CHAPTER 17

USE OF ALKANET (*Alkanna tinctoria* (L.) Tausch) PLANT AS NATURAL HERBAL

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INTRODUCTION

There are many plants used in the dyeing process in the vegetation grown in our country. Today, vegetable dyes have gained importance again. Herbal dyeing, which has been dealing with for centuries, has been abandoned with the emergence of chemical dyes, but today it has become preferred again. In this study, the colors resulting from the natural dyeing process made with the aeronautic plant (*Alkanna tinctoria*), which is among the medicinal aromatic plants, and the friction fastness, water drop and light fastness values on these colors were determined.

It has been scientifically determined that the dyeings made using materials obtained from nature first date back to 3000 BC. At this time, natural dyes are mentioned in a Chinese source and it is stated that not only dyes were obtained but also mordant substances were known in Egypt during the Middle Kingdom period (Uğur, 1988).

Various dyeing and patterning processes have been done throughout history with natural dyestuffs obtained from many plants and living things. B.C. Various print samples were found in the textile remains of the 2500s (Akbostancı, 2014). The times when natural dyes were the only option for textile coloring began to end tragically with the invention of the first synthetic dye by Perkin in 1856 (Shahid et al., 2013). With the increasing environmental awareness in recent years, discussions on the use of synthetic dyes have increased due to environmental pollution, toxic effects that harm human health and

waste problems caused by synthetic dyes (Ali et al., 2007, Deveoğlu et al., 2011). Along with the increasing awareness of synthetic dyes, there is an increasing interest in the use of natural dyes that are renewable, cause minimal environmental pollution, and generally do not have a harmful effect on human health (Mansour, 2013, Gulrajani, 2001, Rungruangkitkrai et al., 2012). The natural dye market is becoming an increasingly growing and demanding sector (Kayahan et al., 2016). With this increasing interest towards natural dyes, the application of coloring textile surfaces with natural printing techniques that people have used since ancient times has become more common. Flowers, leaves, etc. in ecological textile print design. By using plant parts, colorful designs can be obtained on textile surfaces in natural ways (Bilir, 2018).

Natural dyes obtained from plants, animals and some metals, which have been used in dyeing for thousands of years from the first ages to the 19th century, have quickly left their place to synthetic dyes. Due to the development of the chemical industry and the cheap and easy cost of synthetic dyes, synthetic dyes have been replaced very quickly. Although there are many reasons for people to prefer chemical dyes, the feedback that emerged as they were used started to give negative results. The dyeing process and the dyed materials have a direct effect on human health. As a result of scientific research; It has been understood that the chemicals we use, the things we eat, drink and even the air we breathe carry carcinogenic substances that affect the human body and cause very serious diseases. Since medical science is

advancing at the same pace, chemical dyes, which enter our lives with a dazzling effect and rapidly, have started to leave their place to more natural dyeing and dyeing methods, as their negative effects are understood.

In today's world, where concepts such as green world and green textile are spreading rapidly, it has been understood that the waste water resulting from the chemical dyeing process also causes harm when mixed with nature. Although chemical dyes cannot be completely abandoned, the search for methods and raw materials that cause less harm to the world, nature and human life has begun. With the increase in environmental awareness, researchers accelerated interdisciplinary studies and searched for new alternatives to chemical dyes. Along with natural dye, studies have been initiated to expand the production and use of natural fiber. When producing fiber, the way of using the waste parts of plants (artichoke stem, banana peel) has been chosen to reduce the cost.

Research continues on many plants in order to contribute to natural dyeing studies. In order for the colors obtained from the plant to be treated with natural fibers such as wool, cotton, silk and used as a dyestuff, their effects on the fibers and their fastness values should be measured. In this study, Alkanet plant grown in Sivas province and its surroundings was preferred as a dyestuff source. Dyeing processes were carried out using Alkanet plant and different mordant materials. Fastness values, which are important for the use of the obtained colors in the textile sector, were determined.

1. GENERAL CHARACTERISTICS of THE AEROBIC PLANT (*Alkanna tinctoria* (L.) Tausch)

Aviator (*A. tinctoria* (L.) Tausch) plant is in the Tubiflorae order, Boraginaceae (Hodangiller) family, Alkanna genus. Plants of this genus have a hairy and hairy structure. The leaves are straight-edged, not divided into segments, straight-edged, mostly rectilinear, less often arranged in opposite directions. It is a perennial plant, herbaceous in character and grows up to 10-30 cm. Blue flowers of the genus Alkanna bloom in April and July (Anonymous, 1991, Eyüboğlu et al., 1983, Seçmen et al., 1989). There are 4 subfamilies of the borage family, around 100 genera, and about 2000 species. Species of this plant have been found in Sivas (Kangal), Kayseri, Eskişehir and Ankara in Central Anatolia (Anonymous, 1991).

