

Coloring Natural Silk with Natural Dyes Obtained from Plants

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ABSTRACT

The production of natural dyes from various parts of some plants and the dyeing of natural silk with natural dyes in different colors was investigated by experimental methods.

Keywords: Natural silk, silkworm, natural dye, *Júglans régia* L., *Crocus sativus*, *Punica granatum* L., *Isatis tinctoria* L., *Indigofera tinctoria* L., *Allium cepa* L., fabric dyeing.

Natural silk is a product produced by silkworm butterflies. Silkworms are butterflies that go through four stages during their life: eggs, worms, moths, and butterflies. Most of the species of these animals produce silk during the transition from the second stage to the third, in which a silk thread of a dense ovoid structure, called a cocoon, is wrapped around it, which protects it from various external environments and from the attack of enemies. Silkworm caterpillars feed on plants of the Moraceae family, especially the *Morus* genus. About 90% of natural silk is produced by the silkworm (*Bombyx mori* LINNAEUS, 1758), which belongs to the *Bombyx* genus of the *Bombycidae* family [1,2]. Silk is a soft and durable fabric with a pleasant glossy sheen. Natural silk is an easily dyed, valuable raw material, which is characterized by high mechanical and physical properties, as well as an exquisite appearance. A huge amount of labor is expended in the production and primary processing of silk. Therefore, this product of the textile industry, unlike others, is expensive and has limited application [3-5]. Textiles, carpet weaving, embroidery and floral printing on fabrics are some examples of folk arts and crafts, and dyeing is the main process in their production. Dyeing fabrics is a complex process that includes dyeing fabrics, preparing silk for dyeing and bringing the raw materials to a state of readiness for dyeing. The craftsman's creative approach to paints, a good and thorough knowledge of the methods of dyeing raw materials and the tools used for dyeing, allows creating a new range of fabrics and increasing their demand. Failure to choose the correct colors or ignorance of the compositional aspects of color can lead to distortion of patterns and colors on the fabric and the fabric itself [6-10]. The aim of this work is to obtain natural dyes from plants and to dye natural silk with them.

Materials and research methods.

Obtaining natural dyes. Dye obtained from *Júglans régia* shell (brown). Weighed 200 g of walnut shells, poured 8 liters of water and boiled. After boiling, they fermented for a week and stood for three days. Upon completion of the settling process, the dye was filtered off. A dye obtained from the flowers of the *Crocus sativus* plant (yellow). Weighed 30 g of saffron

flowers, added 4 l of water and boiled. After boiling, they fermented for a week and stood for three days. Upon completion of the settling process, the dye was filtered off.

Dye obtained from the shell of the bulb *Allium cepa* L. (red). Weighed 500 g of onion shells, poured 10 liters of water into it and boiled. After boiling, they fermented for a week and stood for three days. Upon completion of the settling process, the dye was filtered off.

Dye obtained from the peel *Punica granatum* L. (red). Weighed 462 g of pomegranate peel, poured 6 liters of water and boiled. After boiling, they fermented for a week and stood for three days. Upon completion of the settling process, the dye was filtered off.

Indigo was obtained from the plant *Indigofera tinctoria* L. (blue). Weighed 4 g of leaves of *Indigofera tinctoria* L., poured 3 l of water and boiled. After boiling, they fermented for a week and stood for three days. Upon completion of the settling process, the dye was filtered off.

Dye obtained from the plant *Isatis tinctoria* L. (green color). Weighed 5 g of the leaves of the plant, the dye was extracted by hand squeezing the leaves. Upon completion of the settling process, the dye was filtered off.

A vinegar solution is prepared by adding 100 g of 96% acetic acid per 100 liters of water. Silk cloth is soaked in vinegar solution. The impregnated fabrics are air dried.

The process of dyeing fabrics with prepared dyes. Brown color. The paint obtained from the walnut peel was poured into a 500 ml flat-bottomed flask, then boiled, 1 g of alum was added to the boiling paint and mixed. Silk cloth is added to the boiling mixture and the cloth is rinsed. Then the dyed fabric is dried in a hanger for 30 minutes. After that, the cloth is removed from the hanger and shaken in a vinegar solution. After shaking, the silk cloth is washed in running water and allowed to dry.

