Journal of Plant Sciences
2015; 3(4): 171-175
Published online June 20, 2015 (http://www.sciencepublishinggroup.com/j/jps)
doi: 10.11648/j.jps.20150304.11
ISSN: 2331-0723 (Print); ISSN: 2331-0731 (Online)

Dyeing the Silk Fabric with Some Colour Plants and Comparing the Light Fastness and Breaking Resistance of the Acquired Colours

Sanli Hurrem Sinem

Art and Design Faculty, Gazi University, Ankara, Turkey

Email address:
hurrem@gazi.edu.tr

To cite this article:
Sanli Hurrem Sinem. Dyeing the Silk Fabric with Some Colour Plants and Comparing the Light Fastness and Breaking Resistance of the Acquired Colours. *Journal of Plant Sciences*. Vol. 3, No. 4, 2015, pp. 171-175. doi: 10.11648/j.jps.20150304.11

Abstract: Silk has preserved its actuality and importance between the textile raw materials with its naturalness, softness, brightness and charm since the first and oldest ages of civilization. It is possible to dye silk fabric with plant dyes. In this study madder (*Rubia tinctorium L.*), walnut tree (*Juglans regia L.*), onion (*Allium cepa L.*), and leaves of olive tree (*Olea europea L.*) plants were used. Colouring made with the non-mordant method and 20 colouring made with the pre-mordant method. A comparative study performed in order to determine; the colour value, light fastness and breaking resistance of the 24 dyed silk fabrics.

Keywords: Natural Dyeing, Silk Fabric, Light Fastness, Breaking Resistance

1. Introduction

Silk has preserved its actuality and importance between the textile raw materials with its naturalness, softness, brightness and charm since the first and oldest ages of civilization. It is possible to dye silk fabric with plant dyes.

In this study the following plants which were used in four plants dyeing used:

1. shoot of under soil of madder (*Rubia tinctorium L.)*,
2. leaves of walnut tree (*Juglans regia L.*),
3. bulb's out peel of onion (*Allium cepa L.*), and
4. leaves of olive tree (*Olea europea L.*)

Colouring made with the non-mordant method and 20 colouring made with the pre-mordant method. A comparative study performed in order to determine; the colour value, light fastness and breaking resistance of the 24 dyed silk fabrics.

1.1. Madder (Rubia tinctorium L.)

It is known that cultivation of madder that has important place for plant dyeing is made largely in Anatolia since Middle Ages.

Fig. 1. *Madder (http://tr.wikipedia.org/wiki/Kökboya_bitkisi).*

Fig. 2. *Shoot of under soil of madder (http://www.pazyryk-gesellschaft.com).*

It is multi-year, repent and climbing plant. It's rhizome are red and branched out. Its trunk is herbaceous, quadrilateral. On the corners of its trunks, there are strong hairs turned back and other surfaces have no hairs.

Flowers are lax, very branched out; they carry many flowers and come together as pyramidal flower shape. Those can be on the point of trunk or leave borders. Longitude of stalks of flowers is 2-8 mm. Mostly, it is common between hedges of fields and gardens, in Manisa, Demirci, Gördes, Konya, Aksaray, Niğde, Kayseri, Kirşehir, Çorum, Yozgat, Malatya, Elaziğ, Adiyaman, Amasya, Ankara, Tokat, Kahramanmaraş, Çanakkale, Muğla in Turkey. It is used for dye, but also animal feed (Makakli 1972, Kayabaşi et all. 1998).

1.2. Walnut (Juglans regia L.)

It is mostly tree. It has glands, which is full of receiver and aromatic substances. While its delicious fruits are eaten, its cultivation is made for a long time.

Fig. 3. *Walnut (http://www.tarimsalhaber.com/portalresimler/1920.jpg).*

Flowers bloom during or after leafing. Its fruits are generally seeded, watery and big. Walnut is grown in almost each region of Anatolia and its *Juglans regia L.* and *Juglans nigra L.* kinds are used for dyeing. Dye is obtained from the stem, trunk peels, leaves and green out-peels of its fruit (Baytop 1984, Anonymous 1991).

