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RESEARCH ON METHODS FOR DETERMINING ANTIBACTERIAL PROPERTIES OF TEXTILE INDUSTRY PRODUCTS

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Abstract

This article examines methods for determining the antibacterial properties of light industry products, as well as issues related to improving their production technology using protective materials. The study analyzes the antimicrobial effects of various composite materials and substantiates technological approaches aimed at enhancing antibacterial efficiency.

Keywords

protective materials, light industry, technological improvement, innovation, functionality.

In our Republic, measures are being implemented to improve the quality and competitiveness of light industry products, aimed at comprehensive processing of raw materials to finished products. The Action Strategy for the five priority directions of the Republic of Uzbekistan's development for 2017-2021, adopted on the initiative of President M. Mirziyoyev, outlines comprehensive reforms in all sectors to increase the competitiveness of the country's economy based on deepening democratic reforms and modernizing leading industries. This includes extensive work in the light industry sectors. The head of our state has repeatedly emphasized "the necessity of not selling raw materials but converting them into finished products for material benefit," with special attention given to achieving this goal [1].

Modern textile industry focuses not only on aesthetic appearance and functionality but also pays special attention to the hygienic and biological safety properties of products. Fabrics operating in various environments can serve as favorable environments for bacteria, where pathogenic microorganisms may proliferate. This can negatively impact human health. Therefore, enhancing the hygienic properties of textile materials through antibacterial treatment is of paramount importance.

Today, the light industry sector aims to produce products that meet human needs and comply with safety, comfort, and aesthetic requirements. Protective clothing is created to protect humans from external environmental influences (heat, cold, chemicals, mechanical impacts) [2].

Currently, research shows that such clothing is widely used not only in military or industrial sectors but also in sports, medicine, and daily life. Clothing made from protective materials plays an important role in ensuring safety and comfort in human life. As a result of scientific research and technological innovations, new generation functional clothing is being created and effectively applied in various fields. In the future, the development of more advanced and universal protective clothing with intelligent technologies is expected [3].

This research aims to produce products in the light industry sector that meet human needs and comply with safety, comfort, and aesthetic requirements. Products created using protective materials are important not only for protection against external influences but also for providing innovative functionality. Technological improvement serves to enhance product quality and improve production efficiency.

1. **Mechanical protective materials** - materials that protect against mechanical impacts (aramid, polyethylene fibers) provide high resistance to lifting, cutting, and scratching effects.
2. **Thermal and chemical protective materials** - materials that protect against heat and chemical substances require special production technologies.
3. **Biological and ecological protective materials** - fabrics with antibacterial and antiviral properties are widely used in the medical field. Simultaneously, recyclable ecological materials are gaining relevant importance [4].

In this research, several scientific sources were studied to conduct experimental research on creating headwear from antibacterial-impregnated knitted fabric. The analyzed literature extensively covers the effects of antibacterial treatment on properties such as elasticity, softness, and adaptability to movement of knitted fabrics.

These factors are important in ensuring the ergonomic and hygienic qualities of headwear. Within the scope of this research, the antibacterial effectiveness in various zones of headwear made from knitted materials treated with antibacterial substances was studied experimentally.

Since headwear directly contacts the human body, its hygienic and protective properties are of crucial importance. For this purpose, the headwear construction was divided into several functional zones, as shown in Table 1 below.

Table 1

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Zone	Reason	Recommendation
Forehead area	High perspiration	Antibacterial coating is essential
Crown area	Root area	Optional, but air circulation is important
Ear area	Contamination and air exchange zone	Good combination of antibacterial and breathable properties
Inner lining	Direct skin contact	Antibacterial fabric or fully impregnated coating recommended

During experimental testing, the existing headwear was divided into main zones. These zones were designated for the purpose of analyzing the functional and hygienic properties of the headwear (fig.1).

