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DEVELOPMENT OF A TECHNOLOGY FOR OBTAINING NATURAL DYES FROM LOCAL PLANTS AND ESTABLISHING THE PRODUCTION OF ECO-FRIENDLY FUNCTIONAL SILK FABRICS USING THIS TECHNOLOGY

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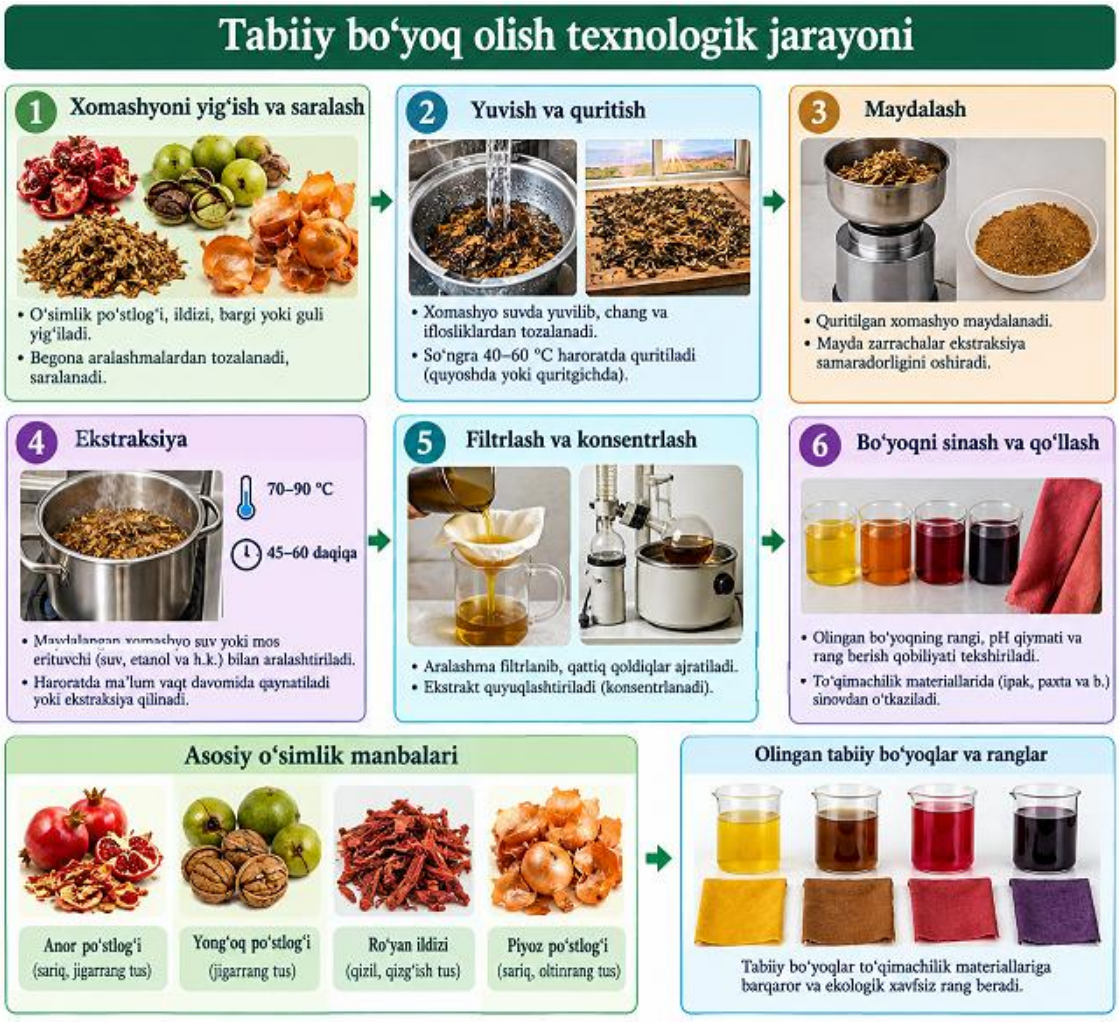
Abstract. This article discusses the development of a technology for extracting natural dyes from locally available plant materials and establishing the production of eco-friendly functional silk fabrics using the resulting extracts. The study considers the potential use of dye-bearing raw materials such as pomegranate peels, walnut shells, onion skins, and madder roots. A technological sequence is proposed that includes raw-material preparation, grinding, aqueous extraction, filtration, standardisation of the dye solution, silk dyeing, and finishing. The possibilities of improving the colour properties of silk fabrics, imparting certain functional properties, and reducing the environmental impact of chemical treatment processes through the use of natural dyes are discussed.

