done by dissolving with acetone, acetone with salt, and distilled water. At first weight of 50g of was dissolved in sufficient amount of acetone, and then solution was taken and diluted up to 100 mL with de-ionized water. After the solution was heated, two pieces of wool and two pieces of cotton were immersed in the heated solution for one hour.

Next the same amount of saffron was dissolved in sufficient volume of acetone, and 5 ml of 50% NaCl, then the compound diluted with 100 mL de-ionized water. The solution then heated, and two pieces of wool and two pieces of cotton were immersed in this heated solution for one hour.

Lastly 50 g saffron was dissolved in 100 ml distilled water and then adjusted at pH 5 by adding few drops of 2.5 M. The solution was boiled at 98ºC, and the dyeing process was performed without performing the distillation process. The colored cloth can be seen in the following figures

A

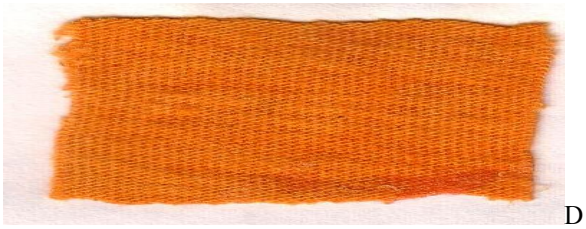
Figure 1A. Cotton cloth dyed with orange color after treatment with saffron extract in acetone

B

Figure 1B. Wool cloth dyed with orange color after treatment with saffron extract in acetone with salt

C

Figure 1C. A raw cloth dyed with orange color after treatment with saffron extract with salt

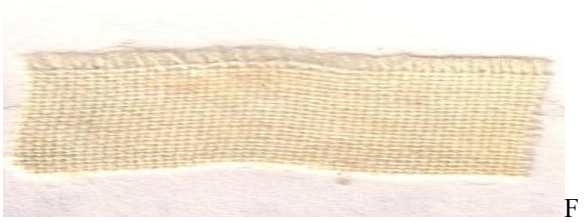


D

Figure 1D. Cotton cloth dyed with orange color after treatment with saffron extract with salt

E

Figure 1E. Wool cloth dyed with orange color after treatment with saffron extract with salt



F

Figure 1F. A raw cloth dyed with yellow to pale brown color after treatment with aqueous saffron extract

2.2 Oaks Dye

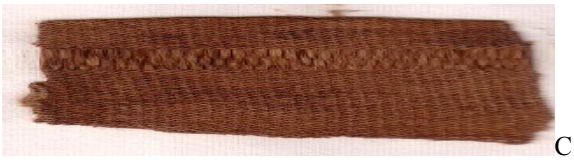
A 50 g of oaks peel was dissolved in distilled water, and filtered via whatman filter paper, and then distillated at 99ºC, where the pH value before distillation was 5. The dyeing process was performed by immersing the cloth with the distillate solution directly. The dyed cloth can be seen in the following figures.

A

Figure 2A. A raw cloth dyed with brown color after treatment with oak extract and salt addition

B

Figure 2B. Wool dyed with dark brown color after treatment with oak extract and salt addition



C

Figure 2C. Cotton dyed with dark brown color after treatment with oak extract and salt addition

D

Figure 2D. A raw cloth dyed with aqueous oak extract

2.3 Punica granatum Dye

A weight of 50g of dried and grinded Punica fruit peel was dissolved in distilled water, and filtered via whatman filter paper, and then distillated. The distillate then mixed by specific weight of $CuSO_4$ and boiled for 15 minutes. The pH value for this mixture was measured (pH =5), and the dyeing color was green. The dyed raw cloth by Punica can be seen in the following figure.

A

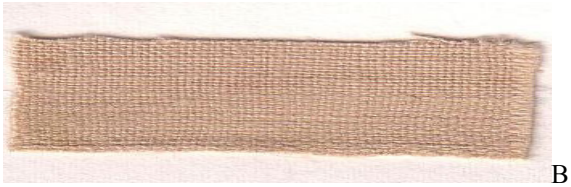
Figure 3A. A raw cloth dyed with light brown color after treatment with aqueous *Punica granattum* extract

2.4 Pistacia Palastina (Wild Pistachio) Dye

An amount of 50 g of crashed Pistacia seeds was dissolved in 2.5 M of NaOH at (pH = 10). The mixture and a piece of cloth was displayed in a container and boiled for 15 minutes where a tan color was obtained. The same process was made again when the pH was converted into acidic medium by adding HCl, and the result of the dyed cloth can be seen in the following figures.

A

Figure 4A. A raw cloth dyed with yellowish-orange color after treatment with mastic extract with salt



B

Figure 4B. A raw cloth dyed with brown color after treatment with mastic extract with KOH

2.5 Carthamus Tinctorius (Ossfer Dye-Safflower)

A weight of 50g of grinded Safflower was dissolved in 2.5 M of HCl, and then filtered via Whatman filter paper. The pH value before dyeing was 6 and the brown color were achieved after boiling the solution at the same pH. The colored cloth of Safflower extract can be seen in the following figure.