Yellow. The dye obtained from the flowers of the saffron tree was poured into a 500 ml flat-bottomed flask, then boiled, 1 g of alum was added to the boiling dye and mixed. Silk cloth is added to the boiling mixture and the cloth is rinsed. Then the dyed fabric is dried in a hanger for 30 minutes. After that, the cloth is removed from the hanger and shaken in a vinegar solution. After shaking, the silk cloth is washed in running water and allowed to dry.

Red color. The paint obtained from the onion peel was poured into a 500 ml flat-bottomed flask, then boiled, 1 g of alum was added to the boiling paint and mixed. Silk cloth is added to the boiling mixture and the cloth is rinsed. Then the dyed fabric is dried in a hanger for 30 minutes. After that, the cloth is removed from the hanger and shaken in a vinegar solution. After shaking, the silk cloth is washed in running water and allowed to dry.

Blue color. The paint obtained from the leaves of the plant *Indigofera tinctoria* was poured into a 500 ml flat-bottomed flask, then boiled, 1 g of alum was added to the boiling paint and mixed. Silk cloth is added to the boiling mixture and the cloth is rinsed. Then the dyed fabric is dried in a hanger for 30 minutes. After that, the cloth is removed from the hanger and shaken in a vinegar solution. After shaking, the silk cloth is washed in running water and allowed to dry.

Green colour. The paint obtained from the leaves of *Isatis tinctoria* L. was poured into a 500 ml flat-bottomed flask, then boiled, 1 g of alum was added to the boiling paint and mixed. Silk cloth is added to the boiling mixture and the cloth is rinsed. Then the dyed fabric is dried in a hanger for 30 minutes. After that, the cloth is removed from the hanger and shaken in a vinegar solution. After shaking, the silk cloth is washed in running water and allowed to dry.

Results and discussion. For any fabric, especially natural fabric, the best dyeing method is to use natural materials such as plants. Alum was used to fix the resulting shade. In this case, alum is also used for coloring in light colors. In fig. 1 shows the results of dyeing natural silk with natural dyes. In fig. 1a silk dyed in the color of warm taupe with a dye obtained from the peel of the fruit of *Júglans régia*. In fig. 1b shows a sample of silk dyed in a light yellow color with a dye obtained from *Crocus sativus* flowers. Ocher dyed silk was obtained by dyeing from *Allium cepa* L. rind (Fig. 1c). Silk dyed with a dye obtained from the peel of the fruit of *Punica granatum* L. gives a pale yellow color (Fig. 1d). The dye obtained from the plant *Indigofera tinctoria* dyes silk a dark gray-violet color (Fig. 1e). Also, when staining with a dye obtained from the plant *Indigofera tinctoria* L., samples of silk were obtained, dyed in yellow-orange and night blue colors (Fig. 1f and Fig. 1g). By dyeing by mixing dyes obtained from *Crocus sativus* and *Indigofera tinctoria* L., a sample of blue-green colored silk was obtained (Fig. 1h). By dyeing by mixing dyes obtained from *Indigofera tinctoria* L. and the peel of the fruit of *Punica granatum* L., a silk sample was obtained, dyed red-orange (Fig. 1j). The dye obtained from the plant *Isatis tinctoria* L. dyes silk an olive green color (Fig. 1i). In conclusion, the following should be noted. A natural dye is a dyed organic compound that has the ability to pass from solution to fibers and bind tightly to them. For dyeing, an aqueous organic solvent, a mixture of water and an organic solvent, an aqueous dispersion and its evaporated state of the dye are used. In addition to the dye, the dye solution also contains various auxiliary chemical compounds. Dyeing textile materials gives them a durable and even color. Dyeing is a very complex process in which the dye passes from the solution into the fiber and binds to its active centers. The color fastness is determined depending on the type of bond formed between the fiber and the dye.