1.3. Onion (Allium cepa L.)

It has multi-year herbaceous feature and they are plants with tuber, onion and rizom. Its leaves have different appearance and mostly they have shapes like ribbon, lance and egg. Its flowers are generally big, sweet scented, colorfull. On the point of its suckers leaves have shape like gleanings unique or bunch.

Fig. 4. *Bulb's out peel of onion (http://odesskaya.all.biz/tr/kuru-sogan-g2717297#.VXVhmc_tmko).*

It is almost grown in each region of Anatolia. Particularly, its agriculture is made largely as plant in Bursa, Balikesir, Manisa, İzmir, Tekirdağ, Kocaeli, Kayseri, Niğde. Its out peel of bulb is used for dyeing. Since past, onion peels are used for wool dyeing in Anatolia. In addition to pirokatesin and benzokatesin acids in out node peels, there are quercetin pigments (Anonymous 1991).

1.4. Olive Tree (Olea europea L.)

Olive that is a multi- year plant belongs to *Olea* specie of *Oleaceae* family of *Ligustrales* team. An olive tree may live in few centuries. It has green leaves every season**.** Its blooming is between March and April. Blooms are bunch shape. In spite of olive come into a lot of flower only 1-5 % of its flowers gives fruit.

Fig. 5. *Olive tree (www.sifavi.com/Bitkiler/zeytin%20yapraği.html).*

Fig. 6. *Olive tree leaves (www.sifavi.com/Bitkiler/zeytin%20yapraği.html).*

That is ideal for yield. Homeland of olive is triangle of Mardin, Kahramanmaraş and Hatay in Anatolia. The cultivator of olive first time is start in B.C. 4000 in Anatolia. And from this place expand other country of Mediteranean. (Aktan and Kalkan 1999).

2. Material and Methods

2.1. Material

The materials of this research are shoot of under soil of madder (*Rubia tinctorium L.*), leaves of walnut tree (*Juglans regia L.*), bulb's out peel of onion (*Allium cepa L.*), leaves of olive tree *(Olea europea L.)* and pure silk textures (without dyed and white).

2.2. Methods

For dyeing of silk fabric with plants determined in material, mordanting and without mordanting methods were applied.

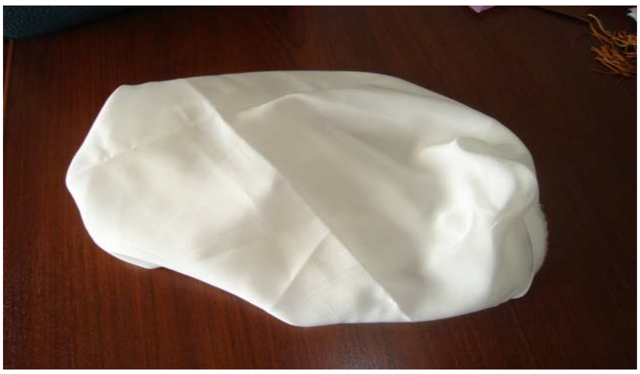

Fig. 7. *Pure silk fabric (without dyed and white).*

2.2.1. Preparation of Dye Extract

To obtain the penetration of dye matter to water, dried whole plants were broken up into small pieces. Whole plants were taken in accordence with silk fabric weight at the rate of the 100%. Pure water was used in accordence with silk fabric weight at the rate of the 1/50. And then plant pieces were boiled in this water for one hour. At the end of time plants remnants were filtered and putted away from the water. In this way dye extract was obtained.

2.2.2. Dyeing Without Mordant

Previously damped silk fabric was boiled in 80 ºC dye extract for one hour. During the boiling decreased water is added equal to vaporized amount. Then it was cooled, rinsed with cold water and dried at shading and airy place.

2.2.3. Mordanting of Silk Fabric

Firstly, silk fabric that was mordanted. For this action, in conformity with the weight of silk fabric that was dyed, 3%

1. alum of aliminium,
2. copper-sulfate,
3. ferrous-sulfate,
4. potassium-bichromate and
5. sodium-chloride.

