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BIOSECURITY STUDY TEXTILE PRODUCTS

Dusmuxamedova Muxtabar Hadjimuratovna[1], Niyazova Mavjuda Saidaliyevna [2], Ahmadov Hamidulla Ne'matullayevich [3], Maksudova Umida Mirzarakhimovna [4]

[1]Department of Design and Technology of Leather Products, Tashkent Institute of Textile and Light Industry, Republic of Uzbekistan. e-mail: muxtabar@gmail.com
[2]Department of Design and Technology of Leather Products, Tashkent Institute of Textile and Light Industry, Republic of Uzbekistan. e-mail: niyazovamavjuda@mail.ru
[3]Department of Design and Technology of Leather Products, Tashkent Institute of Textile and Light Industry, Republic of Uzbekistan. e-mail: khamid.akhmadov.1990@mail.ru
[4]Department of Design and Technology of Leather Products, Tashkent Institute of Textile and Light Industry, Republic of Uzbekistan. e-mail: umida_m_m@mail.ru

Abstract. The article describes : the purpose of antibacterial fabrics, methods of antibacterial treatment of textile materials with biocidal preparations. The concepts between the following three types of materials are given: antibacterial, bactericidal, bacteriostatic, for a clear definition of the differences between them. The necessity of developing antibacterial preparations without using harmful chemical reagents has been substantiated. In the experimental part, the possibility of impregnating tik-sarzha tissue with biopreparations based on nitrogen-containing heterocyclic compounds and 4% solution of microelements (combinations of zinc, copper, iron) in the chelate state was investigated.
Determination of antimicrobial action of tissue samples with different impregnation was carried out by diffusion method in dense agar nutrient medium against some species of bacteria. When antibacterial treatment of investigated tissue samples during the experiment optimal variants of technological modes were obtained. Results of the study made it possible to conclude that antimicrobial activity against all test strains was observed in the samples tested against pathogenic and conditionally pathogenic test strains. The samples tested have antimicrobial activity against the test strains and relatively high antimicrobial activity against the test strain Candida albicans (20- 26 mm). In order to optimize the technological processes of antibacterial treatment of tissues, it is necessary to expand the range of treated biocompositions and continue research.

Key words: *textile materials, biocidal preparations, antibacterial, bactericidal, bacteriostatic.*

Introduction. The idea of producing textiles with antibacterial properties originated in Europe in the 90s and proved itself perfectly in the following decades. Textiles are known to be a good breeding ground for pathogenic bacteria - heat, increased humidity, and porosity of the material are present. Antimicrobial textiles became the solution for people with active lifestyle, such as campers, athletes, soldiers, construction workers, etc. The solution to this problem has become a solution for people with active lifestyles - hikers, sportsmen, soldiers, construction workers, etc.
Naturally, antibacterial textiles are widely used in areas where antibacterial requirements for special

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clothing are prescribed by law (for medical workers, in the food industry, etc.). Antibacterial undergarments impart a sense of cleanliness, freshness, comfort and a deodorant effect. This refers to the preventive, not therapeutic properties of antibacterial textiles.
In recent years, the need to create completely new materials, the lack of which limits the possibility of producing products needed for the modern national economy, has arisen. Due to the enormous material losses caused by the action of microorganisms, more and more attention is now being paid to the bioprotection of various materials, including textiles, which are damaged during their production, storage and operation.
Certain substances and finishing methods are used to impart certain properties to materials. The processes of special treatments can be combined.

Theoretical investigation. Textile fabrics known as bacteriostatic fabrics belong to the biotextile group. They prevent the reproduction of micro-organisms (bacteria), but also stop or inhibit the formation and growth of fungi and prevent the unpleasant odour normally caused by active sweating. Developed mainly for sports (underwear and footwear), bacteriostatic materials now represent one of the priority trends in textile development. The use of the generic term "bacteriostatic" is more commercially acceptable than the use of the term "antibacterial", but the differences between the following three types of materials should be clearly defined:
- *Antibacterial* webs inhibit the proliferation (multiplication) of bacteria, thanks to the action of an active substance that is applied to the fabric during the finishing process. However, it is gradually removed from its surface through washing;
- *bactericidal* webs destroy bacteria by the action of a powerful antiseptic that destroys microorganisms. They are mainly used in medicine;
- *bacteriostatic* webs stop the reproduction of bacteria without killing them. The active ingredient is more or less resistant to washing because it is injected into the fibres and thus itseffect is long lasting.
To date, two well-established technologies for creating a bacteriostatic effect have been developed: finishing (appressing) and injection treatment. A third technology, using the electron treatment process and the active ingredient grafting process, is currently only being developed.
Appliqué is the simplest technology. It consists of applying a chemical antibacterial substance to the fabric during the dyeing process, i.e. in the last stage of production. This method oftreatment has long been criticized because of the unsteadiness of the applied agent during washing, so that the antibacterial effect usually disappears after 5-6 washings. However, recent developments have allowed the antibacterial product to remain active even after 50 washings.
Injection - the properties of the fabric are set at the forming stage, when the antibacterial agent is injected into the polymer itself. It is injected into the fabric through micro-cracks in the fibre under the effect of very high temperature, just before cooling when the fibre is compressed. Often a combination of two or more substances is injected into the fiber.
Inoculation (grafting) - this new technology is currently being successfully tested. It represents electronic processing (activation) of the material with attachment along the active centers of the antibacterial agent. [1]

