



## MINI REVIEW

### Dyeing Techniques and Mordanting Methods Applied in Natural Dyeing of Wool in Turkey

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Hand-woven carpets and rugs in Anatolia in the wool yarn dyed with natural dyes have been used. Carrying values of art, carpets and rugs used for years in terms of paint applied in dyeing techniques are important. There are different techniques as regional and scientific in dyeing for natural dyeing. In this study, dyeing methods with mordanting and non-mordanting methods have been described. Additionally, the diversity of colours and fastnesses in dyeing about mordant and mordanting methods have been given. Today in Anatolia, the natural dyeing has been reviewed and described in the scientific dimension.

**Key Words:** Natural dyeing, Dyeing techniques, Mordanting methods.

## INTRODUCTION

Natural dyeing has been performed for centuries in Turkey as an ancestor handicraft. Natural dyeing which was performed intensely in the past has been brought to the agenda recently and many institutions and organizations have been working on this technique. Plants used for hand woven carpets and rugs vary substantially. Plants not only are grown specially but also they are found naturally in the nature. Dyeing techniques applied in dyeing are important in terms of the fact that carpets and rugs having art value could be used during long periods of time. For natural dyeing, different regional and scientific techniques are used in dyeing.

Today the revival of natural dyeing performed regionally has been important in terms of the fact that dyeing has been common in Anatolia having variety of dyeing plants and making natural dyeing widespread and being known the mordanting techniques have been important.

Those who use natural dyes and hand woven carpet-rug dyers try to develop new techniques and dyeing methods in order to improve colour palettes gained available plants, to have different colours, to produce special prescriptions and to increase their fastness value. The fact that same dyestuffs are used in different countries, but having different colours and colour tones because of different climatic and regional conditions has been the subject of many researches. In compliance with the studies and researches done in Turkey in the field of

natural dyeing it has been notable that there have different mordanting techniques and prescriptions made by diverse mordants<sup>1-9</sup>. There have also been studies done by benefiting from the mixtures in terms of having very different colours by being dyed twice<sup>10,11</sup>.

In this study, information about mordanting techniques applied in natural dyeing, mordants and dyeing methods in Turkey have been given. Before beginning the dyeing process, the extract should be prepared. For the preparation of the extract, there are two techniques as hot and cold.

### Techniques of the extract preparation

**Technique of the preparation for hot extract:** Through this technique, in order to make the dyeing stuff pass into the water, some parts of the plant such as substructure buds (madder), its roots (*Berberis vulgaris*), body shell (walnut), its branches (reddish tree), its leaves (walnut, quince), its flowers (daisy), fruit (buckthorn), its grains (dock) or the whole part of the plant such as mint, love flower, mullein, well spring are pounded in the mortar. Then, these plants, depending on the weight of the wool fiber to be dyed taken optionally between 25, 50, 100 % or 200 % are boiled during 1 h at the rate of 1/50 in the water. The diminishing water during the boiling process are added. At the end of the 1 h boiling process, the remnants of the plants are sent away the milieu by being filtered, so the hot extract is obtained.

**Technique of the preparation for cold extract:** Through this technique, the parts of the plants pounded in the mortar are waited in the cold water during 12, 24 or 48 h at the rate of 1-50 depending on the weight of the wool to be dyed optionally 25, 50, 100 or 200 %. At the end of this process, the remnants of the plants are sent away the milieu by being filtered, so the cold extract is obtained. The dyeing stuff of some plants are not released by the technique of cold or hot extract and for this the brewing method is applied. To illustrate, for the dyeing made by the indigo plant, the brewing system is applied as such:

**Brewing method:** The newly-collected leaves are cleaned, sawed and made as small parts, then they are molded until they become the density of dough. Small balls are made from this dough. Then, these balls are dried on a smoot ground in a well-ventilated milieu for 4 weeks. In order to these balls be fermented, they are powdered and they are frequently sprayed water in order that the fermentation could begin. The water spraying process is continued for 9 weeks. When the fermentation process is concluded, the mass of dough is solidified and they become ready for the dyeing process.