Mordants were taken and they were dissolved in 80 ºC water. Then, silk fabric that was mordanted was put in 80 ºC water and boiled during one hour. After one hour, silk fabric was ready for dyeing by wringing.

2.2.4. Dyeing with Mordant

Mordanted silk fabric was boiled in 80 ºC the previously prepared dye extract for one hour. Then, it was cooled, rinsed with cold water and dried at shading and airy place.

2.2.5. Light Fastness Determination (TS EN ISO 105-B02)

Light fastness determination was done according to TS EN ISO 105-B02 prepared by TSE (Textiles- Tests for colour fastness- Part B02: Colour fastness to artificial light: Xenon arc fading test) (Anonymous 2014).

This standard specifies a method intended for determining the effect on the colour of textiles of all kinds and in all forms to the action of an artificial light source representative of natural daylight (D65). The method is also applicable to white (bleached or optically brightened) textiles.

2.2.6. Breaking Resistance Determination (ISO 13934-1)

Breaking resistance determination was done according to Textiles- Tensile properties of fabrics- Part 1: Determination of maximum force and elongation at maximum force using the strip method (Anonymous 2013).

The method is mainly applicable to woven textile fabrics, including fabrics which exhibit stretch characteristics imparted by the presence of an elastomeric fibre, mechanical, or chemical treatment. It can be applicable to fabrics produced by other techniques. It is not normally applicable to geotextiles, nonwovens, coated fabrics, textile-glass woven fabrics, and fabrics made from carbon fibres or polyolefin tape yarns.

The method specifies the determination of the maximum force and elongation at maximum force of test specimens in equilibrium with the standard atmosphere for testing, and of test specimens in the wet state. The method is restricted to the use of constant rate of extension (CRE) testing machines.

2.2.7. Naming the Colours

Naming obtained colours were arranged subjectively. Obtained colours with these methods were named by the commission consisted of specialists of Gazi University Traditional Turkish Arts Department.

For the naming, dyed silk fabrics were lay on a white ground where the sunlight comes from the side and they formed into groups according to their colours and tone differences. And also Harmancioğlu (1955) was considered for the naming of the colours.

3. Results and Discussion

Madder, walnut, onion and olive tree plants were taken in proportion of 100 % according to the weight of silk fabric that was to be dyed. Then mordanting dyeing were realized by using alum of aliminium, copper-sulfate, ferrous-sulfate, potassium-bichromate and sodium-chloride mordants in proportion of 3 %. Totally 24 dyeing were obtained, 20 are with mordant, and 4 are without mordant.

Colours obtained as result of dyeing were fixed and given in Tables 1-4.

Table 1. *The Colours Obtained from Madder (Rubia tinctorium L.).*

Mordant	Obtained from Colours
Alum of Aliminium	Pink 1
Copper-sulfate	Light Pink 2
Ferrous sulfate	Light Pink 3
Potassium-bichromate	Pink 2
Sodium-chloride	Light Pink 1
Without mordant	Salmon

Plant ratio (100 %) and Mordant ratio (3 %)

Table 2. *The Colours Obtained from Walnut (Juglans regia L.).*

Mordant	Obtained from Colours
Alum of Aliminium	Beige 1
Copper-sulfate	Light cumin
Ferrous sulfate	Light hay yellow 2
Potassium-bichromate	Light mustard yellow
Sodium-chloride	Light hay yellow 1
Without mordant	Beige 2

Plant ratio (100 %) and Mordant ratio (3 %)

Table 3. *The Colours Obtained from Onion (Allium cepa L.).*

Mordant	Obtained from Colours
Alum of Aliminium	Cinnamon 2
Copper-sulfate	Amber
Ferrous sulfate	Curry 2
Potassium-bichromate	Curry 1
Sodium-chloride	Cinnamon 3
Without mordant	Cinnamon 1

Plant ratio (100 %) and Mordant ratio (3 %).

