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DYEING OF SILK AND WOOLEN FABRIC WITH DYE OBTAINED FROM INDIGOFERA TINCTORIA PLANT AND DETERMINATION OF COLOR FASTNESS

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Abstract:
In this study, the object of the study were fibers consisting of 100% wool and silk fibers, the degree of whiteness of the wool fiber was 36.6%, the silk fiber was 40.8%. For staining, natural indigo dye was used, obtained by extracting the plant Indigofera tinctoria L., and $Al_2(SO_4)_3$ was used as a mordant. Dyeing of protein fibers was carried out in the following technological sequence: samples of woolen and silk fibers that underwent the process of preparation for finishing were treated in a 3-10% indigo solution containing 2.5 g/l $Al_2(SO_4)_3$ at a temperature of 90-950C for 60 minutes. Then 3% acetic acid was added to the solution and the process was continued at this temperature for 10 minutes. The color characteristics of indigo-dyed protein fibers were determined on a laboratory colorimeter under standard D65 irradiation. To systematize color characteristics, a system of color circles is used and the L.a.b. color model was used. Geographic coordinates - L*, a* and b* Color values such as latitude, longitude and altitude provide information about where the color is located and about it. The L* coordinate indicates the brightness of the color, C* - color saturation, h - chromaticity, a* - the presence of red or green, b* - the presence of yellow and blue. The color qualities of all samples were determined at a wavelength of 360 nm. Experiments have shown that in the process of dyeing natural fibers with natural indigo dye, a certain type of mordant is used to create a lasting color, and by changing the concentration of the dye in the dye solution, blue colors of different colors can be obtained using one dye.

Keywords: wool fiber, silk fiber, protein fiber, color, concentration, dye, indigo.

INTRODUCTION. Currently, protein fibers are widely used in the textile industry, especially in the processing of pure wool fiber or its mixture with other fibers in the production of high-intensity yarns of various linear densities, woolen fabrics, various technical and special fabrics, carpets and rugs and non-woven materials [1]. Wool fiber has long been the main means of making human clothing and is still widely used in the textile industry due to its unsurpassed properties. Wool fibers, with their vapor and air permeability, water absorption and thermal insulation properties, are an unparalleled fibrous raw material for expanding the range of household and technical textile materials. By treating fabrics made of protein fibers with various nanocomposite materials, it is possible to control their change under the influence of temperature and the environment, as well as such properties as absorbency and vapor permeability, and electrification [2].

Modern research has proven that a number of synthetic dyes are harmful to human health, which is associated not only with the harm of the dye in the dyed textile material, but also with the harmful effects of the environment during their production. Protein fibers are obtained from local plants and their waste products, including onion skins [3], crushed roots, leaves, flowers and fruits of the plant, and insects [4]. Dyes are mainly used for dyeing food, leather and textile products made from natural fibers such as silk, wool, cotton [5]. In recent years, there has been a growing interest in the use of natural dyes in the textile industry as a result of the demand for environmentally friendly and biodegradable products. Although natural dyes are considered a safer alternative to synthetic dyes, they have the following disadvantages: low color fastness, difficulty in creating vibrant colors.

In the production of natural dyes, the discharge of plant waste into wastewater is not toxic, which allows it to be used as fertilizer, and this provides a closed chain system in textile chemical technology [6]. Dyeing of protein fabrics is part of ongoing research to study the chemical composition and properties of silk fabrics.

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Dyeing madder (Rubia tinctorum L.) plays a special role in dyeing woolen fibrous materials with natural dyes. The use of madder in the dyeing process was known as early as the 3rd century BC. The root and rhizome of madder are used to obtain a dye. From each hectare of land, an average of 13-14 centners of dry roots can be collected. Research scientists have shown that protein fibers dyed red have strong bactericidal properties, and also acquire beautiful colors [7].

MATERIALS AND METHODS. In experiments, 100% wool and silk fibers were used as the object of study. As a natural dye, a blue dye was used, isolated from the plant Indigofera tinctoria L. growing in the Fergana region. Aluminum sulfate ($Al_2(SO_4)_3$) was used as a binder. Dyeing of protein fibers was carried out in the following technological sequence: samples of woolen and silk fibers that underwent the process of preparation for finishing were treated in a 3-10% indigo solution containing 2.5 g/l $Al_2(SO_4)_3$ at a temperature of 90-950C for 60 minutes [8]. Then 3% acetic acid was added to the solution and the process was continued at this temperature for 10 minutes. After the staining process, the samples are pressed (compression ratio -100%) and washed. The first washing process was carried out for 10 minutes in a solution containing 2 g/l CAM at a temperature of 400C, subsequent washing processes were carried out in warm and cold water for 10 minutes each. The color quality of the samples was determined on the X-Rite Ci7800 device in the scientific laboratory "Kor-Uz Textile Technopark".

