



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 9, Issue 11, November 2020

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.512**

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)

# A New Type of Medical Gauze of Natural Silk with Antiseptic Properties

**Alimova Halimakhan, Umurzakova Khalima Khabibullaeyvna, Akhmedov Jakhongir Adkhamovich., Aripjanova Dilafruz Uktamovna, Rasulova Nargiza Fayzullayevna.**

Department of Silk technology, Tashkent Institute of Textile and Light Industry, Shohjahon st.5, Tashkent, Uzbekistan.

Department of Silk technology, Tashkent Institute of Textile and Light Industry, Shohjahon st.5, Tashkent, Uzbekistan.

Department of Silk technology, Tashkent Institute of Textile and Light Industry, Shohjahon st.5, Tashkent, Uzbekistan.

Uzbek Scientific Research Institute of Natural Fibers, St. MUSTAKILLIK, 400, Marg'ilan, Uzbekistan.

Tashkent Institute of Textile and Light Industry, Shohjahon st.5, Tashkent, Uzbekistan.

**ABSTRACT:** The research presented in this article was aimed at developing a technology for producing medical gauze from natural silk with high strength characteristics, low surface density and natural antiseptic properties. Also microbiological studies of silk medical wipes impregnated with colloidal silver solution of different concentrations to inhibit the growth of different types of bacteria and fungi.

The material and method of research were developed medical gauze and bandaging material made of silk. Approbation took place in the conditions of medical practices. Antibacterial activity of colloidal silver when used on silk gauze was studied in Vitro on the basis of three series of experiments. To prepare a solution of colloidal silver, a dry powdery preparation "Protargol" was used.

Results. Developed methods for obtaining medical gauze from silk, received a patent for the invention. Apply a new gauze for the treatment of wounds, drainage of the surgical field and burn surface showed that it effectively absorbs and retains wound separation. In the composition of the ointment bandages gauze satisfactorily absorbs the ointment as on fat or on a hydrophilic basis. Breaks and other defects of appearance in the gauze is not noted, silk gauze weakly adheres to the wound surface is easily removed, and does not damage the wound surface.

Conclusion. The research allowed to develop the way of technology for silk gauze with the specified parameters, and also showed that the highest antibacterial activity of silver solution appears at a concentration of 25мкг/мл when used in wet wipes, compared to other modes of treatment

**KEYWORDS:** raw silk, medical silk gauze, surface density, physical and mechanical properties, wettability, colloidal silver, antibacterial effect.

## I. INTRODUCTION

The use of modern bandagings is a priority area of medicine. The rapid development of technologies and the growth of mass production allows to create on their basis a new generation of bandagings, the use of which will allow more effective control over the wound process. An important component of research to create a new generation of dressings is the creation of bandages that provide removal of exudate, toxic substances, maintain optimal humidity, temperature in the wound, gas exchange, prevent reinfection, and at the same time were antibacterial and antiseptic.

Natural silk - one of the most valuable types of textile raw materials, which has unique physical, mechanical, technological properties, providing it with a stable range of applications for women's clothing, underwear, and for medical purposes.

Silk also has unique natural antiseptic properties. It is no accident that since Ancient times it has been used in medical practice [1, 2]. Currently, surgical silk suture materials with different linear density are successfully used in surgical practice.

Scientists from the United States David Kaplan (David Kaplan), Fiorenzo Omenetto (Fiorenzo Omenetto) and their colleagues from tufts University (Tafis University) developed method to produce silk biopolymer microstructures with the high aspect ratios and mechanical properties required to manufacture microneedle systems from the biomaterial of silk fibroin.

Microneedles are emerging as a minimally invasive drug delivery alternative to hypodermic needles.

Silk fibroin combines excellent mechanical properties, biocompatibility, biodegradability, benign processing conditions, and the ability to preserve and maintain the activity of biological compounds entrained in its material matrix.

This combination of properties makes silk an ideal choice to improve on existing issues associated with other microneedle-based drug delivery system. [3].

## II.MATERIAL AND METHODS

At the same time, the unique capabilities of natural silk is not used enough in medicine. Treatment of wounds and wound infection is a task that has to be constantly solved not only in medical structures, but also in everyday life. At the same time, as in medical practice, the most widely used bandaging method is when a dry gauze contour bandage with various drugs is applied to the wound. The method of treatment of wounds under the bandage attracts with its availability and simplicity, it is applicable in all living conditions.

To date, mainly medical gauze and bandagings cotton with high surface density (22.5-36.0 g/cm<sup>2</sup>) are used, approved by state standard [4].

