Newsletter of the Science & Technology Wing Embassy of India Moscow

Compiled by :

Dr. Shishir Shrotriya
Counsellor (S&T)

Mr. Amos Khupboi
Attache (S&T)

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Science & Technology Wing
Embassy of India
9, Ulitsa Vorontsovo Polye
Moscow-103064
Russia

Telefax
+7-495-9160297
Email
snt.moscow@mea.gov.in
Homepage
www.indianembassy.ru

SCIENTIFIC ARTICLES & NEWS

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BRIEF DETAILS-FEW IMPORTANT RUSSIAN R&D INSTITUTES

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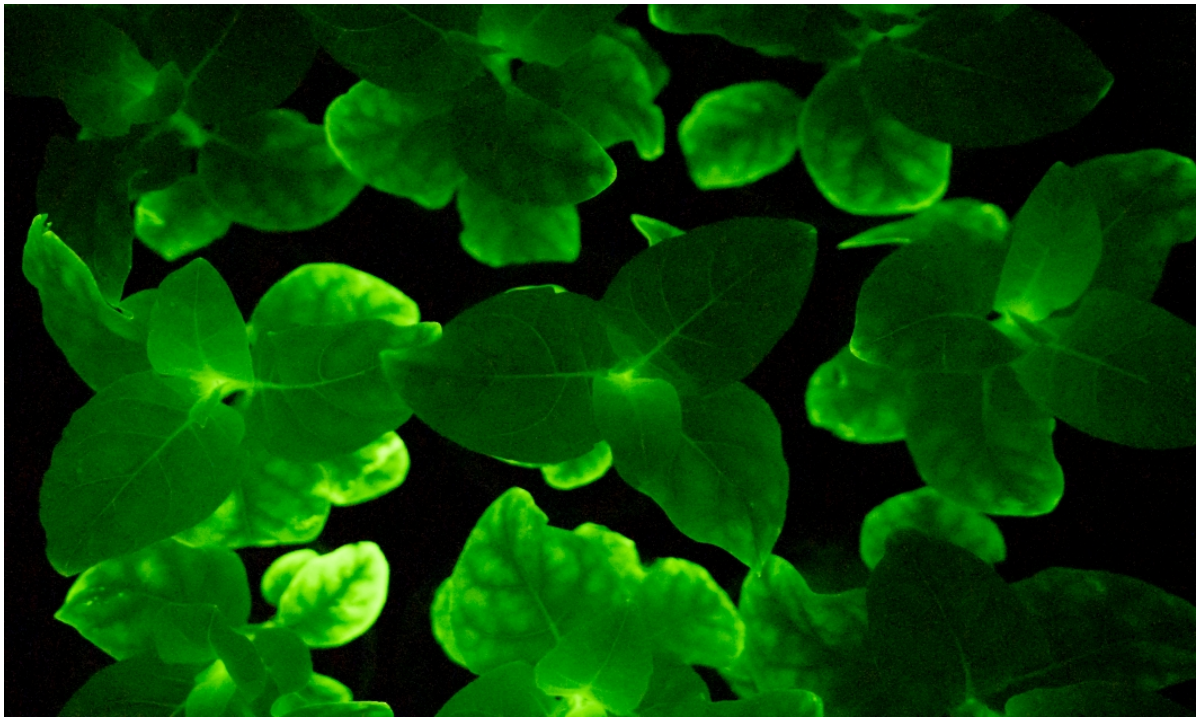
1. SCIENTISTS CREATE GLOWING PLANTS USING BIOLUMINESCENT MUSHROOM DNA

Ornamental house plants with sustainably glowing leaves and flowers are now one step closer to reality, thanks to a breakthrough in which scientists leveraged the bioluminescent powers of mushrooms. Glowing plants are nothing new, as scientists have previously achieved this by using bioluminescent genes found in bacteria. Trouble is, these plants do not glow very brightly, which is probably why they haven't caught on. New research published today in Nature-Biotechnology describes a new technique, in which the DNA from bioluminescent mushrooms was used to create plants that glow 10 times brighter than their bacteria-powered precursors. Botanists could eventually use this technique to study the inner workings of plants, but it also introduces the possibility of glowing ornamental plants for our homes.



The new study, from the Russian Academy of Sciences, describes tobacco plants that were genetically modified to express a recently discovered bioluminescent system found in mushrooms. Tobacco was chosen because these plants are genetically simple and grow quickly, but the new technique should work in other plant species as well.

Key to the process is an organic molecule called caffeic acid, which is found in all plants. Two enzymes convert the caffeic acid into a luminescent precursor, which was then treated with a third enzyme, producing an oxidized molecule capable of shooting out photons, that is, light. Incredibly, the plants produced around 10 billion photons per minute at wavelengths that peaked between 500 and 550 nano-meters (the green range of the visible light spectrum). Plants and mushrooms are not closely related, but the researchers leveraged a metabolic process compatible to both.

This resulted in self-sustaining bioluminescent plants, in which the plants produced their own glow without the introduction of foreign biochemicals. They glowed continuously throughout their life cycles, and the modification didn't seem to harm their normal development and health. The glowing could be seen with the naked eye, appearing in leaves, stems, roots, and flowers of the bioengineered plants.

The breakthrough could provide scientists with a new way of observing the inner workings of plants, such as monitoring their glow to study a plant's metabolism. Interestingly, young plants glowed more brightly than older ones, and flowers turned out to be the most luminous part. Sometimes, the glows ebbed and flowed in patterns, hinting at unknown internal processes.

Excitingly, these plants could also be used for ornamental purposes. And indeed, that's exactly what these scientists are thinking, as the research has spun off into a new company called Light Bio. The project itself was partly funded by Planta LLC, a biotech startup headquartered in Moscow, so commercial implications were very much in mind from the get-go. Other financial contributors included the Russian Science Foundation and the Skolkovo Foundation. A total of 27 contributors are listed as authors on the new paper.

The study was conducted on tobacco plants, but species like periwinkle, petunia, and rose could be modified in the same way, according to the researchers. Looking ahead, the scientists would like to make the plants even brighter and possibly even able to respond to people and surroundings.

2. BIOPHYSICISTS BLEND INCOMPATIBLE COMPONENTS IN ONE NANOFIBER

Russian researchers from the Federal Research Clinical Center of Physical-Chemical Medicine, the Moscow Institute of Physics and Technology, and Lomonosov Moscow State University showed the possibility of blending two incompatible components - a protein and a polymer - in one electrospun fiber mat. The study also demonstrates that the resulting mat can gradually release the protein. Blended mats containing proteins are promising for biomedical applications as burn and wound dressings, matrices for drug delivery and release, and in tissue engineering.

Electrospun mats consisting of ultrafine fibers have numerous applications. They can be used for liquid and gas filtering, cell culturing, drug delivery, as sorbents and catalytic matrices, in protective clothing, antibacterial wound dressing, and tissue engineering.

Electrospinning is a method for fabricating micro- and nanofibers from polymers that involves the use of an electrostatic field. Under a high voltage of about 20 kilovolts, a drop of polymer solution becomes electrified and stretches out into a thin fiber once the Coulomb repulsion overcomes surface tension.

The technique is fairly flexible and enables a range of components to be incorporated into electrospun mats: micro- and nanoparticles of different nature, carbon nanotubes, fluorescent dyes, drugs and antibacterial agents, polymer and biopolymer mixtures. That way the properties of the mats can be fine-tuned to fit a specific practical application.

Polymer-protein mats

An electrospun mat is often manufactured with a carrier polymer, which ensures stable fiber formation and can incorporate additional components. For biomedical applications, biodegradable and biocompatible polymers are usually required, and Polylactic Acid (PLA) is among the most common ones. PLA is used to produce degradable packaging, surgical threads, screws, and pins.

The main problem with using PLA in biology and medicine is its hydrophobic nature, and therefore poor cell adhesion. To address this, the polymer is blended with proteins, because they are nontoxic, hydrophilic, naturally metabolized, and can act as therapeutic agents.

The researchers studied blended mats consisting of the water-insoluble PLA and a water-soluble globular protein called Bovine Serum Albumin, or BSA. Experiments in a water medium showed the protein component to be released from the mat into the solution gradually. Specifically, about half of the protein in the mat was dissolved over a week. This effect suggests possible applications in prolonged release of protein-based drugs.