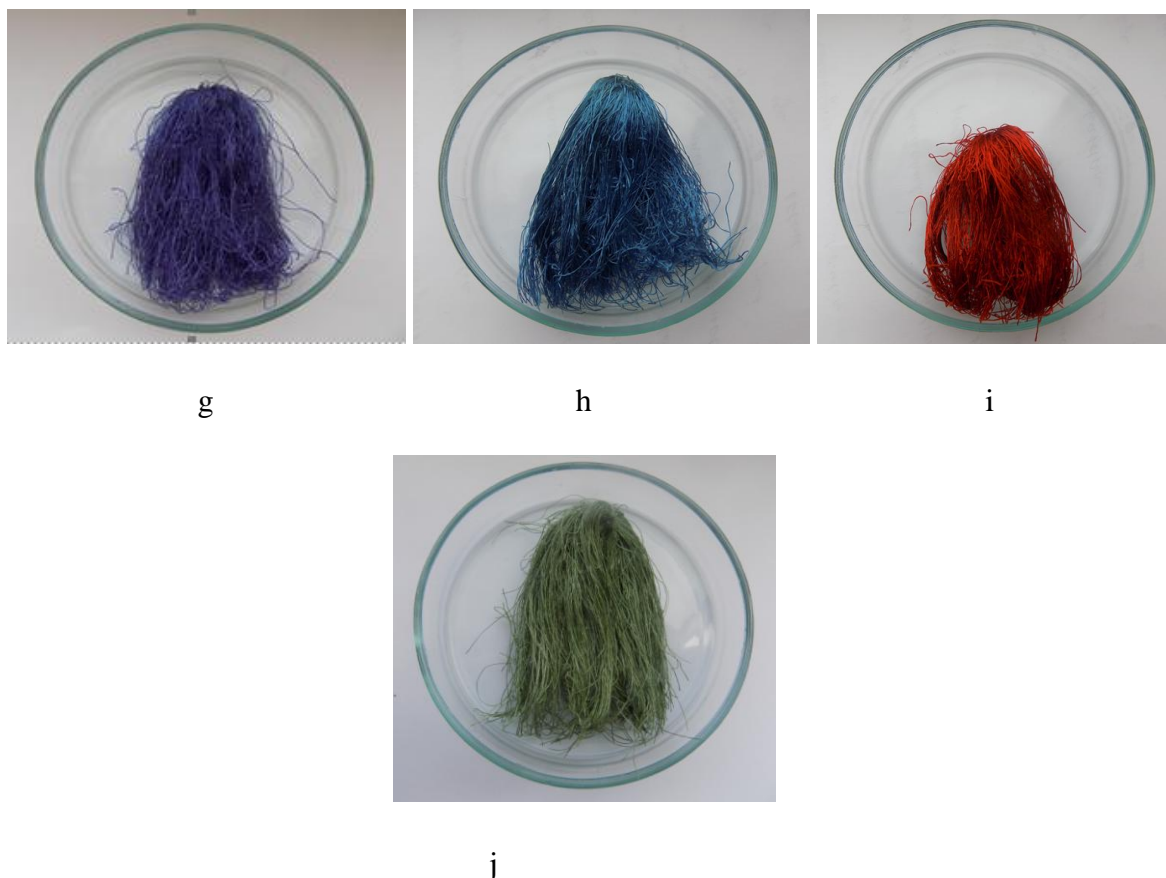


Fig 1. Samples of natural silk dyed with different natural dyes.

Conclusions: According to the results obtained, natural dyes in a range of colors from green to brown were obtained from plants *Júglans régia*, *Sophóra japonica* L., *Allium cepa* L., *Punica granatum* L., *Indigofera tinctoria* L. and *Isatis tinctoria* L. Samples of natural silk were colored with the obtained natural dyes. Bright, stable tones with a natural shine were obtained. Alum was used to fix and obtain light colors. Given the shortage of natural dyes, these dyes can be recommended for dyeing fabrics made of natural silk.

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