The disadvantage of this gauze is the increased weight capacity. Currently, we have developed methods for obtaining medical silk gauze with improved characteristics with a reduced surface density, with a high breaking load and natural antiseptic property. The experimental and industrial samples of gauze weave of silk yarn with a linear density by the basis of 14,28Tex, of raw silk by the weft of 3,23Tex, with the number of threads at 10cm<sup>2</sup> by the basis of 90-100, by the weft of 265-280, breaking load 90,3-122,2N and 125,6-132,5N; respectively, as well as from raw silk linear density 3,23Tex, with the number of threads in 10cm<sup>2</sup> as by the basis, and by the weft of 300-330, with a breaking load of 125,6-132,6 N and 132,7-151,1N. A patent for the invention was obtained for these types of medical gauze [5].

In medical gauze, along with other characteristics, indicators such as, wettability rate (not more than 10c) and capillarity (not less than 10cm/hour) are important. And these indicators are interconnected by the value of the surface density of gauze (g/m<sup>2</sup>).

Five samples of gauze with different compositions of threads were taken, both by the basis and by the weft. Sample 1 - base by silk yarn, weft by viscose, and samples 2,3,4,5 of raw silk of different linear density. The results of the relationship between the surface density and capillarity of new samples of medical gauze are shown in Fig.1.

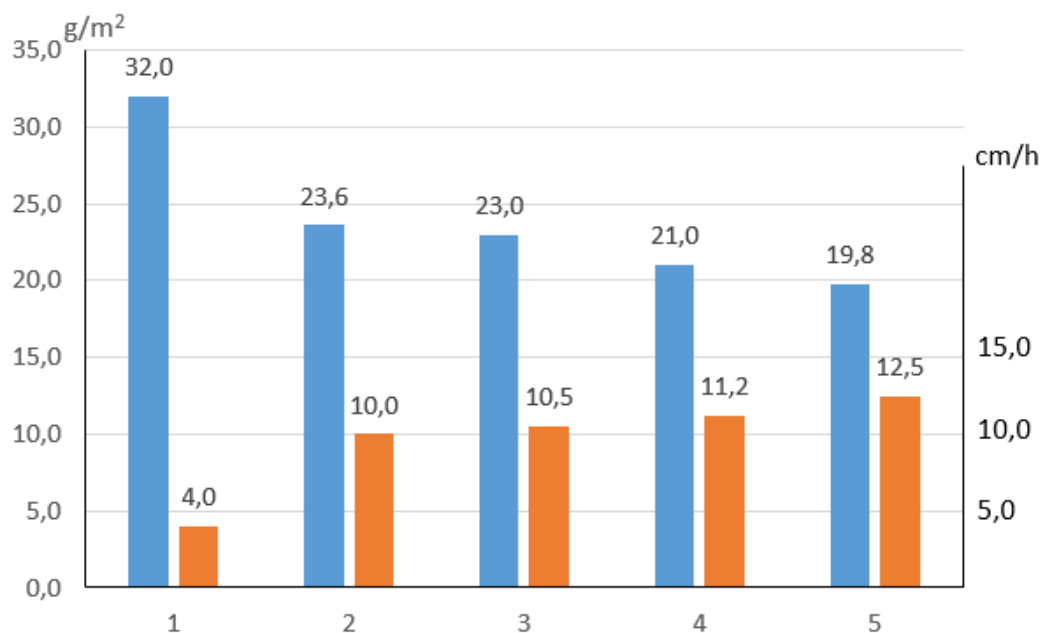


Fig.1. Relationship between surface density and capillarity of new medical gauze samples.

1 - warp silk yarn 14,28tex, weft viscose – 31,0tex; 2 - warp and weft raw silk – 3,23tex; 3 - warp of raw silk 3,2tex, weft 2,33tex; 4 - warp of raw silk 2,33tex, weft 3,23tex; 5 - warp and weft raw silk -2,33tex;

As can be seen from figure 1, only the indicators of sample 1 with silk yarn base and viscose weft do not meet the requirements for medical gauze and are not recommended for production.

Indicators of the relationship between the surface density and the wettability rate of the same samples of silk medical gauze are shown in Fig.2.

