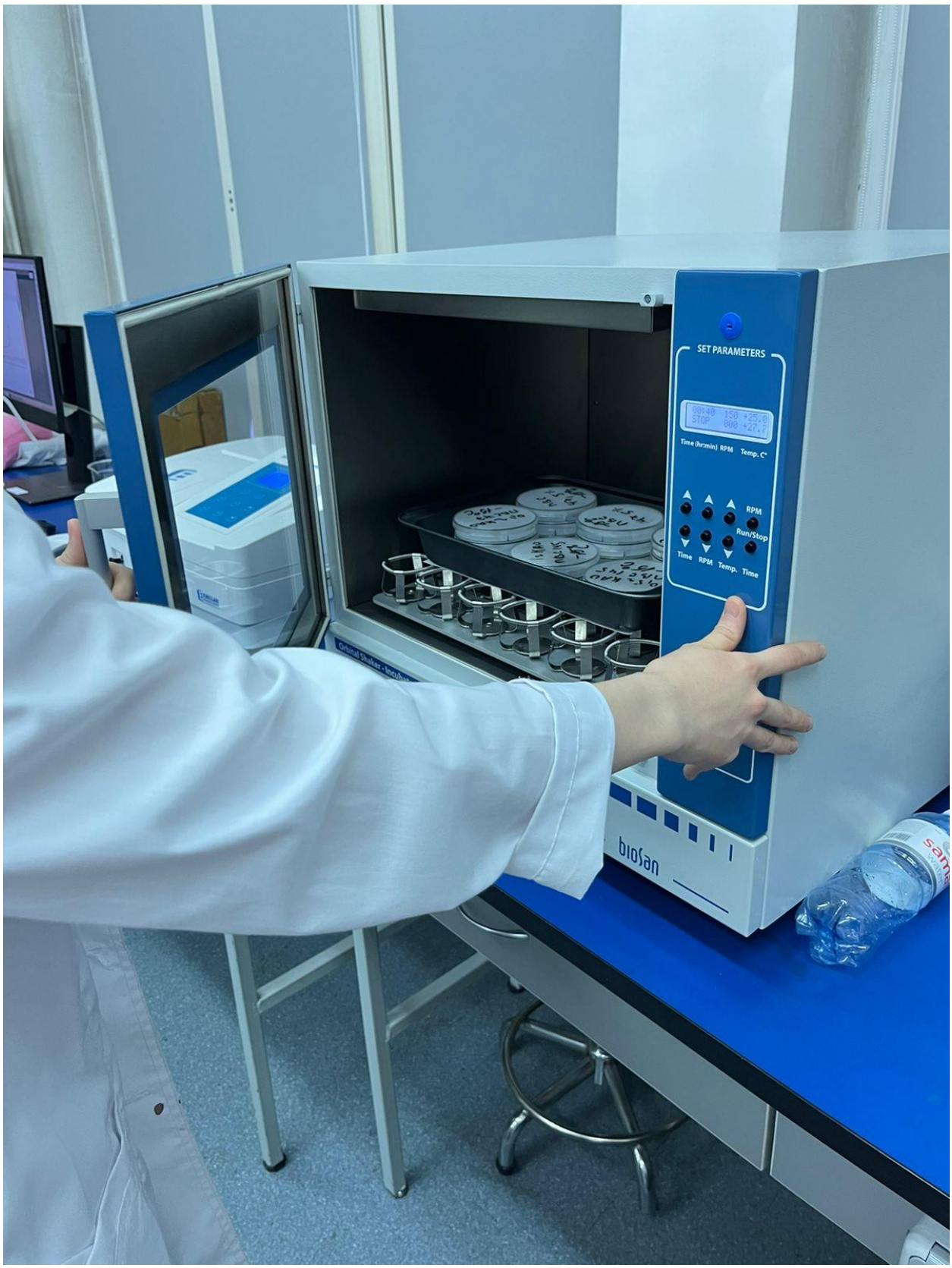
Brief information about the project

Name of the project	AP19678726 "Development of conditions for obtaining hemostatic composites for medical and biological purposes based on Kazakhstan kaolin"
Relevance	The research project is aimed at the development of hemostatic agents based on domestic raw materials - kaolin and auxiliary bioactive agents, which are designed to provide first aid by accelerated stimulation of blood coagulation. Kazakhstan kaolin has good hemostatic properties and can act as a coagulator, the structure of which can be further strengthened by other active styptic agents, and more effectively stimulate the process of blood coagulation due to the negative charge on its surface.
