CHAPTER 18

EVALUATION OF CAROB (*Ceratonia siliqua* L.) FROM MEDICINAL AROMATIC PLANTS AS A DYEING IN TEXTILE FIBERS

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INTRODUCTION

The words organic, ecological and green, which have gained importance recently, have taken their place in the textile sector, and organic/ecological textile and green textile studies have accelerated in parallel with the development of the health sector. Ecology, known as environmentalist studies since the beginning of the 1990s, has closely interested the textile industry and aimed to produce the most suitable products for human health and the least harmful to the environment in all kinds of products and production stages.

Recently, ecological textile (Eko-Teks) constitutes the main lines regarding human health and environmental effects such as chemicals, waste water, workplace conditions, flue gas, noise level, used in the entire process from the acquisition of raw materials to the final product of textile products (Anonymous, 2022). In this context, new dyeing experiments are carried out with the thought that medicinal aromatic plants, which have been a source of life for thousands of years, will be useful in dyeing textile fibers due to their known effects.

Recently, medicinal aromatic plants have been used as dyestuffs in many fields such as food coloring, medicine, cosmetics, after the most basic need of nutrition. These plants are plants that grow on their own in nature, but according to the place and purpose of use, they have been cultured and produced over time. An important part of the medicinal and aromatic plants used for the treatment of diseases are collected from nature. The most striking and researched properties of

medicinal and aromatic plants are their therapeutic properties. Herbal treatment; It has been used in many countries of the world in the form of traditional, complementary and natural treatment and still continues to be used.

The first records of the use of plants for therapeutic purposes date back to BC in Mesopotamia civilization. It has been determined that it belongs to the 5000s and 250 herbal drugs were used (Demirezer, 2010).

Medicinal and aromatic plants are divided into two as those collected from nature and those that are cultivated. Medicinal and aromatic plants collected from nature; There may be parts of plants such as fruits, stems, leaves, flowers that grow spontaneously in places such as forests, pastures, and unused agricultural lands, and sometimes weeds that grow in agricultural lands (FAO, 2020).

In this study, carob plant, which is not included in the known herbal natural dyes group, was selected from medicinal aromatic plants in order to provide layers to the organic/eco textile field. It is known that carob fruit is good for many diseases, carob extract is used as a therapeutic drug and is traded. In addition, dyeing studies with carob plant were not found. By using the fruits of the carob tree and different mordant substances as binders, dyeing experiments were carried out with woolen threads, which have a very important place in the textile industry. Fastness measurements were made on the dyed

wool obtained as a result of the study, and as a result, the use of this plant in the field of textiles was interpreted.

1. CAROB (*Ceratonia siliqua* L.) PLANT

Carob (*Ceratonia siliqua* L.) is an evergreen belonging to the legume family, mainly grown in Mediterranean countries (Zhu et al., 2019; Donmez et al., 2022; Ouahioune et al., 2022). Carob is a maquis with high heat and light demand, drought-resistant and sensitive to frost. Because of these features, temperature is an important ecological factor that determines the distribution of carob (Günal, 2013). According to Durupınar (2015), the carob plant is a tree species that grows in semi-arid environments. It is botanically called *Ceratonia siliqua* L. Since ancient times, the carob plant has been found in abundance in all Mediterranean countries. It is also produced in most Mediterranean countries such as Spain, Cyprus and Italy. Carob production takes place in some North-South African and Asian countries such as Morocco, Greece, Algeria, Turkey, Israel, India and Pakistan. Carob is a long-lived and evergreen tree. After sprouting, they can reach 10 meters in length in 10-15 years, and they start to produce a good amount of fruit from the age of 15. A large tree can produce approximately 500 kg of fruit per year. Carob fruit is dark brown, sickle-shaped, 10-20 cm long and 2-4 cm wide (Rowe et al. 2006). Carob fruit is shown in Picture 1. 315,000 tons of carob seeds are produced annually from approximately 200,000 hectares of land in the world. 38% of this production is done in Morocco, 28% in Spain,

8% in Italy, 8% in Portugal, 6% in Greece, 6% in Turkey and 2% in Cyprus (Batal et al., 2013; Durupınar, 2015).

2. MATERIALS AND METHODS

Ripe fruits of the carob plant were used as material (Photograph 1). Carob fruit was collected from Mersin province, Silifke district, the fruits were dried in a suitable environment and divided into small pieces. As dyeing material, white and 2.5 Nm wool carpet yarn and 10 different (Iron II sulfate, Copper sulfate, Citric acid, Acetic acid, Copper II sulfate, Zinc chloride, Potassium aluminum sulfate, Potassium bi chromate, Sodium hydrosulfite, Tartaric acid,) mordant materials were used.

Photograph 1: Distribution of Colors Obtained From Carob (Kaynar, 2011)

Hot extract preparation, mordanting (pre-mordanting), dyeing of mordanted threads, naming of dyed threads, measurement of light, friction and water drop fastness were made. Mordanting process: Based on the amount of carpet yarns (2.5 Nm. wool) to be used in the trials. 2% and 4% mordant material was taken from the yarn amount and dissolved in warm water. It is important to dissolve the mordant in water to prevent abrasion on dyed wool. The prepared mordant material is mixed in water up to 20 times the weight of the wool yarn to be dyed, the pre-moistened wool is boiled with mordant water for one hour. Hot extract preparation process; Carob plant is prepared at a ratio of 1/1 with wool yarn. 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. The wool thread is placed in the dyed extract prepared at a ratio of 1/20 and boiled for 1 hour after it reaches the boiling point. When the boiling process is finished, the wool is kept in the dye boiler until it cools. After rinsing with plenty of cold water, the drying process is started.