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Silver, copper, salts of mercury ($HgCl_2$), N-acetylpyridinium chloride, 1-chloro- betanaphthol ($C_{10} H_7 OCl$) impart antimicrobial properties to tissues, Hexachlorophene ($C_{13} H_6 Cl_6 O_2$), pentachlorophenol ($C_6 Cl_5 OH$) oxidiphenyl ($C_6 H_5 C_6 H_4 OH$), benzylchlorophenol ($C_{13} H_{11} OCl$), tetracycline ($C_{23} H_{24} O_8 N_2$), phenol ($C_6 H_5 OH$) and others. [2] Copper compared to silver has less pronounced antiseptic properties, but at the same time enhances the effect of silver preparations [3-4].
The traditional methods of giving antibacterial properties include wet chemical modifications, where water and chemical reagents are used in large quantities. The disadvantages ofthese methods are the high consumption of antimicrobial agents, the adverse environmental impact of the chemical compounds used and the narrow spectrum of biocidal action.
The treatment of materials with various metal ions leads to pollution of wastewater and the environment. Deteriorating ecological situation in the world requires the creation of new sanitary and hygienic measures. Therefore, there is a need to impart antibacterial properties to materials without using harmful chemicals. [5-6]
The quality of biocide treatment can be assessed by a microbiological laboratory that has a sanitary and epidemiological certificate for the right to work with infectious agents of III - IV pathogenicity groups and is accredited for this type of activity. Studies for certification purposes can be performed by laboratories specially accredited to conduct certification tests [7].
In practice, there are several methods of controlling the effectiveness of treatment on any particular material, depending on the substrate itself, the type of biocidal agent, the type of microorganisms and the final requirements for the product for biocidal protection. [8].
In this regard, this paper investigated the effect on antibacterial properties of teak-sarzha fabric widely used in clothing and footwear on parts that are in direct contact with the foot and the human body.

Research methods and objects. For research the choice of tissue "Twill" is produced from cotton yarn, warp - 29 tex, weft - 25×2 tex, warp and weft - 220 and 170 threads on 10 cm, twill get wear resistance and practical, fabric is air-tight and has high hygroscopic properties, respectively, and tissue "calico" - cotton fabric with a simple (plain) weave thick threads. Thanks to the simple structure of the fabric, coarse calico is quite affordable for consumers with different income levels.
Molecular weight estimation of 1,3-diallium-benzimidazolium bromide and 1,3-diallium-benzotriazolium bromide by studying the viscosity of diluted solutions in DMF solvent. An Ubellode dilution viscometer (with hanging level) with a capillary diameter of 0.8 mm was used in this work. The diluted reagent solutions were characterized by the value of characteristic viscosity, the average value of which was determined from 10 parallel measurements [9]. The refractometerof reagent solutions was determined using refractometer "RFM" series 900 at 25 ± 2^0 C. Melting point of 1,3-diallbenzimidazolium bromide and 1,3-diallbenzotriazolium bromide according to the procedure [9].
Pseudomonas aeruginosa - Pseudomonas *aeruginosa* is a species of Gram-negative aerobic, motile, rod-shaped bacteria. It lives in water and soil, is conditionally pathogenic to humans, and causes nosocomial infections in humans. Treatment is difficult because of high resistance to antibiotics.
Staphylococcus aureus - Staphylococcus aureus is a gram-positive aerobic microorganism, the most pathogenic; it usually causes skin infections and can cause pneumonia, endocarditis and osteomyelitis.

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Candida albicans fungus is a yeast-like fungus representative of the normal microbiota of human skin and mucous membranes, which under certain conditions causes superficial or invasive (systemic, visceral) candidiasis.
All cultures of *Pseudomonas aerogenosa, Staphylococcus aureus and fungus Candida albicans* GF XX1, part one page 194 [10]. microorganisms, were obtained from the collection of theInstitute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan.