Figure 1. The appearance of the headdress

1. **Front zone** (forehead area)
2. **Side zone** (ear area)
3. **Back zone** (area frequently contacted by nails)
4. **Top zone** (crown area)

Separate samples were prepared for each zone and impregnated with antibacterial substances. The samples were evaluated based on the following criteria:

- Degree of antibacterial effect
- Bacterial types: *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*

The antimicrobial effect of the samples was determined against certain bacterial types using the agar diffusion method: Escherichia coli, Staphylococcus aureus, and Candida albicans fungus (State Pharmacopoeia XXI, Part 1, page 194). All microorganism cultures were obtained from the collection of the Institute of

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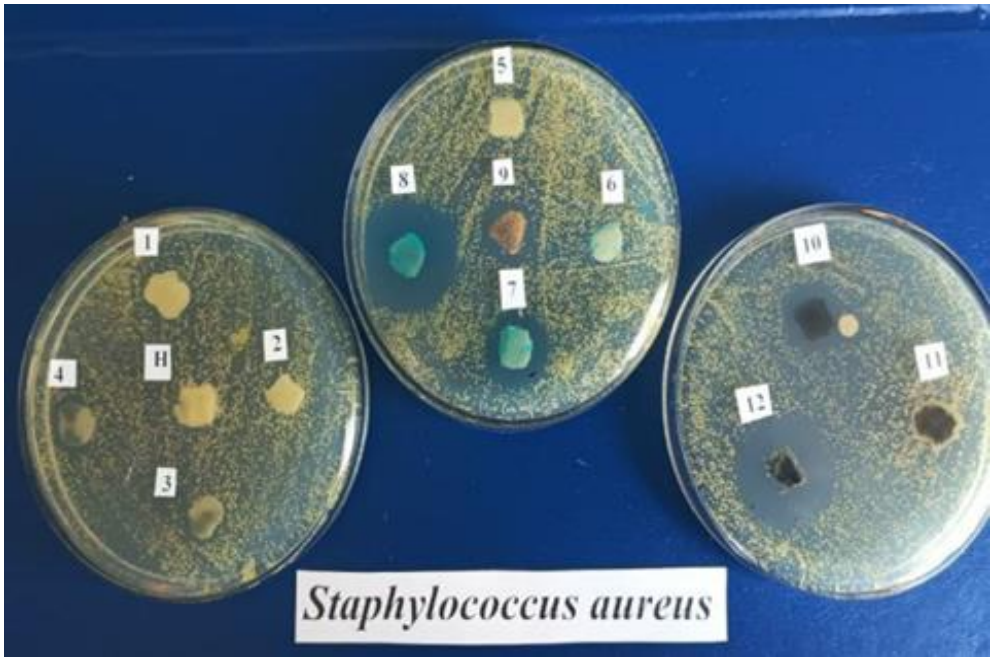
Microbiology of the Academy of Sciences of the Republic of Uzbekistan. The determination was carried out using the agar diffusion method in solid nutrient medium [5]. During the experiment, samples 3m and 4m showed high antimicrobial bactericidal inhibition zones against all three test strains: Escherichia coli, Staphylococcus aureus, and Candida albicans, with inhibition zone diameters of 29 mm, 28 mm, and 12 mm, respectively (Figures 2, 3).