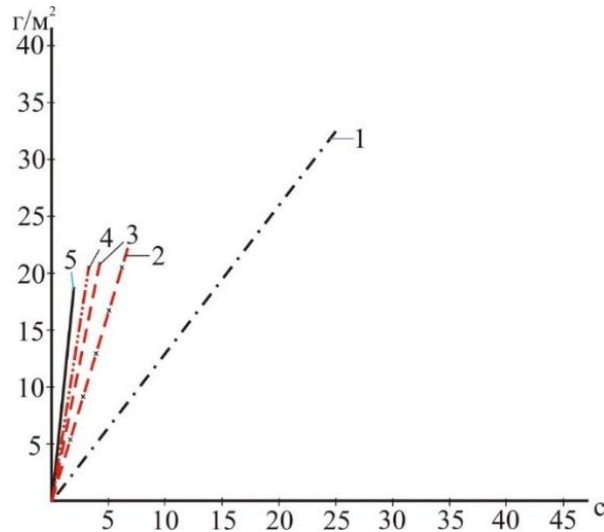


Fig.2. The relationship between the surface density and speed of wettability.

- 1 - warp silk yarn 14,28tex, weft viscose – 31,0tex; 2 - warp and weft raw silk – 3,23tex; 3 - warp of raw silk 3,2tex, weft 2,33tex; 4 - warp of raw silk 2,33tex, weft 3,23tex; 5 - warp and weft raw silk -2,33tex.

As can be seen from figure 2, also the indicators of sample 1 with a silk yarn base and viscose weft show non-compliance with the requirements for medical gauze.

Physical and mechanical properties of gauze made of silk thread and cotton yarn are shown in Fig.3.

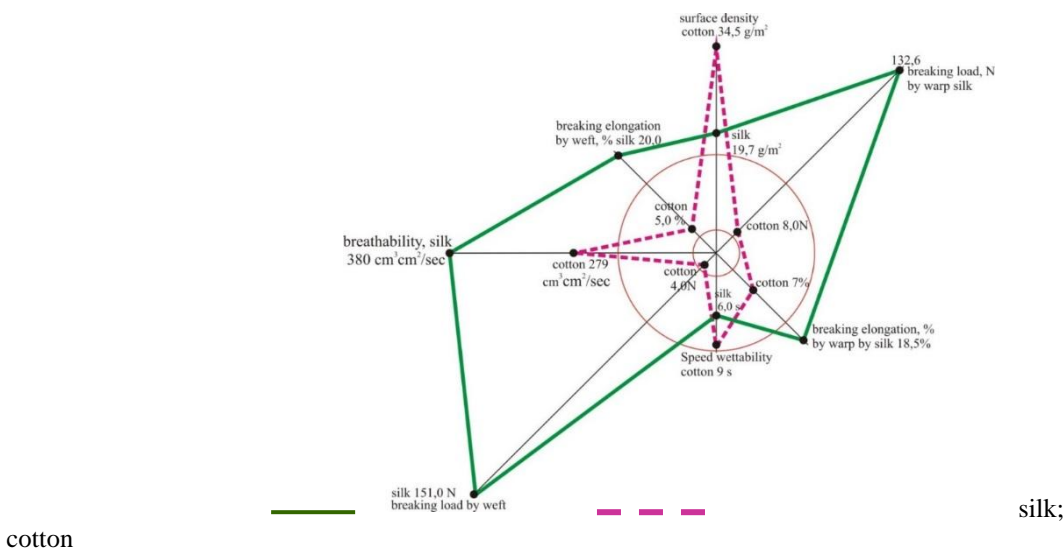


Fig.3. Physical and mechanical properties of gauze of silk thread and cotton yarn

As shown in Fig.3. all indicators of the new sample of natural silk gauze meet the requirements for medical gauze and significantly exceed the performance of cotton gauze.

Continuing the study in order to enhance the antibacterial activity of medical products made of silk gauze for single use, it was impregnated with colloidal silver solutions. To prepare the solution, a dry powdered preparation of colloidal silver "Argentum proteinate" was used. Before use, it was dissolved in sterile distilled water at an initial working concentration of 1%, or 10 mg/ml. Using this 1% working solution, intermediate dilutions of 12,5, 25, 75, 100 µg/ml were prepared, which were used for 3 series of experiments:

In the first series of experimental studies, we studied the sensitivity of 10 species of bacterial cultures taken for study. As microbial cultures were mainly taken strains of bacteria and fungi, which most often cause purulent-inflammatory processes. In these experiments, we carried out a direct action of silver solution in different concentrations on microbial cultures in Petri dishes. The strains were grown for 18-20 hours on a beveled MPA (meat-peptonic nutrient agar) with the addition of 0.1% glucose, suspended in a physiological solution, brought the cell concentration to  $10^9$  per ml according to the optical turbidity standard OSO 42-28-29-85 and prepared a number of 10-fold dilutions to  $10^3$  cells/ml, which were freshly prepared and used in all experiments.