THE DISCUSSION OF THE RESULTS. Natural dyes are widely distributed in nature and are very diverse. Often natural dyes in different natural sources have the same or different structure. Therefore, it is advisable to classify them according to their chemical composition. Indigo belongs to the class of heterocycles and is the oldest natural dye. Indigofera tinctoria L. is a tropical plant from whose leaves the famous indigo blue dye, the "king" of dyers, is obtained. Indigofera tinctoria L. belongs to the legume family and is an annual semi-shrub plant 1-1.5 m high [9].

Dyeing of textile materials from protein fibers with natural dyes makes it possible to produce products from eco-textiles. The introduction of environmentally friendly, natural, competitive dyes of plant origin in the process of chemical processing of natural fibers and the creation of environmentally friendly technologies on the basis of this is one of the most important tasks.

In this study, the possibility of dyeing samples of wool and silk fibers with natural indigo dye (Indigofera tinctoria L.) was studied. In the process of dyeing with natural dyes, the influence of the concentration of aluminum sulfate ($Al_2(SO_4)_3$) on the intensity of coloration formed in wool and silk fibers was studied (Fig. 1).

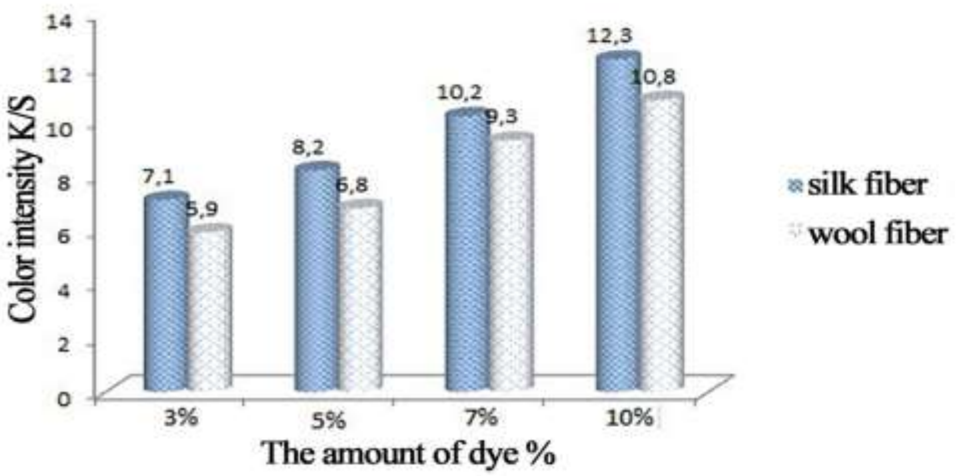

Fig.1. Dependence of the color intensity of protein fibers on the concentration of the dye.

From the analysis of the experimental results, it follows that an increase in the dye concentration affects the color of the fibers. With an increase in the concentration of the dye to 3% -10%, the formation of colors of high intensity is observed.

In order to study the effect of $Al_2(SO_4)_3$ on the quality of dyeing, wool and silk fibers were dyed under

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the same conditions and at the same concentration of mordant and 7% dye solution. The indigo dye is brought to the required volume by adding the required amount of water, and the dyeing process is carried out with the addition of mordant. The color characteristics of indigo-dyed wool and silk fibers were determined on a laboratory colorimeter under standard D65 irradiation. To systematize color characteristics, a system of color circles and the L.a.b. color model are used (Fig. 2).