After the process of the preparation of the extract, the dyeing process begins. The dyeing techniques are applied by two ways such as without mordanting and mordanting. In addition to the common techniques used for the mordanting of wool fiber, different techniques found as a result of the scientific researches are applied.

#### Mordanting techniques

**Pre-mordanting:** The mordants are melted in warm water at the rate of 1-50 by being taken at the rates varying from 0.5 to 20 % depending on the weight of wool fiber. The wool fiber which was dampened before is stifled in this mordanting water after boiled 0.5 or 1.0 h. The wool taken from the mordanting water is mangled and made ready for the dyeing process. This mordanting method is applied in public as making the wool threads wait in child excretion or animal excretion during one night.

**Final mordanting:** The wool fibers are dyed as of the technique which is made without mordanting. Then, they put in the water at the rate of 0.05 or 20 % depending of the weight of the wool in proportion of 1-50 and they are boiled during 0.5 or 1.0 h, so the final mordanting is made. After they get cold, they are rinsed with much cold water and are dyed in a dim light.

**Mordanting together:** The pre-determined mordant is added in the extract while putting the wool in the obtained extract. The wool thread becomes both dyed and mordanted. They are boiled during 1 h and then they remain for cooling at the end of the 1 h. After they are cooled, they are rinsed and dried in a well-ventilated and dim light milieu.

**Mordanting twice:** The wools mordanted through the pre-mordanting technique are put in the extract and the dyeing is made. At the end of the dyeing process, the dyed wool is boiled during 1 h in the water at the rate of 1-50 depending on the weight of the wool with the determined second mordant.

**Mordanting by mixing two mordants simultaneously:** The pre-mordanting process is same, but this is the process made by mixing two different mordants at the same rate of

50-50 % by making stable the mordant which gives the best fastness value and the best colour in compliance with the plant used.

**Mordanting by boiling the wool threads with mordant simultaneously:** The boiling process is performed by putting together the plant and mordant together with wool threads simultaneously determined in compliance with the weight of wool threads. In this technique, the wool thread is both mordanted and it takes the dye in its body while the extract is being obtained.

To date, for the dyeing process made with several plants, these mordanting methods are applied and it has been tried to determine the advantages and disadvantages of these methods one another. For the mordanting of wool threads, pre-mordanting method is mostly used. In some regions, all these methods are applied simultaneously.

When pre-mordanting, final mordanting and mordanting together methods are compared, it has been found that there is no significant difference between the colours obtained and their fastness value, but the pre-mordanting method is more appropriate.

It has been determined that when the mordanting methods are applied by mixing pre-mordanting and two mordants simultaneously, more different colours are obtained and their fastness value increases. During the process when two mordants are added equally at the rate of the mordant (3 %) to be used during the dyeing process, the mordants giving the most beautiful colours and fastness value are made stable and other mordants are changed. When the mordanting is performed as mentioned above, colours and fastness give good results.

Because there is no significant difference in the mordanting together method, it has been found that the pre-mordanting technique is more appropriate one.

It has been determined that, during the mordanting method in which the plant, mordant and the material to be dyed (wool), although the dyeing process is quite short, there are some problems for the fact that the wool thread takes the dye in its body and there are some plant remnants on the wool thread.

Finally, for the fact that the mordanting methods are applied easily, they do not cause any complication and they are understood easily by everyone, the pre-mordanting method is used. During the special and fine workings, mordanting methods are benefited by mixing together two mordants simultaneously.

**Dyeing methods:** Although the dyeing methods vary depending on the regions, they are classified as mordanted and without mordanted methods as a result of the studies made up to the present. The mordanted dyeing method varies in itself.

**Dyeing without mordant:** The wool is put in the extract by dampening which was obtained before. It is boiled during 1 h and the diminishing water is consolidated. After the dyed wool is cooled, it is rinsed with much water and is dried in a well-ventilated and dim light milieu.