While measuring the light, friction and water drop fastnesses, prepared by 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, the fastness tests were completed based on TS 717 (Anonymous, 1978a) and TS 423 (While determining the water drop

fastness which is important in textile products, TS 399 (Anonymous, 1978b) and TS 423 (Anonymous, 1984b) which was also prepared by TSE) The results were prepared in tabular form and interpreted.

3. RESULTS AND DISCUSSION

In the dyeings made with the dye extract prepared from the carob plant, a total of 21 dyeings were made. Photograph 2 shows the colors obtained as a result of dyeing. These colors are; Light and dark coffee bean with acetic acid, light and dark aqua green with Iron II Sulphate, buff 1 with Potassium Aluminum Sulphate, buff 2, Coffee with milk 1 with Tartaric Acid, coffee with milk 2, light coffee bean, olive green with Oxalic Acid 1, olive green 2, brown coffee foam colors were obtained by dyeing without mordant.

Mordant	Painting Example	Obtained Colors
Acetic acid 2%		Light coffee bean
Acetic acid 4%		Dark Coffee bean
Copper II sulfate 2%		Aqua green 1
Copper II sulfate 4%		Dark aqua green
Ferrous sulfate 2%		Brown color 1
Ferrous sulfate 4%		Brown color 2
Potassium aluminum sulfate 2%		Baked apple 1
Potassium aluminum sulfate 4%		Baked apple 2
Potassium bichromate 2%		Camel hair 2
Potassium bichromate 4%		Camel hair 2
Sodium Sulphate 2%		Beige 1
Sodium Sulphate 4%		Beige 2
Tartaric acid 2%		Coffee with milk 1
Tartaric acid 4%		Coffee with milk 2
Oxalic acid 2%		Olive oil green 1
Oxalic acid 4%		Olive oil green 2
without mordant		Coffee foam

Photograph 2: The Distribution of Colors Obtained From Carob (Kaynar, 2011)

Light and friction fastness values obtained from dyeing with carob plant fruit are given in Table 1.

Table 1: Fastness Values Obtained From Carob Plant (*Ceratonia siliqua* L.)

No	Used Mordant Substances And Their Proportions	Light	Friction
1	Asetic asid% 2	5	3
2	Asetic asid % 4	5	3-4
3	Copper II sulfate % 2	6	2
4	Copper II sulfate % 4	6	2
5	Zinc chloride % 2	4	3
6	Zinc chloride % 4	4	2
7	Ferrous II sulfate % 2	6	2
8	Ferrous II sulfate % 4	6	1-2
9	Potassium aluminum sulfate % 2	6	3
10	Potassium aluminum sulfate % 4	6	3
11	Potassium bichromate % 2	4	4-5
12	Potassium bichromate % 4	5	3
13	Citric acid % 2	4	2-3
14	Citric acid % 4	5	3
15	Sodium hydrosulfite 2%	4	3
16	Sodium hydrosulfite 4%	5	3
17	Tartaric acid 2%	5	3
18	Tartaric acid 4%	5	3
21	without mordant	5	2-3
	Minimum	4	1.5
	Maximum	6	3.5
	Ortalama	5	2.6
	Standart sapma	0.7	0.5

In Table 1, it was seen that the light fastness value changed between a minimum of 5 and a maximum of 6 as a result of dyeing with the carob plant. In the dyeing experiment without using mordant, the light fastness value of 5 was obtained. Values of 5 and above are considered “good” when evaluating light fastness measurements. When the friction fastness values are examined, it is seen that there are values between a minimum of 1-2 and a maximum of 3-4. The colors obtained from this plant can be used in the field of textiles.

CONLUSIONS

Green production and green marketing have become one of the issues that the producers that contribute to the country's economy attach importance to. In particular, measures are taken to produce, develop and promote products that are recyclable and compatible with the environment. In this context, the preferred environmentally friendly dyes have started to take their place in every field of the textile industry. Many plants in the natural flora in our country are included in medicinal aromatic plants, increasing their preference rates in different areas of use. As people's awareness of choosing natural products for the environment and healthy life increases, the interest in these products increases. As a result, both preferred products emerge and new labor needs arise in many areas such as the supply, processing and re-cultivation of plants used in dyeing, contributing to the country's economy and the creation of new employment areas.

In this study, natural herbal dyeing studies were carried out with the Carob (*C. siliqua* L.) plant, which is located in the natural vegetation of our country and is used in many areas other than dyeing. Among the textile fibers, woolen yarns, which give the best results with vegetable dyeing, were chosen as the dyeing material. Dried plant roots were taken with the amount of wool in a ratio of 100% in a 1-to-1 ratio, boiled with different mordants at 2% and 4% for 1 hour, and fastness measurements (light and friction fastness) were applied to the obtained colored wool yarns. 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. In dyeing made with dye extract prepared from carob plant; Colors of coffee coffee foam were obtained with light and dark coffee beans, dark aqua green, Potassium, Buff 1, Buff 2, milk coffee 1, milk coffee 2, Light coffee bean, olive green 1, olive green 2, and coffee. In this study, it was concluded that the “colors of nature” preferred in products called nature-friendly green textiles were obtained, and carob fruit could be preferred in herbal dyeing.

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