The 2 most important compounds found in the root of the plant are alkannin and shikonin. Shikonin *Lithospermum erythrorhizon* is a red naphthoquinone pigment produced from plant cells. Alkannin is the first pigment substance isolated from the root of the aerial plant and accepted as the main component of dark red pigments. In 1935, extracts from shikonin and alkannin were found to be enantiomers of each other. For the last 25 years, alkannin and shikonin and their derivatives have been known to have antitumor activity that prevents tumor formation in some skin cancers in cancer treatment. The aerobic plant is used in the pharmaceutical industry, cosmetics, and dyeing liquors. In addition, the extract prepared with aerobics, fennel,

cinnamon, rosemary, cumin, black pepper and olive oil is used in rheumatic diseases (Tabata et al., 1999).

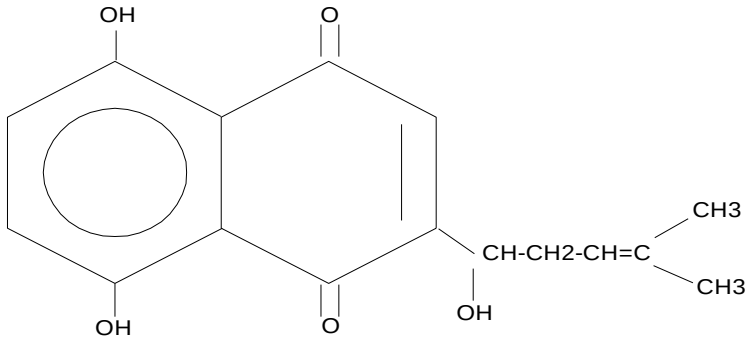


Figure 1: Clear formula of alkannin substance (Anonymous, 1991)

From a chemical point of view, there is 5-6% alkanine (Anchusine) dye in the aerial roots. The clear formula of alkanine is given in figure 1. It is mostly found in the flowers and roots of the aerialist. It is also found in some oils and resins, as well as Alkane (Anchuzin). It is divided into two acids, anchosine acid. Both Alkanna acid, Anchusine $C_{14}H_{14}O_4$ (or $C_{15}H_{12}O_4$) Anchuse acid has been used as a coloring agent for a long time. When these acids are left under sunlight, they lose their shine, darken and darken and become dull. Alkanine, on the other hand, dissolves in ether, vinegar, oils and chloroform, completely disintegrating at 220^{o}C. It is also insoluble in water. It consists of two kinds of substances that give red color to Alkanna acid, which dyes alkalis blue, and Anchuzin acid, which dyes them green. Care must be taken when boiling, as Anchusa acid is quite easy to replace with Alkanna acid (Korur, 1937, Anonymous, 1991).

A. tinctoria (L.) Tausch root was dissolved in different solvents and the solutions were run on TLC plates, and different dyestuff extractions were obtained from the aerial root. Some components (alkannin, shikonin and teracrylalkannin) in dyestuff extractions have been determined (Von et al., 2003; Spyros et al., 2005; Öztav, 2009).

2. MATERIALS AND METHODS

As material, underground shoots of Alkanet (aviator) plant, threads (white and 2.5 Nm) and 10 different mordant substances were used. Havaciva was collected from the rural area of Kangal county, Sivas province, and dried by laying on cloth or paper material in an airy place. These mordants are; We can count as Iron II sulfate, Copper sulfate, Citric acid, Acetic acid, Copper II sulfate, Zinc chloride, Potassium aluminum sulfate, Potassium bi chromate, Sodium hydrosulfite, Tartaric acid.

Dried Alkanet plant roots and dye extracts were prepared, the wool yarns were pre-mordanted with each mordant substance, the fastness measurements (light, friction, wet and dry water drop) of the dyed wools were made.

During the mordanting process, 2% and 4% mordant material was prepared according to the weight of the wool yarns. Mordant water was obtained by mixing the selected mordant into the warm water prepared in a ratio of 1 to 20 in proportion to the amount of wool. The moist wools, which were kept in water for a while and the excess

water was removed, were put into the mordant water and the boiling process was started. At the end of the one hour boiling period, it was left to cool in the same boiler, and after cooling, it was slightly squeezed and dried.

While preparing hot extract; Underground shoots of the plant (*A. tinctoria* (L.) Tausch) are cut into small pieces or ground into powder. It is prepared with wool yarn and dry plant rate of 100%. In cases where the plant is not dried, 500% of the plant is taken according to the wool in order to contain the same amount of dyestuff. Plants are boiled for 1 hour in water 20 times the amount of wool. The hot extract, which is separated from the plant residues by filtering after cooling, is ready for dyeing.