The experiments of the second series of studies are devoted to the study of antibacterial activity of silk napkins, which in 2 modes were impregnated with silver solutions:

- in the first mode, the locking of silk napkins was carried out in room conditions;
- in the second mode, the impregnation of silk napkins was carried out in a water bath at a temperature of 60°C for 30 minutes.

The obtained silk napkins in both modes were dried and sterilized in a drying Cabinet at a temperature of 160°C for 1 hour. From the obtained sterile dry silk napkins, small clippings (1 cm<sup>2</sup>) were prepared. Which were then introduced into a Petri dish and placed on the surface of the nutrient medium with grown strains of bacteria.

In the third series of experiments, originally prepared silk napkins from which cut pieces of size 1 cm<sup>2</sup> placed them in Petri dishes and sterilized in an autoclave with a temperature of 1100C for 1 hour. After that, observing the strict conditions of asepsis and antiseptics in box, soaked them in silver solutions at various dilutions and left for 30 minutes. Then these pieces in a wet state, impregnated with a solution of silver in different concentrations, were transferred to prepared culture media with bacterial crops. Subsequently, these Petri dishes were introduced into the thermostat for 24 hours at a temperature of 37° C , after the incubation period, the cups were removed from the thermostat and a special ruler was used to measure the diameter of the microbial growth delay zone around the clippings of 1 cm<sup>2</sup> silk napkins and expressed in mm.

### III.RESULT AND DISCUSSION

To compare the degree of antibacterial activity of silk napkins impregnated with silver solution, we took the antibiotic Erythromycin for control. The results of the research are given in the table.

Table. Sensitivity of some bacteria and fungi to the action of silk gauze wipes impregnated with silver solutions in different concentrations under inVtro conditions

Notes: units are given in mm of zone of growth inhibition of bacteria and fungi.

№	Microorganisms	The concentration of the drug µg/ml				Erythro- mycin
		12,5	25	50	100	
1	<i>Staphylococcus aureus</i>	10,0±0,2	16,0±0,2	15,0±0,3	15,0±0,3	12,0±0,2
2	<i>Staphylococcus epidermidis</i>	18,0±0,4	15,0±0,3	15,0±0,4	12,0±0,4	10,0±0,1
3	<i>Staphylococcus saprofiticus</i>	7,0±0,1	12,0±0,2	12,0±0,2	12,0±0,2	10,0±0,1
4	<i>Streptococcus pyogenes</i>	19,0±0,3	28,0±0,5	17,0±0,3	17,0±0,4	12,0±0,2
5	<i>Escherichia coli</i> JII	11,0±0,2	12,0±0,3	11,0±0,4	11,0±0,4	7,0±0,1
6	<i>Escherichia coli</i> JIH	13,0±0,2	20,0±0,3	19,0±0,3	19,0±0,2	10,0±0,1
7	<i>Proteus vulgaris</i>	13,0±0,2	19,0±0,3	18,0±0,3	14,0±0,2	16,0±0,4
8	<i>Klebsiella</i>	16,0±0,4	18,0±0,3	15,0±0,4	15,0±0,3	15,0±0,3
9	<i>Candida albicans</i>	12,0±0,2	21,0±0,4	15,0±0,3	15,0±0,3	7,0±0,1
10	<i>Pseudomonas aeruginosae</i>	7,0±0,1	20,0±0,2	20,0±0,4	20,0±0,4	15,0±0,3

From table. it can be seen that the silk napkin impregnated with a solution of silver at a concentration of 25 µg/ml more effectively showed its antibacterial effect on all bacteria and fungi, we consider it the most rational concentration for impregnation. It should be noted that the napkin with a solution of silver in this concentration had the most pronounced effect on bacteria such as: *Streptococcus* ( $28\pm 0,5mm$ ), *Escherichia* ( $20\pm 0,3mm$ ), and fungus *Candida* ( $21\pm 0,4mm$ ). Also, these tables show that all variants of silver solutions have a more pronounced antibacterial effect compared to the control.

The results of the clinical trial showed that the bandagings of the new silk medical gauze in weave by the basis of silk yarn with a linear density of 14.28 Tex and raw silk by weft 3.23 Tex, with the number of threads on the area of 10 cm<sup>2</sup> on the basis of 90-100, 265-280 weft, have a fairly uniform structure.

They are well absorbed with biological fluids and drug solutions. When using a new gauze in the form of napkins for wound treatment, drainage of the surgical field and the burn surface, it is found that it effectively absorbs and holds the wound compartments.