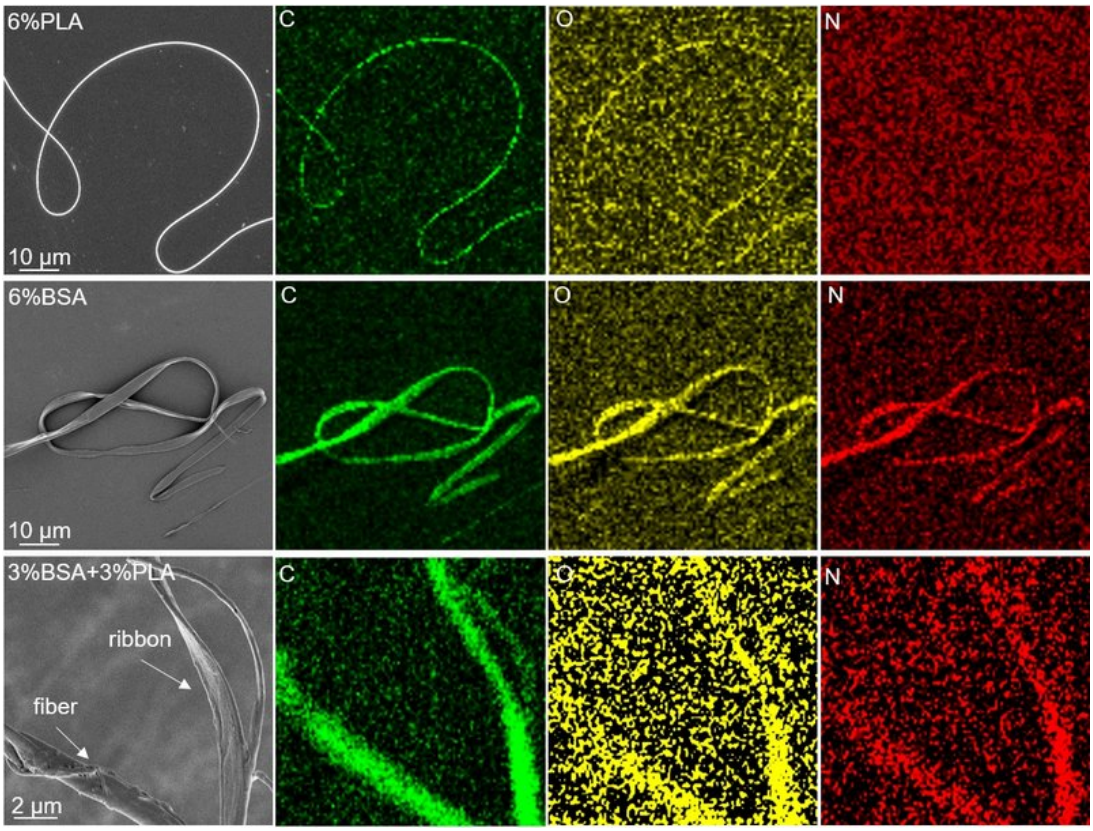


Fig.1 : EDX analysis of the fibers made of PLA (top row), BSA (middle), and the PLA-BSA blend in equal proportions (bottom). The color mapping corresponds to the chemical elements, with the carbon, oxygen, and nitrogen shown in green, yellow, and red

To predict the properties of the blended mats, the team had to study protein distribution in them. The caveat is that most polymers do not mix well. In a polymer-protein-solvent system, the components tend to separate into two solutions. Although

this does apply to PLA and BSA solutions, electrospinning allowed the researchers to overcome phase separation in mats. They showed both components to be present in every fiber (fig. 1) with three independent analytic methods: fluorescence microscopy, EDX spectroscopy, and Raman spectroscopy.

"Electrospun polymer-protein blended mats have many possible applications. By varying the amount of protein, you can tune how fast mat bio-degradation happens. The protein's numerous functional groups enable us to modify the mat surface by attaching chemical compounds to it. Protein-based blended mats could also be used as selective filters or for prolonged drug release, for example, in burn and wound dressings," as commented by the researcher, Dmitry Klinov, Head of the Laboratory of Medical Nanotechnologies at the Federal Research Clinical Center of Physical-Chemical Medicine of the Federal Medical and Biological Agency (FMBA) of Russia.

3. BLOOD AND SWEAT: WEARABLE MEDICAL SENSORS WILL GET MAJOR SENSITIVITY BOOST

Bio-sensors integrated into smartphones, smart watches, and other gadgets are about to become a reality. Researchers from the Moscow Institute of Physics and Technology describe a way to increase the sensitivity of biological detectors to the point where they can be used in mobile and wearable devices. The study was supported by the Russian Science Foundation (RSF).

A biosensor is an electrochemical device that determines the composition of biological fluids in real-time. Blood glucose meters used by diabetic patients may well be the only mass-market biosensing devices in use today. But futurologists say household appliances will soon be able to analyze sweat, saliva, aqueous humor, and other bodily fluids to identify a person, make medical tests, diagnose disease, or continuously monitor the health of an individual and make optimal diet suggestions accordingly.

Until recently, such applications were not seriously considered, because the available devices were not sensitive enough and were prohibitively expensive for the consumer market. However, it may be that a breakthrough is about to happen. A team of researchers from the MIPT Center for Photonics and 2D Materials has proposed a radically new biosensor design, which could increase detector sensitivity many times over and offer a similarly impressive reduction in price.

"A conventional biosensor incorporates a ring resonator and a waveguide positioned in the same plane," explained MIPT graduate student Kirill Voronin from the Laboratory of Nano-optics and Plasmonics, who came up with the idea used in the study. "We decided to separate the two elements and put them in two different planes, with the ring above the waveguide."

The reason researchers did not test that sensor layout before is that manufacturing a flat, single-level device is easier in a laboratory setting. By depositing a thin film and etching it, both a ring resonator and a waveguide are produced at the same time. The alternative two-level design is less convenient for manufacturing unique experimental devices, but it turned out cheaper for mass-producing sensors. The reason for this is that the technological processes at an electronics plant are geared toward layer-by-layer active component placement. More importantly, the new two-tier biosensor design resulted in a many times higher sensitivity.

A biosensor operates by registering the slight changes in the refractive index at its surface, which are caused by organic molecule adsorption. These variations are detected via a resonator whose resonance conditions depend on the refractive index of the external medium. Since even the slightest fluctuations in the refractive index cause a significant resonant peak shift, a biosensor responds to nearly every molecule that lands on its surface.

"We have positioned the strip waveguide under the resonator, in the bulk dielectric," said paper co-author Aleksey Arsenin, a leading researcher at the MIPT Laboratory of Nano-optics and Plasmonics. "The resonator, in turn, is at the interface between the dielectric substrate and the external environment. By optimizing the refractive indices of the two surrounding media, we achieve a significantly higher sensitivity."

The newly proposed biosensor layout has both the source and the detector of light within the dielectric. The only part that remains on the outside is the sensitive element. That is, the gold ring several dozen micrometers in diameter and one-thousandth that in thickness (fig. 1).

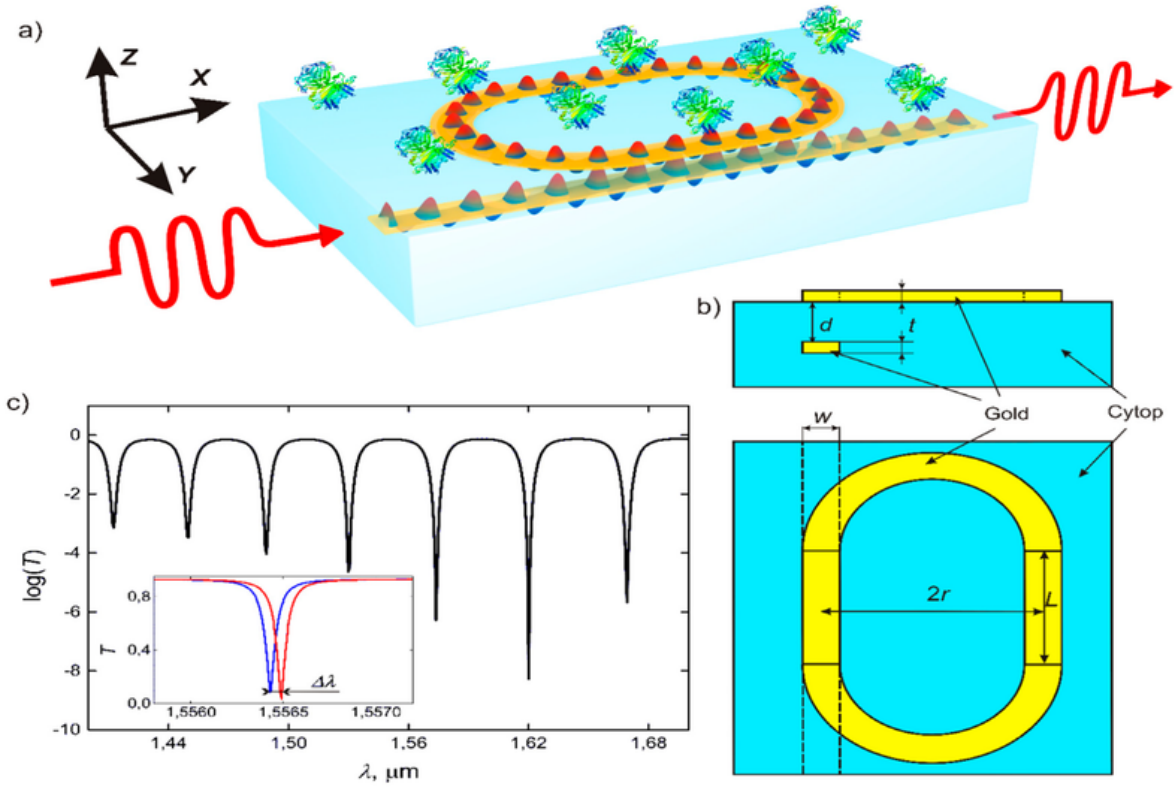


Figure 1. Biosensor layout (a, c).

