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Reviewing the History of Textile Dyeing in Iran and Introducing the Novel Method by using Nano Technology

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Abstract

This article examines the color position and dyeing of textiles in Iran during different time period. In this research, observing the past dyeing methods and awareness to today's chemical and industrial dyeing, an attempt has been made to produce color shades using nanomaterials. In this research, copper/silver nanoparticles were purchased from Sigma Aldrich Company and using chemical methods two orange-red and brown colored shades was created on cotton fabric. The results showed the success of colors created. Considering the nature of the materials used, it can be stated that these colors do not have any side effects on the environment.

Keywords: Textile; Nano Material; Traditional Dyeing

1. Introduction

Color is an integral element of nature. Most of the living and non-living material in the universe has more or less benefited from color, many objects and phenomena are expressed in colorful forms: from diverse colors of rock, water, soil, colorful flowers and plants, glittering wings and feathers of birds, and rainbow. In other words, color recognition itself is another story. Light-sensitive receptors that work in a complex network of brain and nerve for sight, these receptors in nature according to light resolution and recognition different colors among the living creatures is incomplete. But, by the complex brain system the weak vision is compensated and detects the color spectrum range. Human uses color in various celebrations and ceremonies and gradually learn various ways to obtain color from nature (Jahanshahi Afshar, 2001).

Color covers a wide range of topics from color physics, psychology, tradition and culture. In Dehkhoda dictionary “Color” is the effect of light on the appearance of objects, which is called

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"hue". Color emerges with the effect of absorption and part of light reflection. In scientific definitions, the wavelength obtain from light radiation is absorbed by objects and after reflection is seen in the invisible color area, that is observed by the eye and analyzed by nerve cells in the brain to understand the type of color by human (Shahparvari et al, 2017).

In Islamic aesthetics color has a special place and studied from a metaphysical point of view. Colors are the distinguishing features of Islamic art that, in addition to its decorative appearance, have a nature and truth which results from the reproduction of light (Shahparvari et al, 2017). Ages ago dyeing has been buried in the dark depths of human life without any definite date for it. But it is certain that over time and development of human societies, simple color methods for dyeing has been converted to more complex techniques. In addition to the use of various minerals material and different parts of plants (stems, roots, leaves, flowers, bark, seeds), humans were able to obtain various colors from insects and plant pests (Jahanshahi Afshar, 2001).

The remains of painting during the ancient period especially cave paintings that have been painted in various forms, depict the long history of human familiarity with dyeing. According to some scholars, ancient Asian civilizations such as China, Iran and India about 2000 years B.C. were completely acquainted with the materials used to dye wool and silk fibers and used it in the best possible way (Jahanshahi Afshar, 2001).

1.1. Color and Dyeing in Iran

Color is one of the main elements in the valuable Iranian artworks. Meantime, the coloring system of Iranian work of art, has always been influenced by factors such as traditional criteria and contracts, social beliefs and religion, mysticism, culture, etc., that have been transferred from generation to generation through one artist to another. The element of color can be studied in one of the most practical handicrafts of Iran, namely cloth weaving in Islamic era: obviously, this handicraft has been influenced by the above-mentioned factors in different Islamic periods, and we evidence the creativity of many Iranian artists in this field. The valuable period in the art of cloth weaving with the presence of the most beautiful element of color can be clearly seen during the Seljuk to Safavid era (Rezaei Azar, 2018).

The common belief of all researchers in the decorative and visual arts of the East is that the Iranians masters have used colors in the artworks of the eighth century to the late Safavid, especially in cloth and miniature carpets (Suresrafi, 1999). The dyeing with natural material has kept its important reflection in the art and carpet weaving industry (Rahimpour, 2019).

In fact, there is no doubt that the colors used in the old Iranian carpets were natural and plant colors, the prominent types as the carpets of the Safavid period are embellishing preservers in the world museums. Till date most of the colors of these carpets has remained attractive and pleasant, and even if they have changed over time, it has been due to their desirability and increasing quality (Suresrafi, 1999).

The most important sources of natural dyes are plants, from which the obtained colors are exposed to sunlight, washing and use that over time find a gentle glow on the fibers. Undoubtedly, the radiance of the beautiful carpets that have remained in the museums of the world from the past, especially the Safavid era, has caused the illusion that natural colors are sufficient and desirable for use in carpets, and if there is a color change in the carpet colors, it has been a pleasant color change. The comparison of plant color with industrial colors (sometimes its stability reaches the highest standards of color stability) is not appropriate (Suresrafi, 1999).