Experimental part. In contrast to known biocidal drugs, the synthesis of nitrogen-containing heterocyclic compounds is performed easily at atmospheric pressure at room and higher temperatures. Evaluation of toxicological properties revealed that the synthesized nitrogen-containing heterocyclic compounds do not have toxic, locally irritating, and allergizing effects on humans [11- 12].
The following preparations were experimentally selected for the treatment of teak twilllining with preparations providing comfort of footwear, its protection against microbes:
- products based on nitrogen-containing heterocyclic compounds;
-4% solution of microelements (combination of zinc, copper, iron) in chelated state.

Table 1

Technical properties of nitrogen-containing heterocyclic compounds

	Name	FormulaGross	Aggregation condition	Molas ses	Rf	D20.4,g/cm 3	$T_{пл}$,° C	Solubility
1	1,3-benzimidazolium bromide	From$_{13}$ H_{15} N_2 Br	White crystals	279	0,24	0,9577	40-145	water, ethanol, DMF
2	1,3-diallyl-benzotriazolium bromide	From$_{12}$ H_{14} N_3 Br	White crystals	280	0,18	1,0012	35-140	water, ethanol, DMF

The advantages of treatment of footwear lining materials by biocidal preparations based on heterocyclic compounds before the considered methods: production cycle of treatment is sharply reduced, the risk of commodity losses due to microorganisms is reduced, the quality of the finished product increases [13].
Determination of antimicrobial action of tissue samples with different impregnation was carried out by diffusion method in dense agar nutrient medium against several types of bacteria: *Pseudomonas aerogennosa, Staphylococcus aureus and fungus Candida albicans*.

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Table 2

Cultivation conditions for test microorganismsto prepare an inoculum

Microorganisms	Feeding environment	Incubation temperature	Seed incubation time (hour)
experiment №1 *Pseudomonas aeruginosa* *Staphylococcus aureus*	Nutritious broth (Hi-media), MuellerNiltonagar (TM Media)	34 ± 2.5^0 C	from 18 up to 24
experience №2 *Candida albicans*	Saburo-agar(Hi-media)	34 ± 2.5^0 C	of 44 up to 52

During antibacterial treatment of the studied tissue samples during the experiment optimal variants of technological modes were obtained. Cloth samples were treated with aqueous solutions of microelements in chelated state (experiment №1) and solutions of heterocyclic compound containing element nitrogen (experiment №2).

The grown cultures of test bacterial strains were washed off the surface of slanted agar with sterile 0.9% isotonic sodium chloride solution. Using the domestic standard of turbidity titer cell-test strains the number of opportunistic bacteria and fungi in the solution up to 10^7.

Study results. According to the results from the 1st and 2nd control samples tested for antimicrobial activity showed no antimicrobial activity against all test strains (Pseudomonas aeruginosa, Staphylococcus aureus, Candida albicans), but the samples were infected with bacteria. An unknown bacterium was observed to grow on the surface of the growth medium.

The tested samples have antimicrobial activity against test strains (*Pseudomonas aeruginosa, Staphylococcus aureus, Candida albicans*). The samples showed high antimicrobial activity against test strain *Candida albicans*.

Two parallel studies were carried out during the microbiological testing. Table 3 shows theinoculants of the test microorganisms.

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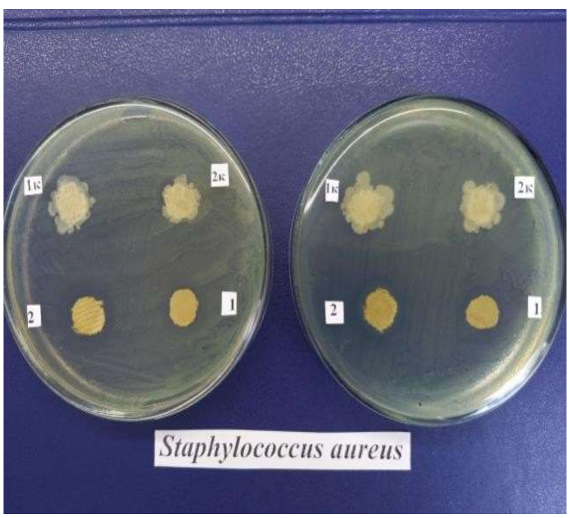
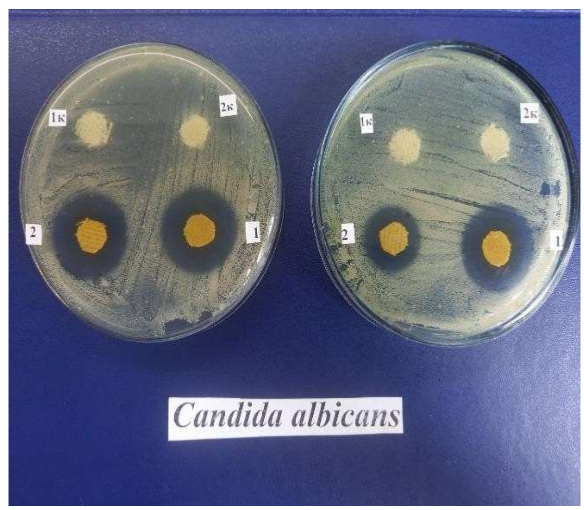
Table 3