The waveguide is inside the dielectric substrate. The resonator, realized as a ring waveguide, is positioned at the interface between the dielectric material and the biological fluid that is analyzed. A change in the fluid's refractive index shifts the resonant curve (b). Credit: Kirill Voronin et al./Sensors (https://www.mdpi.com/1424-8220/20/1/203)

According to Voronin, the team's method for making biosensors more responsive will take the technology to a qualitatively new level. "The new layout is intended to make biosensors much easier to manufacture, and therefore cheaper," the physicist said. "Optical lithography is the only technique necessary to produce detectors based on our principle. No moving parts are involved, and a tunable laser operating in a tight frequency range will suffice." Valentyn Volkov, who heads the MIPT Center for Photonics and 2D Materials, estimates that it will take about three years to develop an industrial design based on the proposed technology.

4. RUSSIAN AND AMERICAN SCIENTISTS DISCOVER NEW MICROBE FIGHTING MECHANISM IN BAIKAL BACTERIA

Researchers from the Irkutsk State University (Russia) and University of North Florida (United States) have discovered that Lake Baikal's large bacteria do not produce antibiotics, as similar organisms do, but fight microbes using other compounds that were never researched before, Russian Science Foundation said.

"Irkutsk University biologists, together with their Florida counterparts, have examined metabolism of Baikal actinobacteria — large micro-organisms capable of synthesizing biologically active substances. It turned out that these bacteria lack genes that code enzymes, required for antibiotic production. This means these bacteria fight microbes using other proteins and, possibly, chemical compounds unknown to the science," the message says.

Actinobacteria is a class of bacteria of large size and complex shape, capable of breaking down toxic chemicals that pollute the environment. They produce secondary metabolism products, which they do not need for growth and development, but which fulfill other roles. These chemicals include compounds used in medicine to suppress growth of pathogen bacteria and fungi.

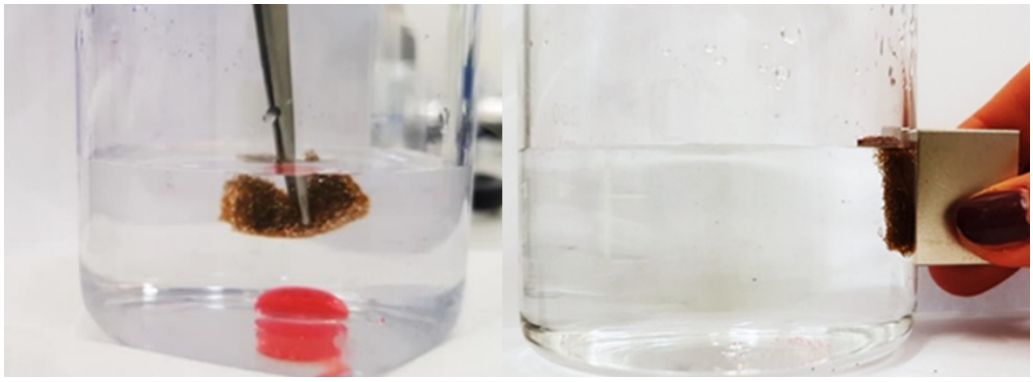
Under the new study, Russian and American researchers examined secondary metabolism products in 24 strains of actinobacteria, discovered in Lake Baikal sediments. They have isolated their DNA and examined the genes that code biologically active compounds. It turned out that these strains lacked genes for Flavin Adenine Dinucleotide (FAD)-dependent halogenases.

FAD is an enzyme, used in many biochemical processes. This enzyme is responsible for combination of halogen atoms, such as bromine and iodine, with various molecules. This leads to creation of antibiotics, such as tetracycline, chloramphenicol, and others. In the meantime, although Baikal actinobacteria lacked those genes, biological activity was observed in 75% of the examined strains, so the researchers have concluded that it happens due to some other enzymes.

"Normal actinobacteria might include halogen atoms into chemical molecules they synthesize. The lack of such ability in Baikal bacteria is their unique feature, which suggests long evolution in ultra-fresh environment. Special features of Baikal actinobacteria indicate their significant potential for production of yet unknown antibiotics and natural compounds," says lead researcher Maxim Timofeyev.

5. SUPERHYDROPHOBIC MAGNETIC SPONGE TO HELP PURIFY WATER FROM OIL PRODUCTS

Scientists of Tomsk Polytechnic University (TPU), have developed a new material capable of purifying water effectively from oil products. It is based on an ordinary household polyurethane sponge. The research team made it superhydrophobic - it repels water, while effectively sorbing oil product molecules.



"New oil production methods, especially the ones related to production on the seabed and ocean floor, raise up the risk of spills. We all know about the environmental impact of the accident that happened on a drilling platform in the Gulf of Mexico in 2010. Therefore, one of the most urgent scientific problems is to obtain selective sorbents capable to extract oil products from a water-oil mixture, avoiding interactions with water.

The latter point is crucially important since interactions with water basically result in some resultant products to end up in the water and affect the ecosystem. Furthermore, water saturation drops the sorbent effectiveness. Therefore, we had to find affordable material and make it hydrophobic and efficient for the mentioned goal. We decided in favor of a regular washing sponge," Pavel Postnikov, Associate Professor at TPU Research School of Chemistry & Applied Biomedical Sciences, says.

Diazonium salts, special organic compounds, were used to make a sponge hydrophobic. The sponge was placed in an aqueous solution with diazonium salts and heated to 60 °C. The resulting active radicals attacked the sponge and formed on the surface new organic groups with hydrophobic properties, being at the same time sensitive to oil products. They act as sorbents that selectively absorb oil molecules.

"The second issue is to find an efficient way to remove this material from water. We chose a magnetic sorbent collection. We added iron nanoparticles in the structure of the sponge, obtained by our original method and characterized by increased susceptibility to nonpolar molecules. We also added hydrophobic organic groups. As a result, we obtained material that almost does not interact with water despite the fact that it is a sponge," the scientist explains.

Petroleum products in water are in the form of an emulsion. This implies that their microscopic droplets are distributed in another liquid, in our case, in the water. According to the researchers, in practice, such emulsions are often highly stabilized. It means they are difficult to separate into individual components.