Table 4. *The Colours Obtained from Olive tree (Olea europea L.).*

Mordant	Obtained from Colours
Alum of Aliminium	Bone colour 2
Copper-sulfate	Olive green
Ferrous sulfate	Light cream
Potassium-bichromate	Light beige
Sodium-chloride	Dark cream
Without mordant	Bone colour 1

Plant ratio (100 %) and Mordant ratio (3 %)

Light fastness, breaking resistance (Nw) and max. extension (%) values of the colours obtained from plants were fixed and given Tables 5-8.

Table 5. *Light Fastness and Breaking Resistance Values of The Colours Obtained from Madder (Rubia tinctorium L.).*

Mordant	Light fastness value	Breaking resistance	Max. Extension %
Alum of Aliminium	3	339,22	35,55
Copper-sulfate	2/3	316,64	34,64
Ferrous sulfate	2	303,61	42,31
Potassium-bichromate	3	304,14	43,06
Sodium-chloride	2	333,89	43,78
Without mordant	3/4	259,32	30,81
Non dye silk texture	-	386,8	27,00

Plant ratio (100 %) and Mordant ratio (3 %)

Table 6. *Light Fastness and Breaking Resistance Values of The Colours Obtained from Walnut (Juglans regia L.).*

Mordant	Light fastness value	Breaking resistance	Max. Extension %
Alum of Aliminium	2/3	249,38	36,86
Copper-sulfate	4	264,10	37,76
Ferrous sulfate	3	217,26	34,32
Potassium-bichromate	3	307,04	38,35
Sodium-chloride	2/3	282,40	37,26
Without mordant	3	284,15	30,10
Non dye silk texture	-	386,8	27,00

Plant ratio (100 %) and Mordant ratio (3 %)

Table 7. *Light Fastness and Breaking Resistance Values of The Colours Obtained from Onion (Allium cepa L.).*

Mordant	Light fastness value	Breaking resistance	Max. Extension %
Alum of Aliminium	1/2	241,61	36,07
Copper-sulfate	2/3	260,44	39,98
Ferrous sulfate	3/4	298,85	38,59
Potassium-bichromate	1	296,77	40,70
Sodium-chloride	1/2	267,13	37,07
Without mordant	2	291,70	41,82
Non dye silk texture	-	386,8	27,00

Plant ratio (100 %) and Mordant ratio (3 %)

Table 8. *Light Fastness and Breaking Resistance Values of The Colours Obtained from Olive tree (Olea europea L.).*

Mordant	Light fastness value	Breaking resistance	Max. Extension %
Alum of Aliminium	2	276,60	33,12
Copper-sulfate	3/4	273,14	31,09
Ferrous sulfate	3/4	288,80	35,23
Potassium-bichromate	3/4	318,35	35,73
Sodium-chloride	3	282,48	35,48
Without mordant	3	279,32	34,30
Non dye silk texture	-	386,8	27,00

Plant ratio (100 %) and Mordant ratio (3 %)

Table 1-4 was examined, color change was observed;

- For Madder; from light pink to salmon
- For Walnut; from beige to light cumine
- For Onion; from cinnamon to curry
- For Olive tree; from bone colour to olive green

Table 5-8 was examined, Light fastness was observed;

- For Madder; from 2 to 3/4.
- For Walnut; from 2/3 to 4.
- For Onion; from 1 to 3/4.
- For Olive tree; from 2 to 3/4.

Breaking resistances of dyed fabrics by influence of mordants can be seen from the Table 5-8. Breaking resistance and Max. Extension % was observed;

- Non dye silk texture > 386,8
- For Madder; from >259,32 (without mordant) to >339,22 (Alum of aliminium).
- For Walnut; from >217,26 (Ferrous sulfate) to >307,04 (Potassium-bichromate).
- For Onion; from > 241,61 (Alum of aliminium) to > 298,85 (Ferrous sulfate).
- For Olive tree; from > 273,14 (Copper-sulfate) to > 318,35 (Potassium-bichromate).