#### Dyeing with mordant

The wools mordanted before are boiled in the extract which was obtained as cold and hot during 1 h and then left to the cooling themselves. Then, they are rinsed with much water and dried in a well-ventilated and dim light milieu.

**Overdyeing (top dyeing):** According to the written sources, between 800-1600 A.D. the communities dealing with natural dyeing in British Islands in Northern Europe applied colour mixing method in order to obtain the colours they desired<sup>12,13</sup>. By dyeing another colour on the one which is on a dyed textile material, the method of changing the colour however they desired or adjusting it has been known in several countries and it is called overdyeing or top dyeing. Overdyeing method is applied in order to have the colours which cannot be obtained by natural dyeing methods with a single natural or which should be completely changed or are not satisfactory<sup>14,15</sup>. In the textile dyeing, two dyestuffs either can be mixed in a solution or can be integrated on a single textile material<sup>16</sup>. This method is applied by mixing the naturals or extracts in several regions of Turkey. As for the examples of colours obtained by the dyeing made with overdyeing method, these are wool carpet threads with aluminium alum mordant, in order to change the light green colour, burgundy when dyed at first in peppermint extract, very light green when dyed in the leaf of peach and light brown colour when dyed in nutshell.

When dyed firstly in the daisy extract giving light reddish yellow colour and then when dyed in mader extract it gives light tanner colour. But when dyed in peppermint extract it gives very dark green and when dyed with nutshell it gives soil colours. In the dyeings made by the method of plant mixing, when the threads of aluminium alum mordanted wool carpet are dyed with the extract prepared by the equally mixing of peppermint and mader it gives light tile colour, when dyed with the extract prepared by the mixing of peach leaves it gives extra-virgin olive oil and when dyed with nutshell it gives brown-like cruet colour. In the dyeings made by the method of extract mixing, when the threads of aluminium alum mordanted wool carpet are dyed with the extract prepared by the mixing of peppermint and madder it gives light tile colour, when dyed with the extract prepared by the mixing of peach leaves it gives vine leaves preserved colour and when dyed with nutshell it gives light soil colours<sup>11</sup>.

**Double-dyeing method:** This method is based on the fact that the same dyeing extract is used again and again until the textile material loses its colouring feature during the dyeing bath or until dyeing substances found in the dyeing bath draw away completely on the textile material. In compliance with some dyeing techniques, dyestuffs found in a given ratio in the dyeing extract can be absorbed by wool fiber, therefore the same extract can be used until the dyestuffs are used up in the dyeing bath. Some chemicals are added in the millieu in order to quicken and strenghten the absorption of the dye by the wool, consequently it is provided that dyestuffs in the extract pass completely on wool fiber<sup>16,17</sup>. When the same dye extract is used plenty of times, more than one tone of the same colour can be obtained by the single extract. The first dyeing gives the darkest tone and the last dyeing gives the lightest tone. Because water which is back out of the millieu by being evaporated during the dyeing process is consolidated and available dyestuffs are absorbed by the wool fiber, colour tones are getting a little bit lighter during each dyeing process. This method preferred especially by textile artists for the natural dyeing is applied commonly in Turkey by the textile artists.

For example, five different colour tones can be obtained from under soil component of the madder plant (*Rubia tinctorium* L.) by using  $KAl(SO_4)_2$  mordant through the method of double-dyeing. These colour tones are seen that they have the darkest tone during the first dyeing and the lightest one during the fifth dyeing. The differences among the colours obtained after the lightest tone can hardly be distinguished. Colour palette has the colour beginning from main colour of light red to dark pinkish orange, dusty rose, pinkish orange and light pinkish orange which are the ones being lighter respectively. These are the colours used usually for the kirkitli and shuttle weavings of traditional Turkish handicrafts. In view of the fact that having colours that follow each other, these colours may create a colour palette that can be used for the thread of hand weaved carpet, rug, handling and tapestry, for the goods that are made as lace, knitting and hand weaving with shuttle, for tie dyeing, home textiles and decoration materials<sup>10</sup>.