Keywords: natural dyes, mordant, locally sourced plant material, environmental safety, functional textiles, extraction, raw materials.

Introduction. In the textile industry, alongside improving production efficiency, the rational use of water resources, reducing the chemical load, and enhancing product functionality are important scientific and technological challenges. In particular, functionalising fabrics made from natural silk with natural colourants and biologically active components, while preserving their high consumer value, is a promising direction.

Conventional dyeing processes use synthetic dyes, auxiliary reagents, and colour-fixing agents. Their environmental impact is determined not only by the origin of the dye but also by the composition of the reagents used, wastewater characteristics, water and energy consumption, and waste-management practices. Therefore, the use of natural raw materials offers an important opportunity to develop environmentally preferable alternatives.

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The main aim of the research. The aim is to develop an effective technology for obtaining natural dye extracts from locally available plant materials and to substantiate a technological process for producing functional silk fabrics that meet environmental safety requirements using these extracts.

The following tasks are planned to achieve this aim:

1. To select dye-bearing plant materials available locally and study their colouring properties.
2. To substantiate the processes of collecting, sorting, drying, and grinding the raw materials.
3. To determine the effects of temperature, time, and the raw-material-to-solvent ratio on aqueous extraction.
4. To evaluate the pH, colour intensity, and storage stability of the resulting extracts.
5. To dye silk fabrics with natural dyes and, where necessary, select environmentally acceptable mordanting methods.
6. To test the colour fastness of dyed fabrics to washing, rubbing, and light exposure.
7. To assess functional properties, including ultraviolet protection or antimicrobial activity, only through appropriate tests.
8. To determine the water, energy, and raw-material consumption of the proposed technology and evaluate its potential for industrial implementation.

Research object and subject. The research object is the process of extracting natural dyes from local plant materials (pomegranate peels, walnut shells, onion skins, and madder roots), as well as the technological process of dyeing silk fabrics with these dyes and producing eco-friendly functional textile materials.

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The research subject comprises the effects of technological parameters-such as extraction temperature, duration, and the raw-material-to-solvent ratio-on dye yield and colour properties, as well as the factors governing the colour fastness, physical and mechanical properties, and functional characteristics of silk fabrics treated with natural dyes.

Scientific novelty of the research. The study envisages developing an environmentally appropriate technological method for extracting natural dyes from local plant materials, including pomegranate peels, walnut shells, onion skins, and madder roots, and substantiating the main parameters of the extraction process.

- The effects of plant-material type, extraction temperature and duration, and the raw-material-to-solvent ratio on the yield, colour intensity, and stability of the resulting natural dye extracts are planned to be determined.

- The study aims to improve the technological conditions for dyeing silk fabrics with local plant dyes and identify factors affecting interactions between the dye and silk fibres, as well as the colour's resistance to washing, rubbing, and light exposure.

- The potential to maintain or improve the physical, mechanical, and functional properties of silk fabrics treated with natural dyes will be assessed, and technological recommendations will be developed for applying the findings to the production of environmentally safe textile products.







Conclusion. Locally available plant materials are promising sources for obtaining natural dye extracts and can potentially be used to dye textile materials. A technological sequence is proposed that includes raw-material preparation, grinding, aqueous extraction, filtration, and quality control of the

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extract. Natural dyes can impart different shades to silk fabrics; however, the optimal dyeing conditions must be determined experimentally for each type of raw material. To produce eco-friendly functional silk fabrics, it is necessary to assess not only the natural origin of the dye but also the safety of mordants, wastewater, colour fastness, and the fabric's physical and mechanical properties. Functional characteristics such as ultraviolet protection and antimicrobial activity can be confirmed only through appropriate laboratory tests. Industrial implementation requires standardisation of raw-material quality, reduced water and energy consumption, consistent colour reproducibility, and assessment of technical and economic efficiency.

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