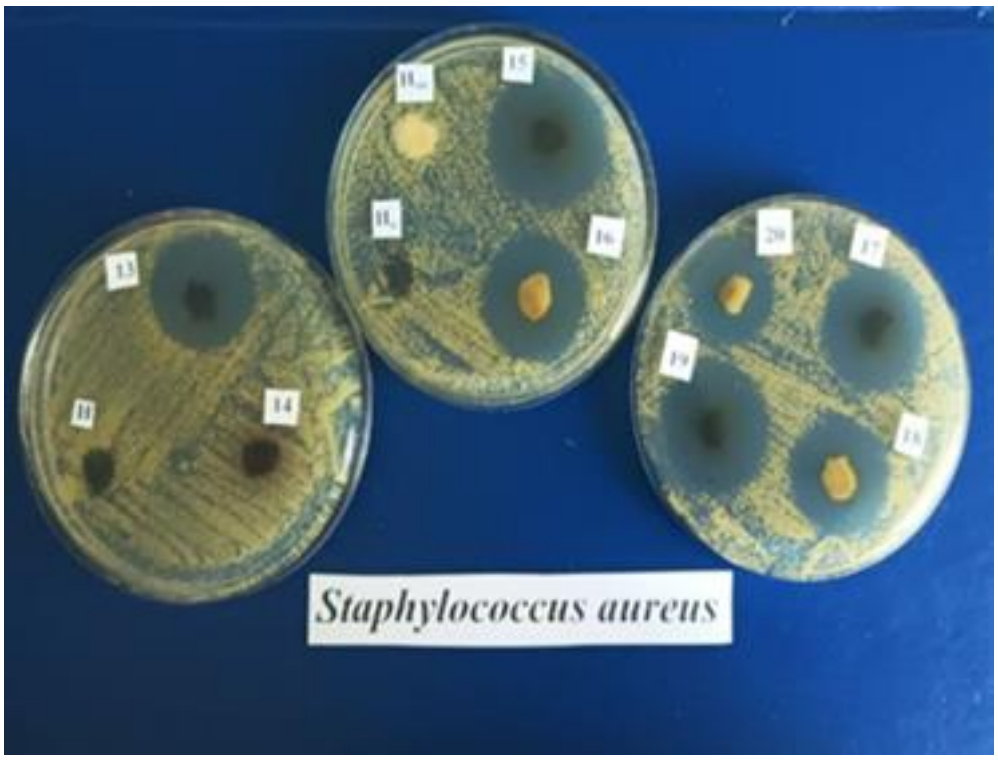


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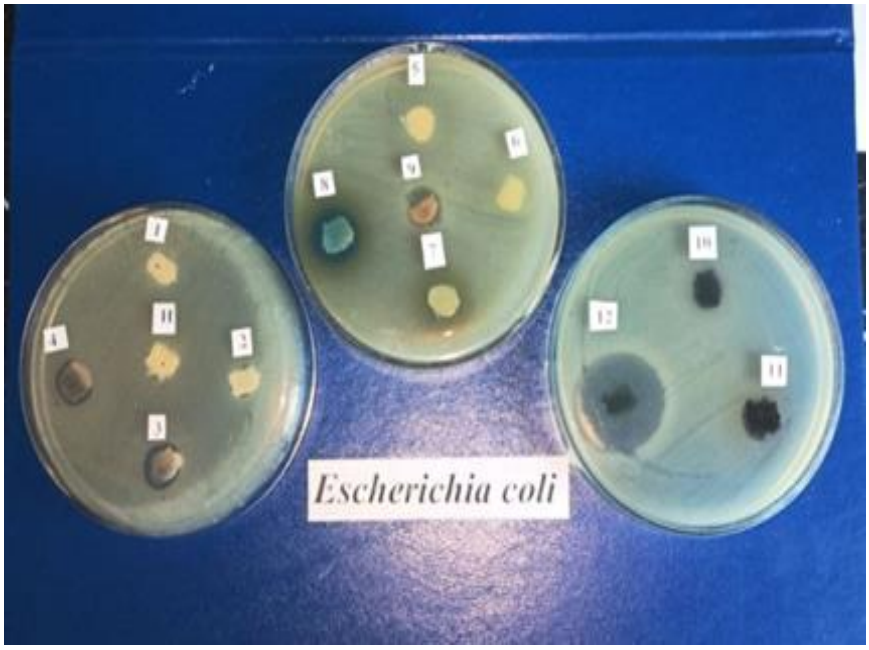
Figure 2. Test strain *Staphylococcus aureus*, where H - control of white or black materials