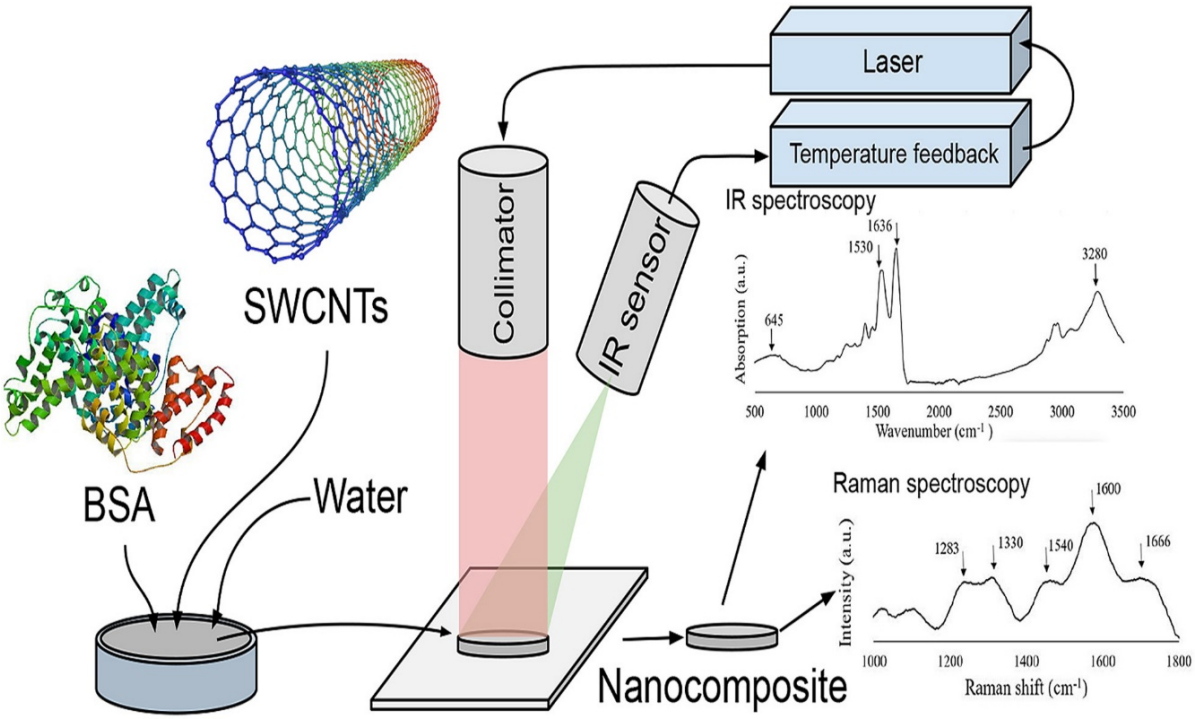
"We tested our material with both highly stabilized and low stabilized emulsions. The experiments demonstrated that the material is excellent. We also tested its effectiveness on industrial oils that can pollute natural water bodies. The material also showed its high efficiency," Pavel Postnikov says. Furthermore, the studies showed that the new material can be reused several times. "In experiments, we used it at least five times and there was no drop in its efficiency," the scientist says.

6. ORGAN REGENERATION

A new approach to organ regeneration, which has no analogues in price and efficiency, has been developed by scientists of the National Research University "MIET". The material created by them, as the authors explained, will allow to restore heart tissue after a heart attack in just two to four months. The data are published in the journal Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy.

Specialists of MIET for the first time in the world, according to them, managed to find a way to chemically bind carbon nanotubes with molecules of the most common blood protein — albumin. The physical mechanism discovered by them allowed us to develop a new method of laser 3D printing of nanocomposites.

"Under the action of a laser, a strong covalent bond occurs between albumin and carbon nanotubes, which makes it possible to print structures of a given shape. Living cells — for example, connective tissue, or myocardium - easily take root on such scaffolds (scaffolds), so that it is possible to effectively restore damaged tissues of the body," said Alexander Gerasimenko, head of the laboratory of biomedical nanotechnologies of the Institute of biomedical systems OF NIU MIET.



A figure above scheme for forming nanocomposite structures by laser printing and an image of a monolayer of connective tissue cells on a nanocomposite structure

As the scientists explained, the heart implants created by them are three to four times cheaper than Russian and six to eight times cheaper than foreign analogues, surpassing both in a number of parameters. In addition to scaffolds used in tissue engineering, the technology is also suitable for the production of biosensors, microfluidic systems and even advanced anti-cancer drugs.

"We are able to print a material that is similar in characteristics to heart tissue: it can contract with the myocardium and has electrical conductivity, allowing the heart's biological currents to pass through. Also, our method allows you to regulate the porosity of structures, ensuring the penetration of both living cells and the germination of capillaries and nerve endings, " explained Alexander Gerasimenko.

Before implantation, the printed scaffold is populated with living cells and matures for some time. According to the specialists OF NIU MIET, a number of successful experiments have shown that it is possible to use stem cells that can turn into cells of the tissue in which they are transplanted.

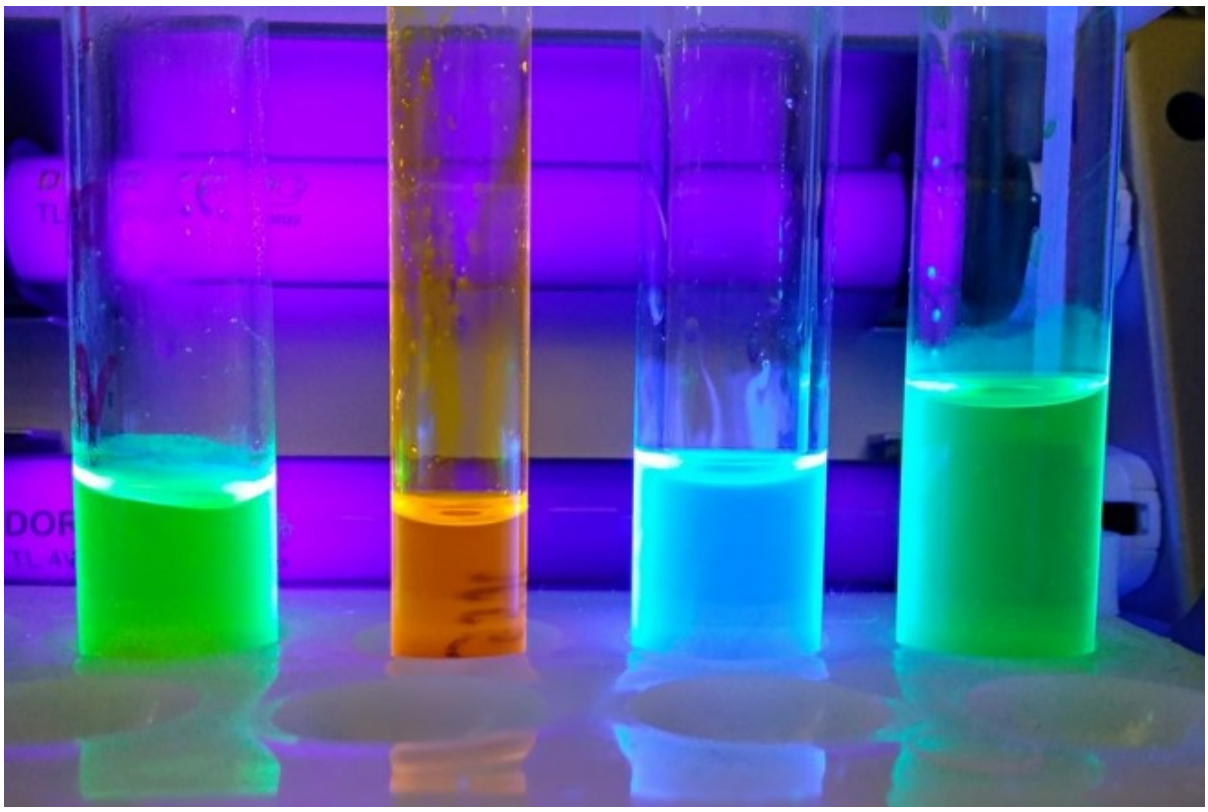
Scientists are confident that their method will effectively combat such pathologies as congenital heart defects and myocardial infarction, aneurysm, atherosclerosis and cardiosclerosis. According to the researchers, the nanocomposite "patch" for a myocardial infarction completely restores the affected area after two to four months, and the framework is then dissolved.

The scientists noted that the technology was implemented in close cooperation with leading Russian scientific and technical centers. In the future, the team intends to implement the method in clinical practice, as well as adapt the technology to create coatings for various implantable systems.

7. RUSSIAN BIOLOGISTS WORK ON NEW MATERIALS FOR TARGETED DRUG DELIVERY

Scientists of the Ural Federal University (UrFU) are working on a project of the targeted drugs delivery for the diagnosis and treatment of malignant tumors. To make this process more efficient, it is planned to develop new luminescent molecular carriers and organic fluorescent nanosized particles. The project was supported by the Russian Science Foundation (RSF).

“Fluorescence is the absorption of a quantum of light by a substance, followed by the emission of another quantum that has properties that are different from the original. This is an extra-ordianry phenomenon that we encountered in our research,” explains Natalia Belskaya, project manager, Professor of UrFU. We are actively studying the physics of this phenomenon, mastering the methods of its study and prospects for use. Substances with such unique photophysical properties are of great interest due to a wide range of applications, for example, as biomolecular labels or probes for research in biology, medical diagnostics. In addition, it is an important component of modern methods of treatment of socially significant diseases, which, in the first place, include malignant tumors.”



Photoactive substances are also necessary for the development of organic photonics, the creation of luminescent (LEDs and displays, luminescent qualitative and quantitative analysis, luminescent probes and tags) and photovoltaic devices (photodetectors, color-sensitized solar cells) – all these technical areas of using fluorophores strongly dictate the need for search and research new substances with specific optical properties.