### Conclusion

In Turkey, it is traditional to subject the freshly dyed materials to a short immersion in an alkaline ash solution. As a rule, the colours darken and the wool fibers become more glossy. The solution is prepared by mixing ashes preferably oak ash in water. Dipping the dyed material in tannic bath also results in change in the colour, usually a darkening and often increases the resistance to fading. Such a tannic bath can easily be prepared from an extract of barks, fruits or other parts of plants.

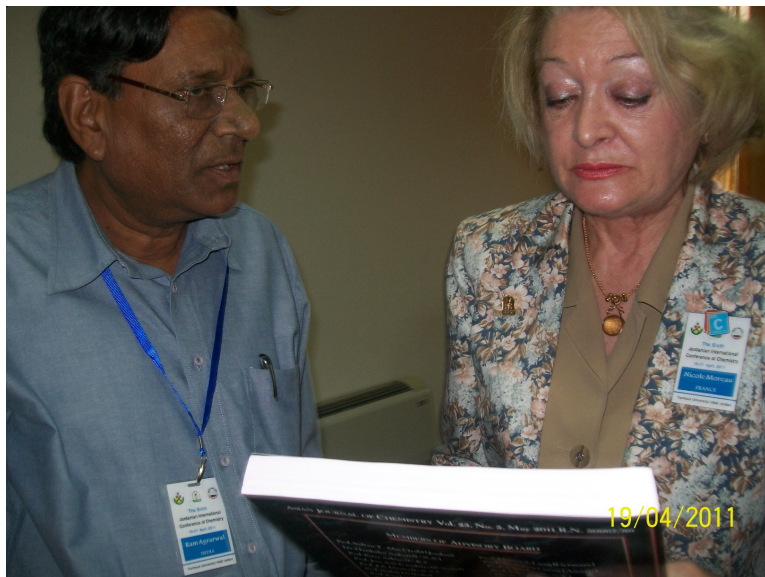
The flora of Turkey include about 8500 different types of plants. The dyeplants are sorted by the colours they produce on wool: red and violet, yellow and orange, brown and black. The practice of dyeing with natural dyestuffs is at least 4000 years old and is a "science before there was science" just as there must have been "art before art existed". Though natural colouration is known from ancient time as artisanal practice for handicrafts, paintings and handloom textiles, the chemistry of interaction of such colourants with textile materials is of relatively recent interest for producing ecofriendly textiles. It is only recently (the first artificial dye was invented in 1857 A.D.) that the textile industry has turned to synthetic dyes. Today, many are rediscovering the joy of achieving colour through the use of renewable, non-toxic, natural sources.

Wool, the chief textile fiber of Turkey, was available in white as well as in many different natural shades of browns and greys. Such shades could be and often were spun and woven without ever being dyed. Wool dyes very easily, though, there are several different dyeing and mordanting methods. The most frequently used mordanting of wool method is premordanting (before dyeing) in Turkey. Natural dyes are not recommended for synthetic fabrics or fibres.

According to several reseaches, whether pre-mordanted or simultaneous mordanted or post-mordanted, the colour depends not only on the natural colourant but also on the mordant and mordanting assistant used. A dyer must know the use of proper combinations of fibre-mordant to achieve best colour fastness. It will help to popularize the use of natural dyes by solving some of its problems relative to application methods, reproducibility and colour fastness.

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Prof. (Dr.) Ram K. Agarwal, Editor-in-Chief, Asian Journal of Chemistry presenting a copy of Asian Journal of Chemistry to Ms. Nicole Jeanne Morean, President, International Union of Pure and Applied Chemistry (IUPAC) during 6th Jordanian International Conference of Chemistry at Yarmook University, Irbid, Jordan on 19th April 2011.