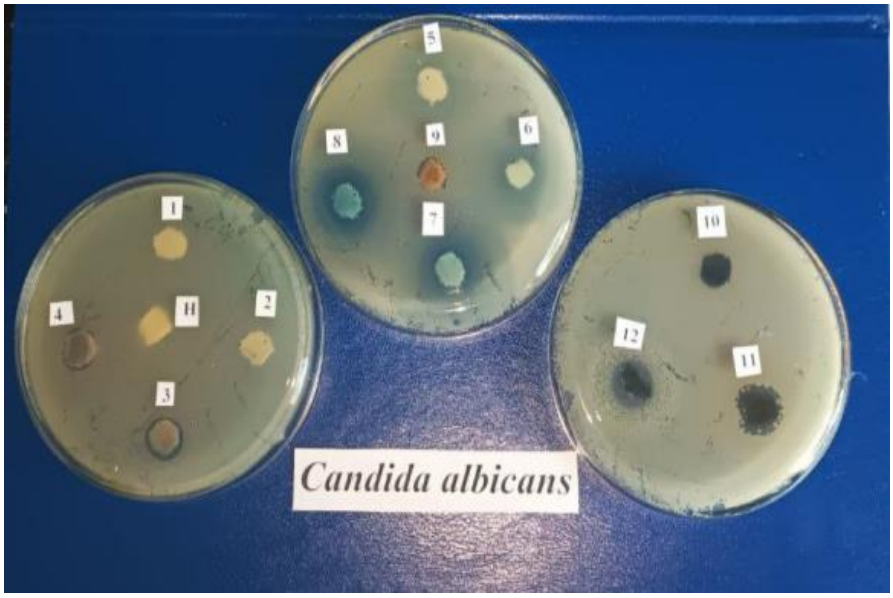


Figure 3. Test strains *Candida albicans* and *Escherichia coli*, where H - control of white or black materials

According to microbiological research results, samples 3m and 4m showed high antimicrobial bactericidal inhibition zones against two test strains: Escherichia coli and Staphylococcus aureus. They also showed a smaller antimicrobial bactericidal inhibition zone against the Candida albicans test strain.

From the presented research results, antibacterial treatment is of paramount importance in headwear made from knitted materials to meet hygienic and sanitary requirements. However, instead of treating the entire headwear surface, resource-efficient solutions can be achieved by applying antibacterial substances specifically

to zones with high hygienic risk - the **forehead area** and **ear area** - while maintaining effectiveness.

1. Hygienic Hazards in the Forehead Area

The forehead is one of the areas where sweat glands are very active on the human face. Due to perspiration, sweating, and external environmental influences (sun, wind, etc.), this zone creates favorable conditions for bacterial proliferation. The direct continuous contact of headwear specifically with the forehead area necessitates antibacterial coating.

2. Bacterial Activity Around the Ear Area

The area around the ears is more oily and moist due to skin structure and has a high bacterial load from a hygienic standpoint. Simultaneously, especially when headwear is worn for extended periods, air circulation in these areas decreases, causing bacterial proliferation. Antibacterial treatment in this zone enhances the overall hygienic effectiveness of headwear.

Based on this, it can be concluded that antibacterial treatment of the forehead and ear areas of headwear, while meeting hygienic requirements, represents a functional and economical solution. Antibacterial treatment of these specific zones in headwear helps reduce microbial spread and aims to eliminate its negative impact on human health. This approach, particularly in industrial-scale production, allows for rational allocation of material resources, reduction of production costs, and maintenance of the product's functional effectiveness. In this case, achieving goals in terms of ecological and economic efficiency of headwear and sanitary-hygienic requirements will be successful.

Furthermore, economically efficient use of antibacterial treatment enables ensuring long-term service of the product. Precise zone identification allows for analysis of the microbiological condition of each part of the headwear, their hygienic effectiveness, and evaluation of the impact of antibacterial treatment.

REFERENCES

1. Decree of the President of the Republic of Uzbekistan No. PF-4947 dated February 7, 2017, "On the Action Strategy for the Further Development of the Republic of Uzbekistan in 2017-2021."
2. B.B. Mandal. Protective clothing: Managing Thermal Stress. Springer, 2020.
3. S. Lim & M.S. Dargusch. Lightweight materials for industrial applications. Materials & Design Journal, 2018.

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4. A.R. Horrocks & S.C. Anand. Handbook of Technical Textiles. Woodhead Publishing, 2015.

5. Institute of Microbiology, Academy of Sciences of the Republic of Uzbekistan. Experimental Results Report, 2023.