“Targeted delivery involves a delivery of a biomolecule, or a diagnostic molecule or a sensor and is followed by its release from this complex system at a predetermined time. The case is suitable for studying the biological system or treating pathologies in medicine – notes Natalia Belskaya, and light radiation is one of the attractive external influences (stimuli) that initiates the release of a biomolecule or drug. Why exactly we need light radiation? Because it is not invasive, its effect can be carried out with high spatial and temporal accuracy, its action may be easily reproduced using various devices, its intensity can be easily controlled.”

When biologists implement such a targeted photo-delivery the toughest thing is choosing a photo-trigger (fluorophore) compound and the process of releasing a drug or diagnostic molecule from a photo courier using remote photo-irradiation. A feature of their upcoming studies is the use of original effective fluorophores synthesized over the past years in the university’s laboratory. The photophysical properties of these organic fluorophores, and for some of them the behavior in biological media (cytotoxicity, penetration into the cell and cellular organelles, the possibility of using flow cytometry), have already been studied.

8. RUSSIA, ITALY WORKING ON TREATMENT OF COVID-19 WITH PLASMA-BASED DRUGS

The Russian Direct Investment Fund (RDIF) is working together with Kedrion, an Italian company, and with the FSI investment fund on launching a project on treating COVID-19, a disease caused by the novel coronavirus, using drugs based on human blood plasma, the fund's press release informs.

"The RDIF is actively cooperating with Italian companies in the sphere of medical technology to find new means of combating the coronavirus. Together with one of the global leaders in the production of blood plasma-based products, the Kedrion company, and the FSI investment fund, we are working on launching a project in Russia on treating the coronavirus with drugs based on human blood plasma," head of the fund Kirill Dmitriev said.

9. CORONAVIRUS VACCINE IN RUSSIA MAY BE REGISTERED IN AUGUST

Now the development of the vaccine is at the stage of preclinical trials, which will last about another month

The coronavirus vaccine can be registered in Russia in August, said the Director of the National Research Center for Epidemiology and Microbiology named after N. F. Gamalei, Alexander Gunzburg.

"I think by the end of summer [they will register the vaccine]. I would like to [think so], I would answer that way. In August, I hope that everything will be as planned and there will be no surprises," he said in an interview for the film "Dangerous Virus 5" on the channel "Russia-1".

Now the development of the vaccine is at the stage of preclinical trials, they will last about another month. At this stage, toxicity, reactogenicity, and other criteria are determined, based on which it will be possible to begin testing the vaccine in humans. The vaccine, according to Gunzburg, will be administered in the right shoulder, but all Russians will not be able to receive it at the same time. "The Ministry of Health is thinking about how to do this, what capacities can be released to maximize their production of vaccines," he added.

10. AI FINDS POTENTIAL COVID-19 DRUGS THAT CAN BE USED ON HUMANS IMMEDIATELY

Researchers from Skoltech and AI company Gero has reviewed the existing drugs and other agents tested on humans and found potential coronavirus treatments. The list of found drugs has been released to initiate urgent clinical trials and collaborations. Gero, is led AI-driven drug discover and used its AI platform to identify the potential anti-COVID-19 agents that have been previously tested on humans. Six of them have been approved, three were withdrawn, and the other nine have been already tested in clinical trials. The emergency of the situation, as well as the legal and regulatory status of these agents, make it possible to start immediate clinical trials for most of the suggested drugs.

The company used its AI drug discovery platform to identify molecules with potential effects on the coronavirus replication. The fact that this time the potential treatments were found among the existing drugs marks a significant improvement over previous efforts to use AI to predict molecules active against COVID-19. The discovery makes it possible to start clinical trials in a matter of weeks.

Some of the drugs have been well known for decades and approved in many countries for human or veterinary use, some of them even have confirmed effects against SARS-CoV and SARS-CoV-2 viruses, while others have not been known previously for any related effects.
The drugs found to be potentially effective include:

- Niclosamide – an oral anthelmintic drug used to treat parasitic infections in millions of people worldwide. Niclosamide has been approved in Italy, the United States (now withdrawn), France, and some other countries.
- Nitazoxanide – a broad-spectrum antiparasitic prescription drug, that is used in medicine for the treatment of various helminthic, protozoal, and viral infections. Approved in the U.S., India, Mexico and some other countries. Niclosamide and Nitazoxanide have been recently recommended to be tried as COVID-19 treatment in patients.
- Afatinib - a prescription medicine approved in the U.S. for the treatment of patients with metastatic non-small cell lung cancer (NSCLC), along with 28

countries within the EU, China, and some other countries. Ixazomib - a prescription medicine used in combination with the medicines REVLIMID® (lenalidomide) and dexamethasone to treat multiple myeloma in patients who have received at least one prior treatment for their multiple myeloma. Approved in the U.S., EU and some other countries.

- **Senolytics** - The list of potential anti-COVID-19 drugs also includes several senolytics. **Senolytics** molecules that "kill" the so-called senescent or damaged cells) are attracting the growing interest from the academic world and the biotech industry for their potential against a range of age-related diseases and ageing itself.

Although, some of the drugs with anti-coronavirus potential have been approved for use on humans for other medical indications and are immediately available to the public, the researchers strongly urges against self-treatment and reaffirms the necessity of acting in line with the national regulations, including the rules for off-label use of available drugs.

The research also extends to urge pharmaceutical companies to share structural and/or omics data on their drug pipelines to find anti-COVID-19 and other new uses for their drug candidates using Gero AI drug discovery platform.

AI based drug discovery aims at new drugs targeting complex diseases using the next-generation artificial intelligence platform. The latest research has managed to overcome limitations of the previous-generation AI by offering not just a correlation analysis of biological big data, but causative models built with the use of physics of complex dynamic systems in addition to advanced machine learning. The first time the capabilities of this approach have been showcased was for a such complex condition as ageing. The interventions designed recently have enabled life extension and rejuvenation of multiple species, including mammals, demonstrating unprecedented results for the entire field.

11. GRANT SUPPORT FOR PROJECTS AIMED AT COMBATING COVID-19

RVC JSC announces the launch of an anti-crisis program of grant support for technological project developers within the framework of the NTI to combat the COVID-19 pandemic and its consequences.
Grant size: up to 50 million rubles, subject to 30% co-financing. Approval term: up to 1.5 months. Approved projects will also be able to get support in overcoming administrative barriers in the framework of interaction with the NTI working groups, which include representatives of relevant authorities. Few projects are listed below (www.rvc.ru_vs_covid19)

(a) **Express test** for coronavirus, we use the technology of the side stream - immunochromatographic tests. Their principle of operation is similar, for example, to a pregnancy test. A key part of the test is a detection reagent, in its role are gold nanoparticles of 30-40 nanometers associated with specific recombinant antigens to SARS-CoV-2. Conceptually, there will be a magnet with which we attract the specific antibodies that are in the patient's blood sample. If there are antibodies, then there will be two lines on the test, if not, one.

(b) **Tissue microchip**, will provide an opportunity for accelerated testing of anticoronavirus drugs and test systems that Russian developers are working on today. Reducing the duration of preclinical studies and technical testing will be possible through the use of tissue microchips. These microchips are a set of different fabrics that are packaged on a special substrate. Previously, to see how a drug interacts with 60 tissue samples, at least 60 experiments had to be done. Now this set of tissues can be placed on one microchip and get accurate results in one experiment. On average, it takes several years to develop new vaccines, and drug development can take up to 10 years. Tissue microchips allow you to go through some stages of drug testing much faster.

(c) **AI Based scan analysis**. The experience of the coronavirus epidemic development observation shows that CT and X-Ray studies are the most important methods for the coronavirus infection comprehensive diagnostics. Severe cases of coronavirus and mortality associated with it are closely related to the development of viral and bacterial (secondary) pneumonia, which is why these methods have become widely used for patients with suspected coronavirus infection and suspected lung damage caused by it. The results of these studies play a crucial role in patients treatment and the workload of radiologists significantly increases as a result. Botkin.AI, has quickly developed and integrated into its platform a product for the pneumonia detection. This will reduce risks and remit the possible consequences of COVID-19. Due to the complicated epidemiological circumstances and the need for quick reaction on virus spread, the new platform product will be provided for all medical organizations involved in the diagnosis and treatment of patients with COVID-19 for free.