Purpose	**The goal of the project is** to develop conditions for obtaining domestic (local) hemostatic agents (DHA) based on Kazakhstan kaolin Alexeev's field, Kokshetau region. Kazakhstan kaolin can be used as the main potent hemostatic agent and act as a porous framework for other hemostatic components and at the same time to strengthen the process of blood clotting.
Objectives	A way to achieve the project goal through the following logically interrelated sequential tasks: 1. Conduct a scientifically based selection of biocompatible, environmentally friendly "mucoadhesive agents" for the modification of Kazakhstan kaolin 2. To establish optimal conditions to produce modified kaolin with a good specific surface area and active sites susceptible to the introduction of polyvinyl alcohol (PVA) as an additional modifier to increase the porosity of the frame of the proposed composite material. 3. To enhance the hemostatic properties of kaolin, chitosan, introduced into the structure of natural and modified kaolin by impregnation, will be used as an organic hemostat. Hemostatic membranes of a triple composite material based on kaolin/PVA/chitosan will be obtained at different ratios of chitosan to the main composition of the porous framework of PVA/kaolin. 4. To develop conditions for application to the structure of hemostatic composites based on kaolin/PVA/Chitosan of known biodegradable agents to impart moisture-retaining and dust-suppressing properties 5. To investigate the hemolytic activity of selected promising hemostatic composites obtained to assess the hemocompatibility of materials and prepare recommendations for practical use.