A

Figure 5A. A raw cloth dyed with brown color after treatment Safflower extracts

2.6 *Rhus Coriaria*

A 50 g of Rhus coriaria fruits was dissolved in acetone without Salt, and100 mL de-ionized water. Two pieces of wool and two pieces of cotton were immersed in the solution whit pH = 5, and boiled for 15 minutes, and then the temperature was ranged at 76-96°C for 1h.

Salt was then added to the solution of Rhus coriaria fruits mensioned above, and the mixture was boiled along with two pieces of wool and cotton for one hour.

Figure 6A. Wool cloth dyed with brown color after treatment with aqueous concentrated *Rhus coriaria* extract

Figure 6B. Cotton cloth dyed with brown color after treatment with concentrated *Rhus coriaria* extract

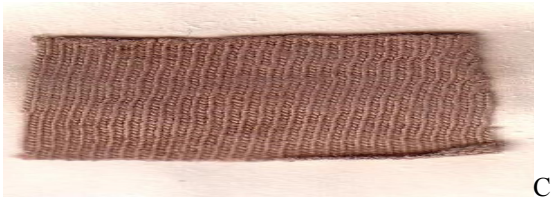


Figure 6C. A cotton cloth dyed with brown color after treatment with aqueous concentrated *Rhus coriaria* extract

Figure 6D. A wool cloth dyed with brown color after treatment with aqueous concentrated *Rhus coriaria* extract

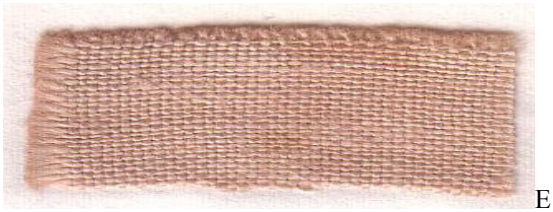


Figure 6E. A raw cloth dyed with brown color after treatment with *Rhus coriaria* aqueous extract

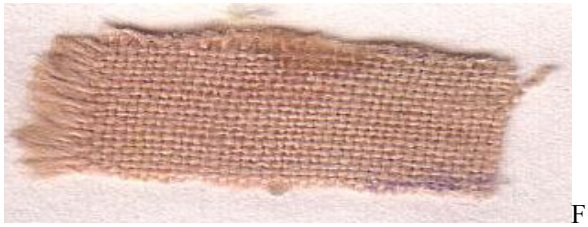


Figure 6F. A raw cloth dyed with brown color after treatment with concentrated aqueous sumac extract with salt

Figure 6G. A cotton cloth dyed with brown color after treatment with *Rhus coriaria* and saffron mixture extract

Figure 6H. A raw cloth dyed with brown color after treatment with *Rhus coriaria* and saffron mixture extract

3. Results and Discussion

The results obtained in this project indicated that the investigated medicinal plants are suitable as natural dyes for different types of cloth which we can indicate as follows:

3.1 Crocus sativa (Saffron)

In section 2.1 the obtained results shows that the wool and cotton was dyed with orange color, and the color did not change after washed either by hot or cold water. Results obtained from saffron dyes when treated by acetone and with or without salt almost the same orange color resulted as we can see in Figure1A-E. Whereas when

saffron extracted with water the raw cloth were colored by yellow to pale brown color as we see in Figure1F.

3.2 Oaks Dye

Raw cloth with oaks dye and salt were colored in brown (Figure 2A), where wool and cotton with oak extract and salt colored in dark brown (Figure 2B & C). While raw cloth colored by light brown when dyed with aqueous oak extract (Figure 2C).

3.3 Punica granatum (Pomegranate)

The result obtained for a raw cloth with aqueous Punica granatum dye were light brown color as shown in Figure 3 A.

3.4 Pistacia palaestian (Wild Pistachio) Dye

Raw cloth dyed with yellowish-orange color after treatment with mastic extract with salt (Figure 4A), where similar piece were dyed with brown color after treatment with mastic extract with KOH (Figure 4B).

3.5 Carthamus tinctorius (Ossfor dyes-Safflower)

The brown color was achieved on raw cloth after boiling with the solution ofRhus coriaria and Safflower extract with HCl at PH6 (Figure 5A).

3.6 Rhus coriaria (sumac)

Almost the same dark brown color obtained on wool and cotton cloth dyed with aqueous concentrated Rhus coriaria extract (Figure 6 A-D). While brown color achieved when raw cloth dyed with Rhus coriaria aqueous extract, with concentrated aqueous sumac extract with salt, or Rhus coriaria and saffron mixture extract (Figures 6E, F and H). Similarly A cotton cloth dyed with brown color after treatment with Rhus coriaria and saffron mixture extract (Figure 6G). Moreover, the rose colour appeared when the concentrated solution of Rhus coriaria was used for dyeing without distillation process.

4. Conclusions

Jordan fields during spring season are very replete in various types of medicinal and colored plants. The attempt to use the natural dyes is recommended using due to their non-toxic properties, fewer side effects, and having less cost. So far no serious efforts have been made to document and preserve the natural dyes associating with people. Thus, improvement of precise extraction and dyeing technique is important to make the natural dyes commercially succeeded like synthetic dyes.

It is now evident that cotton and wool cloth are stained with different colors by using the medicinal plants extracts. Therefore it is likely to be concluded that using some of Jordanian medicinal plant extracts as natural dyes might be essential and this may be considered as good investment in different types of cloth and textile manufacture.

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