(d) **Early diagnosis of COVID-19 by the rate of gas exchange in the lungs.** The SARS Cov-2 virus primarily affects the lungs, which leads to a decrease in the intensity of gas exchange in an infected person. Since the initial stage of infection is the penetration of COVID-19 into the target cells, with the alveolar lung cells being the main and quickly achievable target, a decrease in gas exchange intensity may indicate infection already in the early stages. The use of cheap and easy-to-use optical gas sensors that determine the concentration of carbon dioxide in the exhaled air allows you to create and quickly establish a mass production of simple devices that determine the low rate of gas exchange in the lungs even in the absence of external symptoms of the disease, which can serve as a signal for a genetic test for coronavirus patient. The simplicity and ease of analysis using such a device will allow preliminary selection on a massive scale, it is also important that such a technique does not need consumables requiring replacement. The device using a modern element base will be very compact, mobile, in addition, the sensor can be released as a prefix to the smartphone. For mass diagnostics with a single device, only a change or disinfection of the mouthpiece will be required. In the future, the developed sensor can find application in other safety systems, involving the determination of CO2 concentration.

(e) **FusionCrowd.** The project develops simulation modeling mechanisms to evaluate and optimize the results of the proposed restrictive measures, as well as automatically generate human flow management solutions to eliminate crowding. This ensures the manipulation of the intensity of human

flows (flexible schedule); routing of human flows (including marking measures, etc.); management of goal-setting of clients with the aim of breeding them in time and (or) space (by way of pointers, video and audio information, etc.). The software FusionCrowd allows you to configure and reproduce the dynamics of moving people; allows the operator to determine the rules necessary for the correct organization of people in open and closed spaces. The FusionCrowd system can also work by combining various behavioral models that are commonly used to model pedestrians, which increases the reproduction efficiency of pedestrian dynamics. To solve the optimization problem, network models of transmission of infection by airborne droplets and contact-household methods are used.

The system is available in the form of an Internet service and can be configured for various forms of spaces and different types of activities (supermarket, transportation hub, mass service center, enterprise, educational institution, etc.).

12. BIOLOGIST DESCRIBE ORGANS THAT NEED TO BE CHECKED AFTER COVID-19

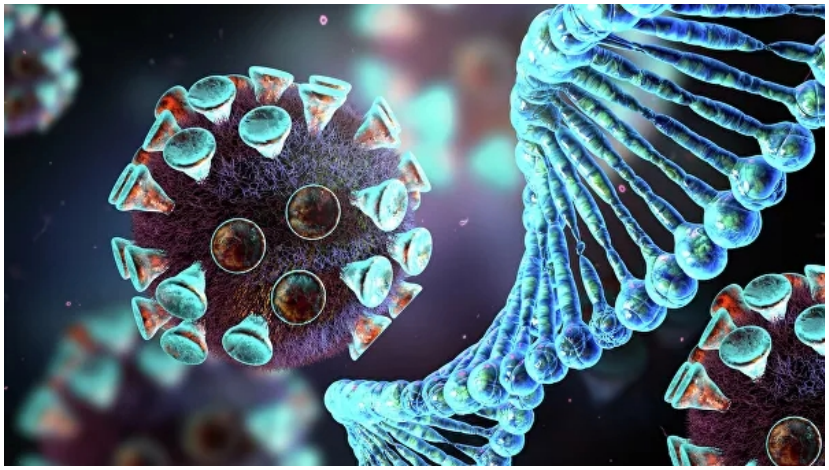
After recovering from COVID-19, first of all, it is necessary to check the lungs, kidneys and brain, told, doctor of biological sciences Ancha Baranova. *“After COVID-19, you need to check three main systems in the body: the lungs, kidneys and the brain. You need to go to the lung specialist with the lungs. You need to also check the kidneys. Their condition will show a very common analysis - blood biochemistry. There is an indicator that reflects how the kidneys are functioning. If everything is okay with him, then you don’t need to go to the nephrologist, otherwise it's better to go, "said Baranova.* According to Baranova, there is already evidence that COVID-19 affects the functioning of the kidneys. In a blood test, you need to look at a specific indicator - glomerular filtration rate.

“The third system is the brain, the functioning of the central and peripheral nervous system. As the virus has repeatedly noted, there are neuroinflammations,” the biologist said.

Baranova reminded that in humans after coronavirus memory may deteriorate, ability to concentrate may decrease, headaches may appear. "Typically, such problems usually do not go anywhere, but in theory it is necessary to work with this. In principle, a neuropathologist can help deal with this," the scientist said.

Actual data on the situation with COVID-19 in Russia and in the world are presented on the stopkoronavirus.ru portal.

13. SCIENTISTS TALKED ABOUT THE EFFECT OF CORONAVIRUS ON THE LUNGS



The lungs of coronavirus infected COVID-19 after the most severe cases will remain vulnerable for six months, 30% of those who recover may have chronic breathing problems, suggest Prof. **Alexander Logunov**.

Pulmonary fibrosis, that is, the appearance of cicatricial changes, can lead to irreversible consequences for breathing and threatens to become a common pathology in the future, said Luca Richeldi, professor of pulmonology at the Roman hospital at Gemelli, who is a member of the scientific and technical committee of the Italian government to combat with the COVID-19 epidemic.

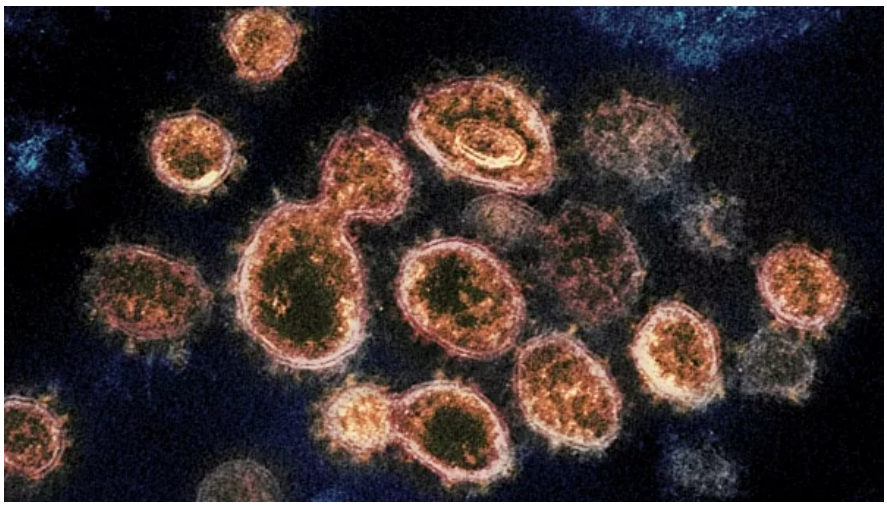
"There is a growing belief that patients who have been in hospitals for a long time have a long time to recover respiratory function, and in severe cases it may not be complete. Therefore, experts warn of the need for respiratory rehabilitation courses and methods for finding out which patients are at risk of getting irreversible damage".

According to Rikeldi, doctors are observing breathing problems "in many patients with COVID-19 who have been hospitalized or intubated," after they are discharged. These difficulties are likely to last for many months, the expert warns.

"Data from the past collected from SARS patients with SARS show that six months after their recovery, they retained pulmonary abnormalities that can be clearly seen on x-rays and restrictive changes in respiratory function. These are decreased respiratory capacity, decreased lung capacity, and weakened respiratory muscles and, above all, less resistance to stress with a decrease in the distance covered in six minutes of walking, "says Rickeldi, drawing parallels with the current epidemiological picture of COVID-19.30% of the survivors have fibrotic changes in the lungs: in fact, he notes, this may mean breathing problems after a simple walk.

Participants in a virtual symposium compared the first data collected during the coronavirus epidemic in Italy and a 2003 study by Chinese doctors about a SARS outbreak. The consequences of pulmonary fibrosis for adults on average should go away within six months to a year, but in some patients the restoration of respiratory functions will be incomplete.

In this regard, experts talk about the need for specific studies for former hospitalized patients who may need pharmacological treatment and rehabilitation. The proliferation of patients with fibrotic lesions of the lung tissue risks becoming a new medical problem.



BRIEF DETAILS-FEW IMPORTANT RUSSIAN R&D INSTITUTES

1. STATE SCIENTIFIC CENTER OF THE RUSSIAN FEDERATION "ARCTIC AND ANTARCTIC RESEARCH INSTITUTE" - THE LEADER OF RUSSIAN POLAR SCIENCE

Brief information

Russia's leading scientific organization in the field of integrated study, assessment and forecast of the state of the natural environment in the Arctic and Antarctic. Its main activity is research and development in the field of Hydrometeorology, Oceanography, climatology, Geophysics, water resources and environmental protection; operational hydrometeorological support of various types of activities in the Arctic, Antarctic and freezing seas of the Russian Federation; predictive and analytical activities in the field of polar research.