Expected and achieved results	**Expected results:** 1. Optimal conditions for obtaining modified kaolin with good specific surface area and active centers, susceptible to the adsorption of hemostatic agents to enhance the hemostatic properties of kaolin, will be established.

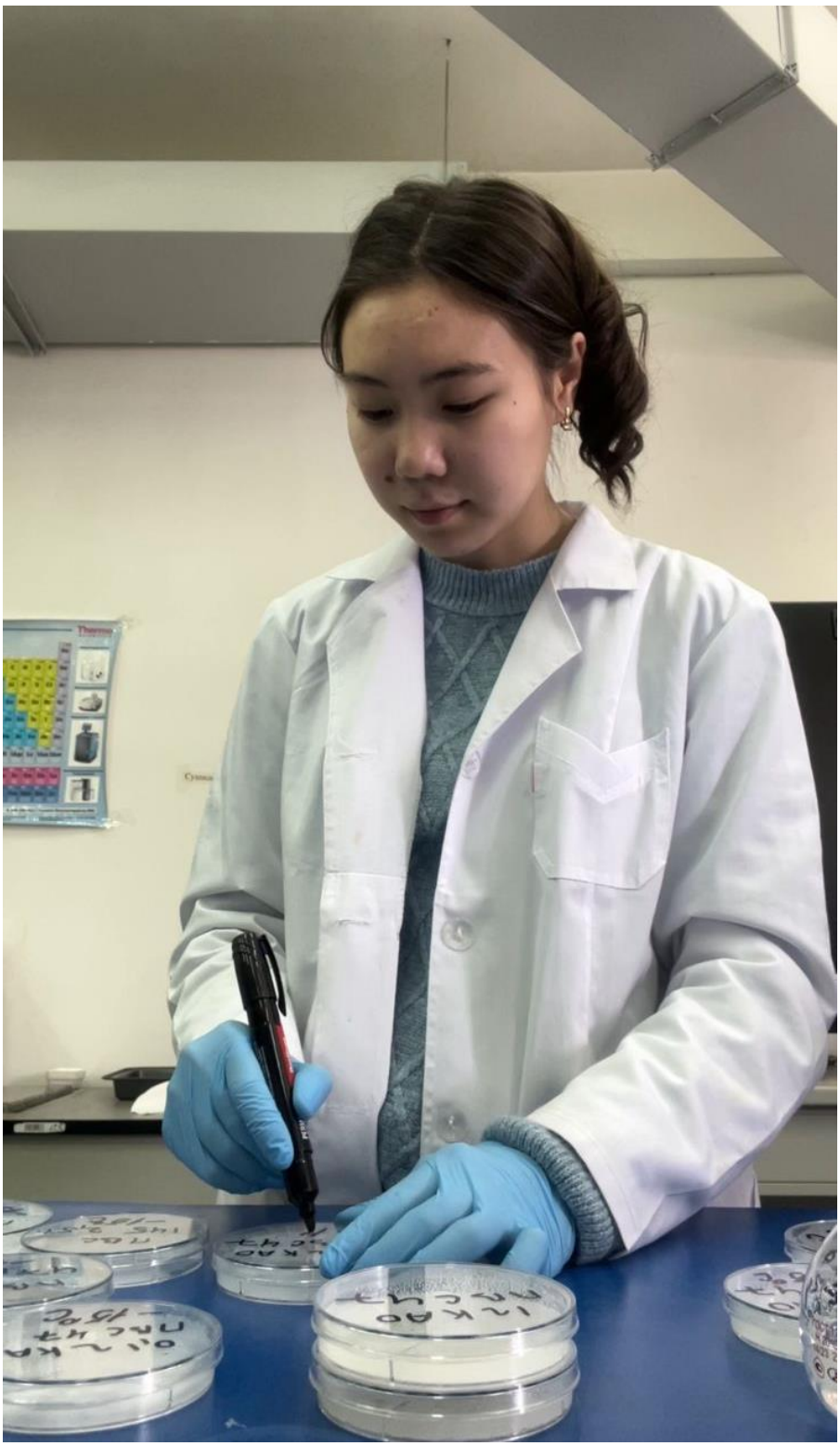
	2. Conditions will be developed to produce a hemostatic composite material based on selected natural or modified kaolin with a certain specific surface area, containing polyvinyl alcohol (PVA) as an additional modifier to increase the porosity of the framework of the proposed composite material. **Achieved Results:** 1. The modification of natural kaolin (KAO) was carried out in two stages. At the first stage, acid treatment of kaolin was carried out with 10% H_3PO_4 at 100 °C for 5 hours, in the ratio S:L = 1:10. Next, the sediment was washed to neutral pH=7. The precipitate was separated, dried and calcined for 2 hours at 500 °C. 2. The elemental composition of natural and modified kaolin was established, which indicates an increase in the silicon oxide content in the modified kaolin from 38.59 to 41.38%. The content of calcium, magnesium, iron, nickel and aluminum in the calcined samples decreased. 3. The specific surface area was studied by the Brunauer–Emmett–Teller (BET) method. Natural kaolin has a low specific surface area of 13.453 m^2/g, after acid treatment the specific surface area increases to 33.166 m^2/g, which leads to an increase in specific pore volume from 0.006 to 0.014 with a constant average pore size. 4. Alkaline modification of kaolin was carried out by heating for 8 hours in 2M sodium hydroxide solution, and the specific surface area also increased 2.5 times. The results of acid and alkaline modification of kaolin were confirmed by SEM images and IR spectra. 