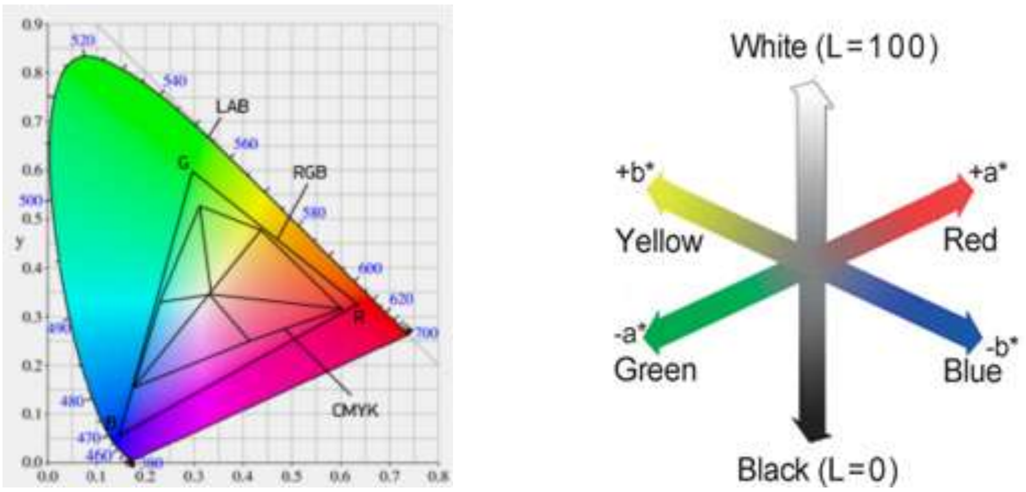
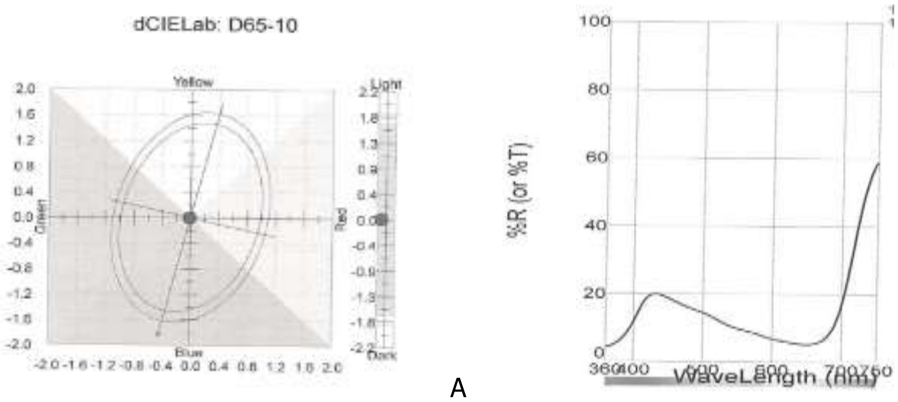


Fig.2. CiE Lab color field model [16].

Geographic coordinates L*, a*i b* Color values such as latitude, longitude, and altitude provide information about the color and its location. The L* oordinate indicates the brightness of the color, C* is the saturation of the color, h is the color, a* is the presence of red or green, b* is the presence of yellow and blue. The color properties of all samples were determined at a wavelength of 360 nm, the results are shown in Figure 3.



A

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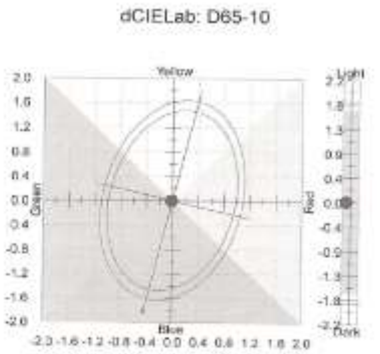

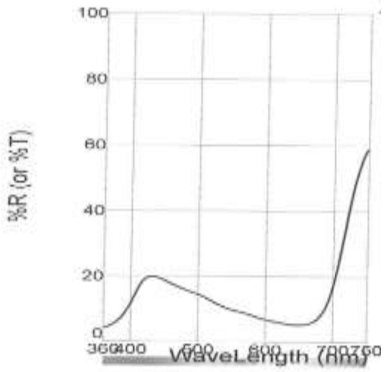

B

Fig.3. Analysis of the color characteristics of wool and silk fibers according to the CiE Lab color field model: A-wool fiber, B-silk fiber

The results show that bright colors are produced when aluminum sulfate is used. We see that the dye concentration shifts the b* coordinate from blue to yellow and the a* coordinate from green to red. Subsequent studies examined the hue and color saturation levels of the fiber. (Table 4).

Tolerances:	DL*tol	DL*tol	DL*tol	DL*tol	DL*tol	DL*tol	Margin	l:c
D65-10 [A -10, F02-10 (CWF)]	1.66	1.02	1.38	1.48	0.94	1.00	0.10	2.00

Standard Name:	L*	a*	b*	c*	h*
100% Jun isk.b.m.ko'k	38.26	-4.61	-19.26	19.80	256.53

Trial Name	DL*	Da*	Db*	DC*	DH*	DE cmc	D/F DEcmc
100% Jun ko'k	0.00	-0.01	- 0.00	0.00	-0.01	0.01	Passed

A)

Tolerances:	DL*tol	DL*tol	DL*tol	DL*tol	DL*tol	DL*tol	Margin	l:c
D65-10 [A -10, F02-10 (CWF)]	1.19	1.48	1.71	1.97	1.23	1.00	0.10	2.00