Background

The institute was established in 1920 and works on priority areas and critical technologies for the development of science, technology and engineering. AARI works within the framework of the priority direction "Rational use of natural resources" on two critical technologies: "Technologies for monitoring and forecasting the state of the environment, preventing and eliminating pollution", "Technologies for preventing and eliminating natural and man-made emergencies".

Participation in the implementation of technology platforms

Participates in the implementation of the technological platform "Technologies of environmental development".

Innovative project Development and implementation of automated technologies for the assimilation of operational data using modern GIS and the formation of databases and data banks on the state of the atmosphere and hydrosphere. Development of

specialized hydrometeorological support systems for ice navigation and operations of oil and gas complex organizations on the Arctic shelf. Development and practical implementation of unique technologies for penetrating lake Vostok in Antarctica; development of new methods for analyzing ice cores and methods for interpreting the data obtained.

Research and experimental base: 18 scientific divisions, including the ice hydrometeorological information Center, the World Sea ice data center, the Polar geophysical center, the center for polar medicine, the laboratory for climate change and the environment, and the Svalbard Scientific coordination center. It has two ice-class research and expedition vessels with unlimited navigation areas: "Akademik Fedorov" and "Akademik Treshnikov". There is a complex of ice pools, a research station "Gorkovskaya" and a field base "Ladoga" (Leningrad region), a Hydrometeorological Observatory (village Tiksi), the Ice base at Cape Baranova (Bolshevik island, Severnaya Zemlya), 5 Russian Antarctic stations (Antarctica). AARI has over 1000 employees, including 345 researchers. The Institute has currently, 17 doctors of science and 106 candidates of science.

Availability of Agreements with Higher Educational Institutions: AARI trains young specialists in cooperation with the Russian state hydrometeorological University (RSMU), Saint Petersburg state University (SPBU), as well as with other Universities (Moscow state University (MSU), Northern (Arctic) Federal University named after M. V. Lomonosov, Herzen Russian state pedagogical University).

Basic departments, scientific schools: Three scientific and pedagogical schools (Climate of the polar regions; Sea ice; Upper atmosphere and near-earth outer space of high latitudes); three scientific and educational structures and postgraduate courses; the basic Department "Geoecology and nature management of the polar regions" (together with the State polar Academy).

Main partners

Actively cooperates with many institutes of the Russian Academy of Sciences, Russian Ministries and other scientific institutions. Amongst other partners are such SSCs as the hydrometeorological center of Russia, the Krylov state scientific center, the D. I. Mendeleev all-Russian research Institute and the all-Russian research Institute of aviation materials. The Institute's services are also utilised by Russian and foreign companies: Gazprom, Rosneft, Yamal LNG, MMC Norilsk Nickel, Varandeysky terminal, Lenskoe United river shipping company, Exxon Neftegaz limited, Exxon Mobil, BP, ENI, Marine Arctic exploration expedition, and others.

International scientific and technical cooperation

AARI has recently signed an MoU for research and support in Southern Oceans with National Center for Polar and Ocean Research (NCPOR), India. It cooperates with foreign organizations in Germany, Norway, Finland, the USA, Canada, Japan, Sweden, France, China, India, Chile and other countries. The Institute has a Russian-German Schmidt laboratory for marine and polar research. Employees participate in the implementation of international projects and grants, the activities of committees, commissions and groups of international organizations related to polar research, such as the world meteorological organization, the Arctic Council, the Scientific Committee on Antarctica, etc.

Contact information

38 Bering Street, Saint Petersburg, 199397, Tel.: 8 (812) 337-31-23, Fax: 8 (812) 337-32-41 ***Website*** *www.aari.ru* ***E-mail:*** *aaricoop@aari.ru*

2. FEDERAL RESEARCH CENTER ALL-RUSSIAN INSTITUTE OF PLANT GENETIC RESOURCES (named after N. I. Vavilov (VIR)

Brief information

The leading scientific organization of Russia for the collection, conservation, study and effective use of collections of the world's genetic resources of plants in breeding and crop production. The only Russian gene Bank of plant resources collected from all continents of the Earth, comprising 325660 samples represented by 64 Botanical families, 376 genera and 2169 species, which serves as a strategic base for the effective and stable development of not only agriculture, but also all branches of the economy and social sphere. The unique herbarium collection, comprising 345,018 herbarium leaves, is located under the UNESCO protectorate. It has nine pilot stations and two branches: "Kuban genetic seed Bank" - preserving the world's gene pool of cultivated plants and their wild relatives; "Polar experimental station" - collection, storage and study of the world's gene pool.

Background

The Institute was founded in 1924. The work is carried out within the priority areas of "life Science", "Rational use of natural resources" and four critical technologies.

Innovative projects

The main innovative products are methods and technologies of selection, new forms of plants, pre-varieties and donors of economically valuable traits; new varieties and

hybrids of agricultural crops that are put into production on the experimental base of the Institute and its stations; strategies for breeding short-stemmed, disease-resistant and low-bentosan grain-forage winter rye (know-how) have been developed. Innovative projects are being developed to create renewable energy sources based on the use of plant resources.

Main partners

Conducts joint research with RAS institutes; RAS: the Main Botanical garden of the Russian Academy of Sciences and maintains contacts with over 100 research institutes and genebanks of foreign countries.

International scientific and technical cooperation

Joint work is being carried out with the UNFA; the international scientific coordination center Bayovercity International (Rome, Italy); the European plant breeding Association (EUKARPIA); the Nordic center for agrobiodiversity (NSB, Sweden); Sidnet (Sweden), etc.

Contact information
42, Bolshaya Morskaya str., 44, Saint Petersburg, 190000, tel.(812) 314-47-37, (812) 314-22-34; Fax (812) 570-47-70
Website ***www.vir.nw.ru***
E-mail: *m.kuznecova@vir.nw.ru*

3. D. I. MENDELEEV ALL-RUSSIAN RESEARCH INSTITUTE OF METROLOGY
(Federal state unitary enterprise "VNIIM named after D. I. Mendeleev»)

Brief information

The leading metrological center in Russia. SSC RF FSUE "VNIIM n. a. D. I. Mendeleev" administrative documents of Rosstandart (formerly Gosstandart) determined the head organization in the country for basic research in the field of Metrology, the Main center of state standards of the Russian Federation, the State center for testing measuring

instruments, the base organization of the Metrological Academy of the Russian Federation.

Research and experimental base

Unique experimental equipment for metrological purposes (54 state primary standards of the Russian Federation, special buildings and structures for their maintenance and use, underground laboratory at depth 45 m, total area 1100 sq.m a large hydro-pool, etc.).

Availability of agreements with higher educational institutions

Within the framework of cooperation with 6 universities of St. Petersburg, the SSC of the Russian Federation FSUE "VNIIM named after D. I. Mendeleev" worked on the implementation of joint programs in scientific, educational, industrial and innovative spheres of activity: Saint Petersburg national research University of information technologies, mechanics and optics; Saint Petersburg state University of aerospace instrumentation; Peter the Great Saint Petersburg Polytechnic University.

Basic departments, scientific schools

There are six leading scientific schools, 2 basic departments of the St. Petersburg national research University of information technologies, mechanics and optics and 1 basic department of the national mineral resource University "Gorny".

International scientific and technical cooperation

It cooperates with foreign national metrological institutes and international metrological organizations in the field of Metrology and standardization and represents Russia in 7 of the 10 Advisory Committees of the International Committee on weights and measures. Participates in key comparisons of national standards organized by the International Bureau of weights and measures (BIPM), the ICMM CC and Regional metrological organizations (RMO).

It is a member of two RMOS: The organization for cooperation of state metrological institutions of Central and Eastern Europe (COOMET) and the Asia-Pacific metrological program (APMP). Participates in the activities of two other RMOS: The organization for European cooperation on standards (EVRAMET) and the Metrological organization of North and Central America (SIM).
The institute participates in the work of the International organization for legal Metrology (OIML), the International organization for standardization (ISO), the International electrotechnical Commission (IEC), the APEC advanced materials Structure (ANMET), the International atomic energy Agency (IAEA) , the Committee on data for science and technology (CODATA), and others. It provides Russia with the 2nd place in the world (after the USA) in the level of metrological services (75% of the positions of calibration and measurement capabilities of Russia in the BIPM database belong to the Mendeleev Federal state unitary enterprise VNIIM).