5. Preliminary conditions for production of hemostatic composite material PVA/kaolin at mass ratios of KAO:PVA were optimized 1g KAO + 0.1% PVA; 1g KAO + 0.5% PVA; 1g KAO + 1.0% PVA. The average specific surface area of kaolin was 13.453m^2/g . 6. IR spectra were investigated for all the samples. The sharp characteristic peak at 1118 cm^{-1} is the dominant manifestation of the PVA structure in the composite, the peak at 1085 cm^{-1} correlates with C-O-C. 7. Analysis of SEM figures confirms that PVA alters the surface pattern of natural KAO and leads to an increase in the porosity of the frameworks for the obtained PVA/kaolin composite membranes. 8. The specific surfaces of pure reagents and obtained composites were investigated. Their analysis showed that the presence of PVA in KAO leads to a decrease in the specific surface of the obtained samples. It follows from this that PVA was introduced and adsorbed on active centers in the structure of kaolin.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if	1. Ospanova Aliya Kapanovna, Scientific supervisor of the project, Ch.Sc.D, professor of Al-Farabi KazNU, professor of the Department of Physical Chemistry,

available) and links to relevant profiles	Catalysis and Petrochemistry h-index-5, https://orcid.org/0000-0001-9954-8575, Scopus ID=55340038000; ResearcherID: ABE-7029-2021. 2. Myroslav Sprynskyy, Performer, Leading Researcher, PhD,DSc, Professor, Nicolaus Copernicus University of Torun, Poland, h-index-22, https://orcid.org/0000-0002-4334-3594, ResearcherID: GCQ-0369–2022; Scopus ID: 18438744500. 