1.2. Color in Fabrics during the Seljuk, Mongol, Timurid and Safavid Period

Colors: Use of different plant materials and insects such as: red seeds, Rubia tinctorum (rose madder), Socotra dragon tree, ginger plant and Anacardiaceae for red color; Sumac (Rhus), saffron, turmeric, Safflower, pomegranate peel, Reseda and grape leaves for yellow color; indigo plant, wood color, Jute plant or litmus for blue color. The mixture of yellow and blue give the green color. The green walnut skin is used for brown color, indigo plant in two different types as black alum (lye), iron rust used for black color (Rezaei Azar, 2018).

1.3. Dyeing in Textiles

In Iran, in addition to various colors used, stabilizing materials were also used to keep the fabric color constant, and to have the desired changes in light color shades. The stabilizers are: alum (aluminum sulfate), Alkali alum (potassium alum), Ammonium alum (Copper and iron sulfate), and extract from terebinth leaves, fresh walnut skin, green pistachio skin, and pomegranate peel (Rezaei Azar, 2018).

This method of color dyeing in Iran is the result of Iranian weaver's experiences in the past centuries, which has been an important factor in the quality of Iranian fabrics and carpets with constant colors (Rezaei Azar, 2018).

1.4. Evolution of Fabric Weaving during the Safavid Period

During the Safavid era in the weaving centers of Iran, fabrics were produced such as silk, borcode (knitted fabrics), velvet, satin, block printed, scarf (cashmere, double and multi ply fabrics) and embossed silk. These fabrics were unique in terms of color variety with beautiful designs and patterns (Talebpour, 2018).

Dyers of the Safavid period obtained different tones of color by combining different materials, which was in fact a diagram of the colors found in nature and included the lightest to the darkest colors (Rezaei Azar, 2018).

1.5. Dyeing

Dyeing is a process in which the color material under certain conditions such as temperature and time affects the fibers or knitted products and dyes it. The carpet dyeing is also part of textile industry. Generally, dyes refer to all natural or chemical materials that have the ability to dye fibers or textiles. Differences can be seen in the comparison between traditional and modern methods due to the application of some traditional materials in dyeing with natural colors. The performance nature and results obtained from natural dyes is scientifically justified and is fully consistent with advanced industrial methods (Suresrafi, 1999).

1.6. Color Selection

In dyeing process, there is a principle in choosing the appropriate color and this issue is applicable to natural and industrial dyes. The concept of a suitable dye in its simplest form is depending on the type of fiber being dyed, (for example; acid dye for wool, and naturally the direct dye used for dyeing cotton fibers cannot dye the wool fibers) (Suresrafi, 1999).

1.7. Nanoparticles

The noble metal nanoparticles have been used since ancient times as decorative pigments for glass and ceramic colors. The famous Dichoric Cup with effect (Dichronic), gold and silver nanoparticles are used as color, an example of the old use of nanoparticles for noble metals in works of art. This cup shows the reflected green color in the light which passes through the bright red color in the light that it is due to the presence of gold and silver nanoparticles in the glass matrix. Silver nanoparticles, as one of the oldest decorative pigments, create not only beautiful colors but also antibacterial properties. Inorganic nanoparticles, especially silver nanoparticles, are cheap, stable and effective in comparison to the organic antibacterial materials. Silver ions have antimicrobial and photoactive properties, and textile products treated with old silver nanoparticles are in limited colors. Consumers want textile products with enhanced functions, such as antibacterial, antistatic, dye resistance and light-ray protection (Johnston et al, 2008; Tang et al., 2011; Metraux and Mirkin, 2005).

2. Practical Work Process (Method)

Cotton fabric was provided by Yazd Baf Company. Silver /copper nanomaterials were purchased from Sigma Aldrich Company. Initially, silver nitrate solution was prepared, and then 2 ml of Trisodium citrate was added with 0.1 gram of Polyvinylpyrrolidone and hydrogen peroxide. Half ml of sodium borohydride solution was added and by using a mixer it was stirred for 30 minutes. It was ultrasonic by adding to it 1% copper and silver nanomaterials. Later, a cotton cloth was added and the ultrasonic was repeated. Finally, the sample was washed with distilled water and dried in an oven. The resulting sample has an orange-red color shade (Figure 1). The same experiment was performed with half percent of nanomaterial which resulted in a golden brown color shade (Figure 2).

Fig 1 Dyed fabric sample with 1% nanomaterials

Fig 2 Dyed fabric sample with 0.5% nanomaterials

3. Conclusion

In this article, dyeing methods and art of dyeing in the past of Iran were studied. Based on the materials presented in the past, the textile dyeing was done using many natural dyes, but despite the fact that industrial chemicals were not used for dyeing, the effluent of these dyes was still harmful to the environment. Today, in most countries, chemical dyes are used for textiles dyeing which has adverse effects. In this article, attempt has been made to create different color shades on the fabric by using nanomaterials so that they can be used as an alternative to industrial chemical dyes. Therefore, using silver/copper nanomaterials were able to create two shades of gold-brown and orange-red on cotton fabric.

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