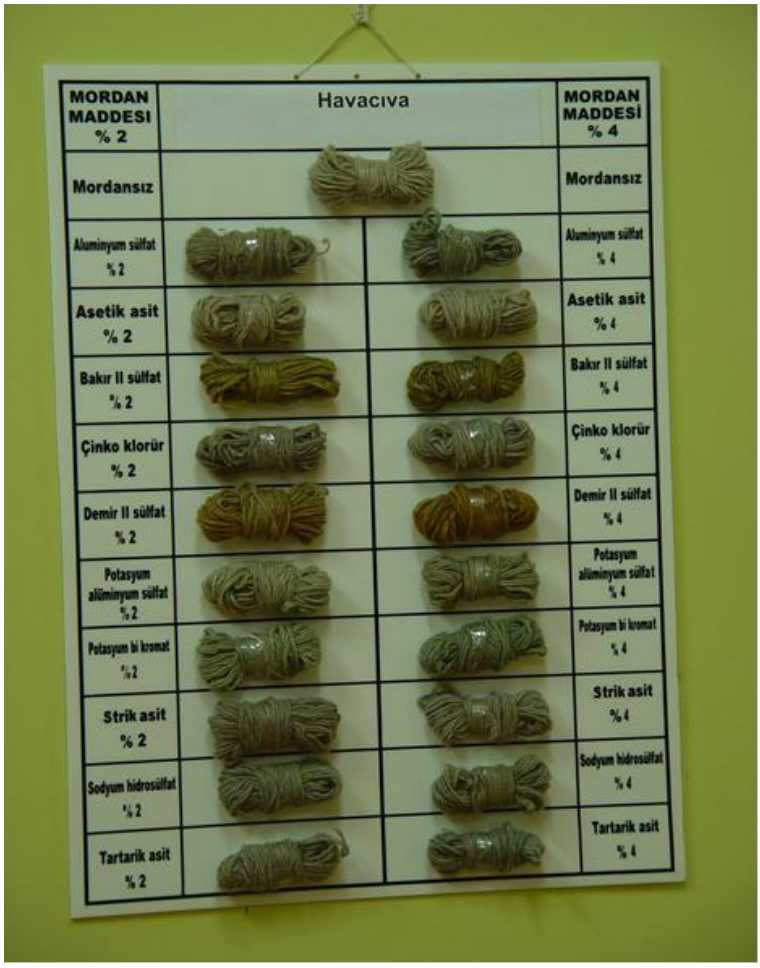
Painting process; The white wools to be dyed are skeined and soaked in warm water for at least one hour before dyeing. A dyed extract of 20 times the wool is prepared. The soaked wools are squeezed lightly and the excess water is removed, and the dyed extract is placed in it and boiled for 1 hour. After it comes to the boiling point, normal water is added instead of the water that is lost by evaporation. When the boiling process is finished, the wool is kept in the dye boiler until it cools. It is rinsed with plenty of cold water and hung in an airy place to dry. Completely dried wools are ready for fastness tests.

While measuring the light, friction and water drop fastnesses, it was taken from the sources belonging to the Turkish Standards Institute. Light fastness is made in accordance with TS 867 (Anonymous

1984a) and DIN 5033 (Anonymous 1978a) methods. While determining the friction fastness, according to TS 717 (Anonymous 1978a) and TS 423. While determining the water drop fastness, which is important in textile products, fastness tests were completed based on TS 399 (Anonymus 1978b) and TS 423 (Anonymus 1984b) prepared by TSE, and the results were prepared in a table and discussed comparatively.

3. RESULTS

Different color tones were obtained from 21 dyed wools in dyeing made with hot extract method by using 1 dyeing and 10 mordant substances in different ratios, with 100% ratio of air-dye according to wool and 10 mordant substances. Looking at Photograph 1, colors called cream, coffee bean, beige, light potato skin, baked apple (dark), shades of green, dark coffee foam, green, henna green are seen.



Photograph 1: The distribution of colors obtained from plant roots (*Alkanna tinctoria* (L.) Tausch*)* (Kaynar, 2011)

In this study, the colors obtained from dyeing with (*A.tinctoria* (L.) Tausch) plant roots were compared with the results obtained from previous studies. Harmancıoğlu (1955), experimented with different mordants (potassium aluminum sulfate, calcium oxide, sodium carbonate, sulfur tin chloride) by using the roots of the aerialist plant,

and reported that he obtained eggplant color, dirty violet, red and blackish colors.

In Anonymous (1991), it is stated that brown is obtained in dyeing with Alkanet plant without using mordant. Sönmez (1992), on the other hand, used potassium aluminum sulphate (alum), copper, iron, chromium as mordant and reported that colors such as tan, blue-green, mustard green, red and purple were obtained.