In the composition of the ointment bandages gauze satisfactorily absorbs the ointment as on fat or on a hydrophilic basis. Discontinuities and other defects in appearance in the gauze is not marked. Changes in the structure and properties after steam, ultrasonic, radiation (<sup>60</sup>Co) and thermal sterilization were not detected. In contact with the wound surface and intact skin allergic and locally irritating effects were not observed. Especially on the burn surface of the skin was not observed the development of microorganisms.

Cotton gauze napkins, when applied to the wound surface, are tightly adjacent to the wound, dry quickly and tend to injure the wound when bandaging patients [6]. At the same time, silk gauze weakly adheres to the wound surface is easily removed, as silk up to 30% of its weight absorbs moisture and thus does not damage the wound surface and is easily removed.

Products with a reduced surface density, with certain natural antiseptic properties are made in the form of medical bandagings, which serve as the basis for gel and ointment bandagings, compresses, immobilization of drugs and preparations, bandaging packages. Sterilization is carried out in any way in accordance with the rules for sterilization of the bandaging material [7].

Generalizing microbiological studies conducted to study the antibacterial effect of colloidal silver prepared from the drug "Argentum proteinate" [8] in different concentrations on 10 types of bacterial cultures. In the first series of experiments, the possibility of ascertaining the fact that with an increase in the concentration of silver solution, there is an increase in antibacterial activity and inhibition of bacterial growth is shown. In this experiment, the best concentration of silver solution can be considered dilution equal to 25 µg/ml [9].

In the remaining series of microbiological studies, it can be argued with high probability that the greatest antibacterial activity of the silver solution, compared with other treatment modes, is manifested when using wet silk wipes.

#### IV.CONCLUSION

The conducted research allowed to develop the technology of obtaining gauze with the specified parameters and to produce an experimental industrial batch of medical silk gauze with natural antiseptic properties.

To enhance the antibacterial effect and to moisturize the created silk bandaging material, the colloidal silver preparation "Argentum proteinate" was taken as an object of study and its good antibacterial activity in vitro was proved, so it and its analogues can be used as a source for the preparation of solutions with appropriate impregnation of the medical bandaging material.

The most effective concentration of the silver solution was 25 µg/ml. As a result, a medical bandaging material was obtained from silk with high antibacterial activity, which does not damage the wound surface and is easily removed.

#### ACKNOWLEDGMENT

This work was supported by Ministry of Innovative Development of the Republic of Uzbekistan under research grant "F-A-2018-026"



#### REFERENCES

1. Abu Ali Ibn Sina. (1985). Canon of medicine. Selected sections. (pp. 768, 291). Pub. «FAN» AS of the Republic of Uzbekistan.
2. Figurovsky N. A. (1969). Essay on the General history of chemistry. From ancient times to the beginning of the XIX Century.- Moscow: Science.
3. Konstantinos Tsioris, Waseem K. Raja, Eleanor M. Pritchard, Bruce Panilaitis, David L. Kaplan Fiorenzo G. Omenetto. (2012). Fabrication of Silk Microneedles for Controlled-Release Drug Delivery (pp.330-335). Advanced functional materials. Vol.22, Issue 2.
4. Gauze is medical. General specifications. GOST 9412-93. Moscow.
5. H. Alimova, B. H. Baimuratov, A. E. Gulamov, D. U. Aripdjanov, A.A. Axunboboev, R.G. Alimov. Medical gauze. The patent for the invention IAP05210. Tashkent. 22.04.2016.
6. Brigham C. J. (2012). Applications of polyhydroxyalkanoates in the medical industry. (pp. 53-60). IJBWI. Vol. 1, N1. Doi:10.6000/1927-3037.2012.01.01.03.
7. A. B. Larichen and others. (2011). Prevention of wound infection and morphological aspects of aseptic wound healing (pp. 728-33). Ves. exp. and clinical surgery. Vol. IV. №4.
8. Kostyleva R. N., Burmistrov V. A. Comparative study of bactericidal activity of colloidal silver / Silver and bismuth in medicine. - Materials of scientific-practical conference, February 25-26, 2005, Novosibirsk, p. 53-60.
9. A. A. Kudrinskiy, A. Yu. Ivanov, E. V. Kulakovskaya, et al. (2014). The Mode of Action of Silver and Silver Halides Nanoparticles against *Saccharomyces cerevisiae* Cells. (p. 7). Journal of Nanoparticles, vol. 2014, Article ID 568635.



**INNO**  **SPACE**  
SJIF Scientific Journal Impact Factor

**Impact Factor:  
7.512**

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
**INDIA**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details