Indicators of antimicrobial activity of treated samples of tik-sarzha

№	Sample Name	*Pseudomonas aeruginosa*	*Staphylococcus aureus*	*Candida albicans*
		Zone, *mm*		
1	1 control sample (calico)	0	0	0
2	2- control sample (twill)	0	0	0
3	3- tissue samples treated with aqueous solutions of trace elements in chelated state (calico)	2	4	26
4	4- tissue samples treated with solutions of heterocyclic compound containing element nitrogen (twill)	6	9	20





Antimicrobial activity of tissue samples with and without impregnation to test cultures.

Conclusion and implications. The advantages of treatment of footwear lining materials with biocidal preparations based on heterocyclic compounds over the considered methods are as follows: production cycle of treatment is sharply reduced; the risk of commodity losses due to microorganisms is reduced; quality of finished products is increased; environmental impact on the region is reduced, as this method does not provide additional treatment with chemical reagents;

Antimicrobial activity against all test strains was observed in the samples tested against pathogenic and

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opportunistic test strains. All samples showed relatively high antimicrobial activity against Candida albicans test strain (20-27 mm). Experimental results confirm that with highactivity of metals, they have some biological effect on living organism when applied to tissue in dispersed form. Due to the presence of antibacterial effects, the study of the therapeutic propertiesof metals is expected to be promising.

The results of the research allow to draw a conclusion - with the purpose of optimization oftechnological processes of antibacterial treatment of fabrics it is necessary to expand the assortment of processed biocompositions and fabrics.

Refrences

1. A. Bukina, E.A. Sergeeva, Preparations for imparting antibacterial properties to fibrous textile materials/ Biochemistry and Biotechnology// P.163-165
2. Safina LA, Tuhbatullina LM, Nurtdinova GA Pre-project analysis of chemical means and structural and morphological transformations that determine the protective properties of clothing for special purposes // Vestnik Technological University. 2014. Vol.17-№5. p. 51-54.
3. E. A. Vanyukova, Modern technologies for obtaining materials of leather and textile industry with antimicrobial properties / / Vestnik Technologicheskogo universitet. 2015. T.18, № 21.
4. Voevodin A.P. Prospects of copper-silver bimetallic devices in medicine / / Materials of the inter-regional scientific-practical conference with international participation "New chemical systems and processes in medicine". - Novosibirsk: SibUPK, 2002,-123p.
5. V. Beklemyshev, L. Mukhamedieva, V. Pustovoy, U. Maujeri. Nanoindustry, 2009, 6, 18-21 pp.
6. U.M.Maksudova., Classification Of Methods For Producing Nonwoven Laying Materials // International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878,Volume-9, Issue-1, May 2020. p.
7. A. F. Ravilova, M. V. Antonova, I. V. Krasina, Comparison of the antibacterial action of various preparations on cotton fabric / Bulletin of the University of Technology. 2017. VOL. 20, NO. 20, P.74
8. Obukhov YI, Razuvaev AV. Methods of assessing the effectiveness of biocide treatment of materials // Biopreparaty. Russia, Moscow, 2011.- No. 3- P.32-35.
9. Control of production of chemical fibers. /Edited by A.B. Pakshver and A.A. Konkin. - Moscow: Chemistry, 1997. - P.608.
10. State Pharmacopoeia of the Russian Federation Publishing house scientific center of expertise of means of medical application 2008-704 pp.
11. ISO 16187:2013, Footwear and footwear components. Test methods to assess antibacterial activity. Publication date : 2013-08. Number of pages : 16. Technical Committee : ISO/TC 216 Footwear.
12.B.A.Buzov, V.Yu.Mishakov, N.A.Makarova, Main indices of quality of textile antimicrobial materials for medical use // J. Technical Textile, 2003. №8. -C. 38-39
13. Ahmadov Kh.N., Maksudova U.M., Dusmukhamedova, Sheraliyev Sh.Sh., Methods For Estimating Biocide Efficiency of Fiber Materials Processing // International Journal of Advanced Research in Science, Engineering and Technology. Vol. 7, Issue 11, November 2020 P. 162-165 (05.00.00; №8) .
14. V. V. Safonov Progress of technology of textile materials finishing // LegPromBusiness Director. -

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DOI 10.6084/m9.figshare.2632599
http://magellanes.com/

№ 2 (28), № 3 (29), 2001. - C. 26-27
15.J.Y. Kang, Textile plasma treatment review - natural polymer-based textiles/ Sarmadi M.A., Kang J.Y. Kang, J.Y. // ATCC Review - 2004. - № 4(10).-P.28-32.