Table 5-8 was examined;

- The value of silk fabric with mordanted by ferrous sulfate and dyed by walnut plant has the minimum breaking resistance (217,26) .
- Silk fabric with mordanted by the alum aliminium and dyed by madder has the highest breaking resistance value (339,22).
- The value of silk fabric with mordanted by copper sulfate and dyed by walnut plant has the maximum light fastness (4).
- Silk fabric with mordanted by the potassium-bichromate and dyed by onion has the lowest light fastness (1).
- Silk fabric with dyed by olive tree has generally the highest light fastness.

In this research, madder plant at least on the strength of silk fabrics, for results of dyeing by walnut plant was the most effective among the other dyeing values. Another similar study, these plants (walnut and madder) for breaking resistance to the effects on wool carpet yarns showed parallel results (Yazicioğlu et all., 1999).

Dyeing by walnut plant (ferrous sulfate mordant) was effect on silk fabrics fraying down. Plant dyeing still continues in different parts of the world regionally, especially in the countries where traditional handcrafts are made densely. In Turkey, many studies and projects have been developed in order to review and improve the plant dyeing, which has a long history. Hence, development and expansion of plant dyeing is vital. Turkey has important flora potential in respect of dyeing plants. Utilization of these dyeing plants in a regional and scientific way and determination of the colors will be possible only with improvement of the plant dyeing tradition.

Plant dyeing, which has been made for centuries in our country, is an important handicraft as it is a heritage and it fills the spare time remained from agriculture. Thus, the importance given to the plant dyeing, information and knowledge given to the people in the rural areas will provide expansion of the art.

References

[1] Aktan, N., Kalkan, H., 1999. The Technology of Olive, University of Ege Press, İzmir (In Turkish).

[2] Anonymous, 2013. Textiles-Tensile properties of fabrics-Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1).

[3] Anonymous, 2014. Textiles-Tests for colour fastness-Part B02: Colour fastness to artificial light: Xenon arc fading test (ISO 105-B02:2014), Public of TSE, TS EN ISO 105-B02, Ankara (In Turkish).

[4] Anonymous, 1991. Dyeing of Wool Fibers with Dyes Obtained from Plants. Turkish Republic Ministry of Industry and Commerce, General Directorate of Small Industry Regions and Sites, Ankara (In Turkish).

[5] Baytop, T., 1984. Treatment with Plants in Turkey. University of Istanbul Press, Number 40, Sanal Printing, Istanbul (In Turkish).

[6] Harmancioğlu, M., 1955. Fastness Levels, on Wool Against Various Effects, of Colours Obtained From Important Plant Dyes in Turkey. University of Ankara, Agriculture Faculty Press. Number: 77, University of Ankara Press, Ankara (In Turkish).

[7] Kayabaşi, N., Arli, M., Erdoğan, Z., 1998. Colours Obtained from Madder and Light and Running Fastness of Those Colours on Wool Carpet Yarns. Agriculture Science Magazine. 4 (3). 84-90 (In Turkish).

[8] Makakli, B., 1972. The Evaluation of Medical Plants. Translation and Anthology Istanbul (In Turkish).

[9] Yazicioğlu, Y., Şanli, S., Tezel, Z., 1999. A Comparative Study On The Tensile Strength Of The Wool Carpet Yarns Dyed With Natural Dyes, In Turkey the early 2000s The Traditional Turkish Handicrafts of Artistic, Design and Economic Dimensions Symposium Releases Ministry of Culture Publications No.2301.

[10] http://tr.wikipedia.org/wiki/Kökboya_bitkisi (Access date: 04.20.2015).

[11] http://www.pazyryk-gesellschaft.com (Access date: 04.15.2015).

[12] http://www.tarimsalhaber.com/portalresimler/1920.jpg (Access date: 04.20.2015).

[13] www.sifavi.com/Bitkiler/zeytin%20yapraği.html (Access date: 04.15.2015).

[14] http://odesskaya.all.biz/tr/kuru-sogan-g2717297#.VXVhmc_tmko (Access date: 04.12.2015).