Standard Name:	L*	a*	b*	c*	h°
100% ipak binafsha	22.97	18.79	-31.57	36.74	300.76

Trial Name	DL*	Da*	Db*	DC*	DH*	DE cmc	P/F DEcmc
100% ipak binafsha	0.01	-0.03G	-0.02 Y	-0.04 D	-0.02	0.02	Passed

B)

Fig.4. Color characteristics of wool and silk fibers:
A) wool fiber B) silk fiber

The Fig/4 data shows that the color saturation of silk fiber is -36.74, and the color saturation of wool fiber is -19.80. This indicates that the color saturation of the silk fiber is 2 times higher than that of the wool fiber. The degree of saturation of the color in these samples indicates the approach of the color to the central axis in the color field L*, a*, b*, i.e., the purity of the color decreases, which is due to the natural color of the wool [10]. The main problem with the use of dyeing processes in the production of natural dyes is that they do not change their properties during storage. Resistance to bacteria during storage of dyes isolated by extraction from Indigofera tinctoria L. plants is one of the indicators of the quality of dye solutions [11]. Changes in solutions of dyes isolated by extraction were observed over time, and the results are presented in the table.

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Table. Influence of dye on storage features.

Shelf life	A dye solution obtained from the plant Indigofera tinctoria L.
Week 1	Without changes
Week 2	Without changes
Week 3	Sediment
Week 4	Sediment, mold has formed on the surface of the solution
Week 5	Sediment, mold has formed on the surface of the solution

From the results of the experiments given in the table, it can be seen that the natural dye can be stored unchanged at room temperature for 14-28 days.

CONCLUSIONS. Experiments have shown that in the process of dyeing natural fibers with natural indigo dye using a certain type of mordant and changing the concentration of the dye in the dye solution, it is possible to create different colors of blue with one dye.

BIBLIOGRAPHY:

1. Мирзахмедова, М.Х., Худайбердиева, Д.Б., Абдукаримова, М.З., Садикова, Г.Қ. Влияние природы активных красителей на качество отделки и окраски шелковых тканей в совмещённом способе // Изв. вузов технология текстильной промышленности. – 2017. -№1.- С.139-142.
2. Mingxing Yang, Khusniddin Ismoilov, Sachin Chauhan,Quan Heng, Zulaykho Islomova / Preparation and Application of Anionic and Cationic Waterborne Polyurethanes and Graphene-Cellulose Nanocrystal as an Antistatic Agent for Cashmere // Scientific Research Publishing «Graphene» New York-2019 Oct. 8.
3. Komatsu K. Studies on dissolution behaviors and structural characteristic ofsilk Sericin. Bull. Sericult. Exp. Sta.1975; 26: pp.135-256.
4. Mondal M., Trivedy K. Nirmal Kumar S. The silk proteins, sericin and fibroin in silkworm, Bombyx mori Linn., - a review. Caspian J. Env. Sci. 2007; 5(2):pp. 63~76.
5. Feng Y., Lin J., Niu L., Wang Y., Cheng Z., Sun X., Li M. High Molecular Weight Silk Fibroin Prepared by Papain Degumming. Polymers. 2020; 12(9):2105. 4. Braaten Ann W. "Wool". In Steele, Valerie (ed.). Encyclopedia of Clothing and Fashion. 2005.Vol.3. ThomsonGale.pp. 441–443. ISBN 0-684-31394-4.
6. Амирова, Т. Ш. (2022, June). Химический состав шелковых и шерстяных тканей. In Conference Zone (pp. 79-80).
7. Амирова, Т. Ш. (2022, June). Химический Состав Шелковых И Шерстяных Тканей. In Conference Zone (Pp. 79-80).
8. Amirova, T. S. H., Ibragimov, A. A., Nazarov, O. M., & Karabayeva, R. B. Physicochemical Analysis, Elemental and Amino Acid Composition of Wool and Silk.
9. Амирова, Т. Ш. (2022, April). ХИМИЧЕСКАЯ ПОДГОТОВКА ТКАНЕЙ ИЗ НАТУРАЛЬНОГО ШЁЛКА. In Conference Zone (Pp. 137-138).
10. .Ибрагимов, А. А., Амирова, Т. Ш., & Иброхимов, А. А. (2021). ХИМИЧЕСКИЙ СОСТАВ МАРГИЛАНСКОГО ШЁЛКА. Deutsche Internationale Zeitschrift Für Zeitgenössische Wissenschaft, (14), 12-15.
11. Ибрагимов, А. А., Амирова, Т. Ш., & Иброхимов, А. А. (2021). Химический состав маргиланского шёлка. Deutsche Internationale Zeitschrift für zeitgenössische Wissenschaft, (14), 12-15.