3. Savdenbekova Balzhan Esimkhankyzy, PhD, Al-Farabi KazNU, lecturer, h-index-2, https://orcid.org/0000-0001-8812-5809, ScopusID=57190410653. 4. Jumagaziyeva Ardak Bisenbaevna, PhD, SR, JSC "Scientific Center of anti-infective drugs", Acting Head of Microbiology Laboratory. h-index-3, https://orcid.org/0000-0002-8610-7321 ScopusID=57210255995. 5. Bekissanova Zhanar Bolatovna, Master of Technology degree, RA, Al-Farabi KazNU, lecturer of the Department of Physical Chemistry, Catalysis and Petrochemistry h-index-3, https://orcid.org/0000-0001-6142-0963, ScopusID= 57218598280. 6. Rakhmatullaeva Dilafruz Talgatkyzy, Master of Al-Farabi KazNU, junior researcher, 1st year doctoral student at the Department of Physical Chemistry, Catalysis and Petrochemistry https://orcid.org/0000-0002-8096-1068. 7. Alimbek Aruzhan Yerlankyzy, 1st year Master of the Department of Physical Chemistry, Catalysis and Petrochemistry of Al-Farabi KazNU, specialist, https://orcid.org/0000-0003-4393-6813. 8. Otegenova Bayansulu Onlassynbekkyzy, 1st year Master of the Department of Physical Chemistry, Catalysis and Petrochemistry of Al-Farabi KazNU, specialist, https://orcid.org/0000-0003-0319-1116.
List of publications with links to them	
Patents	

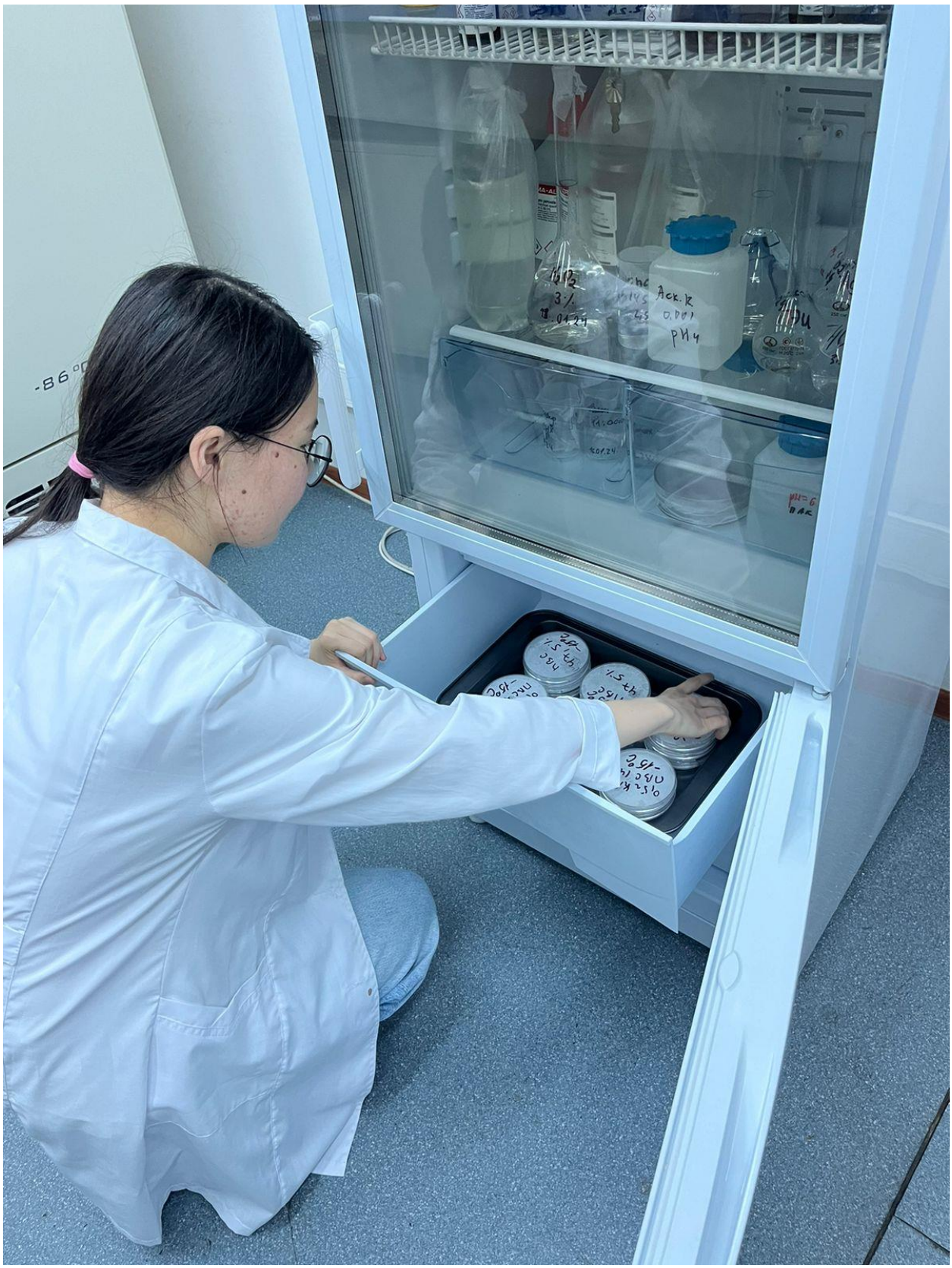
Production of hemostatic composites



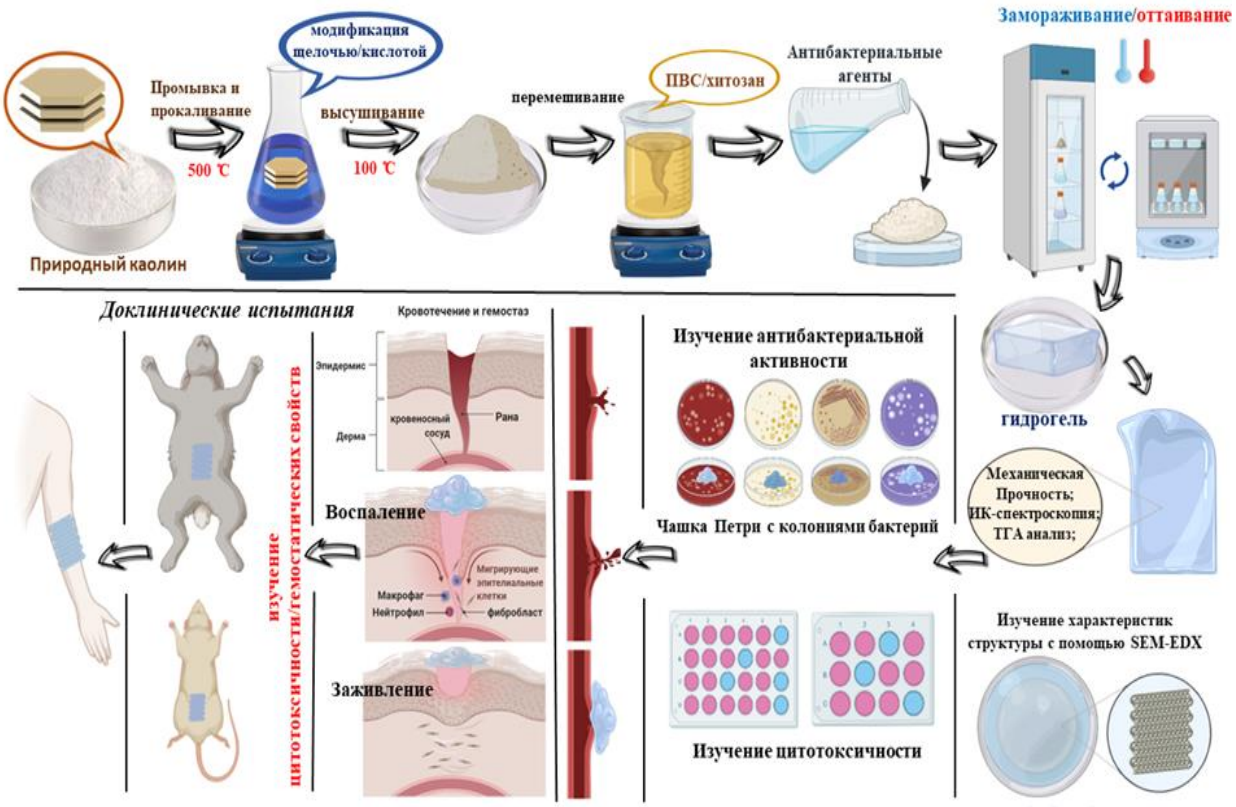
Production of hemostatic composites



Preparation of hemostatic composites by thawing freezing



Preparation of hemostatic composites by thawing freezing



Scheme of production of hemostatic composites and application