As a result of the comparison; It was observed that there are similarities between the colors obtained in this study and the colors obtained by Anonymous (1991), Harmancıoğlu (1955) and Sönmez (1992). Different colors were found with different mordants. In this study, the light, friction and wet-dry fastness levels obtained as a result of dyeing with (*A. tinctoria* (L.) Tausch) plant roots are given in Table 1.

In Table 1, it was seen that the light fastness value varied between 3 and 5 as a result of dyeing with the roots of the Alkanet (Havaciva) plant. In the dyeing experiment performed without using mordant, the light fastness was obtained at the value of 4. It is seen that the light fastness value also changes when the mordants and their ratios change.

Table 1: Fastness Values Obtained From (*Alkanna tinctoria* (L.) Tausch) Plant Fastness Grades

SN	Used Mordant Substances and their proportions	light	friction	wet water drop	dry water drop
1	Asetic asid% 2	4	4	4	4/5
2	Asetic asid % 4	4	4	3/4	4
3	Copper II sulfate % 2	5	4	4/5	5
4	Copper II sulfate % 4	5	5	4/5	5
5	Zinc chloride % 2	4	4	4	4/5
6	Zinc chloride % 4	4	4	4	4/5
7	Ferrous II sulfate % 2	5	5	1/2	4
8	Ferrous II sulfate % 4	5	5	1	4/5
9	Potassium aluminum sulfate % 2	3	3	4/5	5
10	Potassium aluminum sulfate % 4	3	3	4	4/5
11	Potassium bichromate % 2	3	3	4/5	5
12	Potassium bichromate % 4	3	3	4/5	5
13	Citric acid % 2	4	4	4	4/5
14	Citric acid % 4	4	4	3/4	4
15	Sodium hydrosulfite 2%	4	4	4	4/5
16	Sodium hydrosulfite 4%	3	3	4	4/5
17	Tartaric acid 2%	3	4	4	4/5
18	Tartaric acid 4%	4	3	4	4/5
19	Copper sulfate 2%	5		4	4/5
20	Copper sulfate 4%	5		4	4/5
21	without mordant	4	4	4	4/5

Özbek (1996) found light fastness rates between 3-4 in his study with the roots of the Alkanet plant. In the experiments conducted by

Harmancıoğlu (1955) using 50% mordant with Alkanet plant roots, values between 1 and 2 were found in light fastness measurements. Light fastness values of 3 to 5 were determined in this study. The results of this study show similarities with Özbek (1996).

Friction fastness values of dyed wool obtained with different mordant substances of the aerobic plant; It is seen between 3 and 5, and the friction fastness values of dyeing without mordant are seen as 4.

Özbek (1996) found the fastness values (wet and dry water drops) of the colors formed as a result of dyeing experiments with Alkanet plant using different mordants between 4-5. The fastness values obtained in this study (wet and dry water drop) were found to be between 4-5. It is compatible with Özbek (1996). In addition, Akan et al., (2021), in his natural dyeing study with a plant belonging to the Boraginaceae family (*Alkanna strigose* Boiss. and Hohen.) belonging to the genus Alkanet, brown, light brown, dark brown, green, light green, milky brown and light earthy colors has achieved found the light fastness to be 4 and the friction fastness to be between 2-3. When compared, it provides a great similarity in terms of the colors obtained. Light fastness value is compatible. On the other hand, close values were found for rubbing fastness.

CONCLUSIONS

Today, chemical dyes in textile products are replaced by natural or nature-friendly dyes that give importance to human health. By choosing the herbal dyes included in the natural dyes, it is ensured that

the plants included in the natural plant flora are evaluated, the residues of vegetables, fruits and other plants used in the industry are evaluated and added to the production again, these plants are cultivated, and new employment is created with the labor force required during all these processes.

In this study, natural herbal dyeing studies were carried out with the Alkanet plant, which is located in the natural vegetation of our country and is used in many areas other than dyeing. Wool yarns were chosen as dyeing material. Dried plant roots were taken with the amount of wool at a ratio of 100% to 1:1 and boiled for 1 hour with different mordants at 2% and 4% ratios. Fastness measurements (wet/dry water drop fastness, light and rubbing fastness) were applied to the colored wool yarns obtained from these dyeings in accordance with the standards. A color chart was created with the colors obtained in order to inform the people and institutions that will dye in the field of textile. From the roots of the Alkanet plant; Colors such as beige, light and dark green, cream, coffee foam tones, dark baked apples, potato skins, and coffee beans were obtained. It can be said that it would be appropriate to use yarns dyed with the air civa plant in the field of textiles and especially in hand-woven carpets and rugs.

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