Contact information

19 Moskovsky Ave., Saint Petersburg, Russia; tel. 8 (812) 251-76-01; Fax 8 (812) 713-01-14
Website *www.vniim.ru*
E-mail: *info@vniim.ru*

4. FBSI SRC VB "VECTOR (Federal Budgetary Institution of Science : The State Scientific Center for Virology and Biotechnology "Vector")

Brief information

It is one of the largest virological and biotechnological centers in Russia. Fundamental research activities are aimed at obtaining new scientific knowledge in the fields of molecular epidemiology, molecular biology, genetic and cellular engineering, biotechnology, nanobiotechnology, ecology and biosecurity. Applied research is aimed at developing effective tools and methods for the prevention, treatment and diagnosis of infectious diseases. Since 1997, the WHO Collaborating center for orthopoxvirus infections diagnostics and the Museum of strains and DNA of the smallpox virus has been functioning on the basis of the SSC VB "Vector". Since 2009, the WHO reference laboratory for the diagnosis of H5 influenza, the only one in Russia and one of 13 in the world, has been functioning on the basis of the world health organization's SSC "Vector".

The Center's mission is to provide scientific and practical support for countering global biological threats.

Work on priority areas and critical technologies for the development of science, technology and engineering

The work is carried out in the priority areas of science, technology and engineering of the Russian Federation: "Security and counter-terrorism", "Science and life" and on critical technologies: "Biocatalytic, biosynthetic and biosensory technologies", "Biomedical and veterinary technologies", "Genomic, proteomic and postgenomic technologies", "Cellular technologies"," Nano -, bio -, informational, cognitive technologies","bioengineering Technologies".

Participation in the implementation of technology platforms

Fsbu SSC WB "Vector "is a member of the Technological platform" Medicine of the future "and the Technological platform "Technologies of ecological development".

Innovative project

Multiplex test systems for detecting infections transmitted through tick and mosquito bites, multiplex test systems for detecting more than 10 intestinal infections, culture, recombinant and DNA vaccines against socially significant and especially dangerous viral diseases, including the SARS-Cov-2, smallpox virus, polyepitope vaccines against HIV/AIDS and other infectious diseases of humans and animals, new methods of delivery of vaccines and medicines (tablet, micro-encapsulated, nanomicrocapsulated), antiviral drugs and antitumor drugs, new methods of differential diagnosis of somatic diseases using dielectrophoresis, mathematical models of the spread of infectious disease epidemics.

Research and experimental base

A unique scientific and experimental base for conducting research with the most dangerous viruses for humans, including those for which there is no cure and specific prevention, in conditions of complete safety for working personnel and the environment. Modern equipment for conducting molecular biological, diagnostic, biotechnological, and aerosol studies. Availability of a site for the production of vaccine preparations, a site for the production of nutrient media, measles vaccine in accordance with GMP requirements, as well as pilot sites for the production of experimental batches of developed vaccines and medicines.

SARS-Cov-2 related research

In Russia, for the prevention and control of the COVID-19 epidemic at the State Research Center of the World Bank "Vector" of Rospotrebnadzor, is the main center which has developed vaccine prototypes based on six different technological platforms were developed in the shortest possible time. Researchers at Vector have been able to create vaccines based on the widely used recombinant viral vectors of influenza, measles and vesicular stomatitis, as well as on the basis of promising synthetic vaccine technologies: mRNA vaccines, peptide vaccines and subunit vaccines. For the design of vaccines, modern bioinformation systems were used, and the construction and upgrading to finished prototypes was carried out using advanced developments, including in the field of reverse genetics.

Basic departments, scientific schools

The Center has four leading research and teaching schools: Microbiology, immunology and Virology, genetic engineering, and biotechnology. Has an agreement with ASU on the development of basic Department "biopharmaceutical products based on recombinant technologies."

Main partners

It carries out scientific cooperation with institutions of the Russian Academy of Sciences, SB RAS, RAMS, SB RAMS, SB RAS, research institutions of Rospotrebnadzor, with the SSC of the Russian Federation, higher educational institutions and pharmaceutical enterprises.

International scientific and technical cooperation

- with WHO on influenza as a member of the who Global influenza surveillance and response system;
- with WHO as experts of the who Advisory Committee for the study of smallpox virus;
- with the Centers for disease control and prevention (CDC, Atlanta, USA);- with the who reference laboratory for H5-subtype influenza (Hong Kong, China);
- with the WHO Collaborating center for the study of influenza ecology in animals and birds (Memphis, USA);
- The WHO collaborating centre for influenza reference diagnostics and research (London, UK);
- with the Northwest Institute of Plateau biology, Chinese Academy of Sciences, Beijing Institute of biological Sciences, Chinese Academy of Sciences, Institute of immunology of the Academy of Sciences of the Republic of Uzbekistan, national influenza centres of the CIS countries (Kazakhstan, Kyrgyzstan, Azerbaijan, Belarus, Uzbekistan, Tajikistan).

Contact information
630559, Koltsovo village, Novosibirsk region; tel. 8 (383) 336-60-10; Fax 8 (383) 336-74-09
Website:*www.vector.nsc.ru*
E-mail: *vector@vector.nsc.ru*
E-mail: *info@gosniias.ru*

5. STATE RESEARCH INSTITUTE OF GENETICS AND SELECTION OF INDUSTRIAL MICROORGANISMS (FSBI" GOSNIIGENETIKA»)

Brief information

The leading center of biotechnological science in Russia, a leader in the study of the genetics of industrial microorganisms, including actinomycetes, bacilli, various types of bacteria, yeast. It creates competitive technologies using the methodologies of Pro - and eukaryotic organism genetics, bioengineering, immunology, bioinformatics, Biocatalysis and other modern approaches to solving fundamental and applied problems, the production of amino acids, various-purpose enzymes, medicinal products based on recombinant proteins, antibiotics, vitamins, organic acids and alcohols. It supports and develops the all-Russian collection of industrial microorganisms, which includes over 16,000 different strains.
It has a collective use center "Identification and assessment of the biotechnological potential of microorganisms".

Background

The Institute was founded in 1968 and participates in the implementation of the priority directions "Living systems", "industry of nanosystems and materials" and critical technologies: "Biocatalytic, biosynthetic and biosensory technologies", "bioengineering Technologies", "Biomedical and veterinary technologies for life support and protection of humans and animals" and "Technologies for creating biocompatible materials", etc.

Participation in the implementation of technology platforms

Participates in the implementation of technological platforms "BIOTECH 2030" and "Medicine of the future".

Innovative project

In 2007-2012, the most important innovation project of national significance was implemented: "Production of recombinant proteins for medical use based on animal and microbial cell cultures using highly efficient technological platforms". In the period from 2011 to 2014, 4 projects were implemented within the framework of event 2.5 "Preclinical study of innovative medicines" of the Federal target program "Development of the pharmaceutical and medical industry of the Russian Federation for the period up to 2020 and beyond".

Research and experimental base

The Institute has a modern material and technical base, including the necessary equipment for working with microorganisms, their genes and enzymes. The center for collective use "Identification and assessment of the biotechnological potential of microorganisms", the all-Russian collection of industrial microorganisms, as well as two experimental sites allow us to carry out a full range of work on the creation of processes for obtaining recombinant proteins based on mammalian and microbial cell cultures. The Institute has robotic systems for mass screening of mutant variants of enzymes, fermentation and analytical equipment (gas and liquid chromatographs, capillary electrophoresis and isoelectric focusing) for assessing biotechnologically valuable properties of microorganisms, equipment for DNA sequencing, oligonucleotide synthesizers, multi-channel DNA amplifiers, etc.

Patents and certificates

In 2012-2014, 29 patents and 31 decisions on patent issuance were received. currently, 76 patents, including 7 international ones, are supported by Gosniigenetika. In recent years the Institute's specialists have been involved in the preparation of 15 international patents together with leading foreign companies

Availability of Agreements with higher educational institutions

Moscow state University. M. V. Lomonosov, D. I. Mendeleev, PFUR, MGUPP, Sechenov University, MIPT, Russian state agrarian University-MA, MITHT named after M. Y. Lomonosov.

Basic departments, scientific schools

There are 2 Research and educational centers "Microbial biotechnologies" and "Nanotechnology". Employees of the Institute conduct special courses, give lectures at the Lomonosov Moscow state University, MIPT, etc.

Main partners

Cooperation with the Biological and Chemical faculties of Lomonosov Moscow state University, IBH. Academicians M. M. Shemyakin and Yu. a. Ovchinnikov (RAS), V. A. Engelhardt Institute of molecular biology (RAS), A. N. Bach Institute of biochemistry (RAS), V. N. Orekhovich Institute of biomedical chemistry, Endocrinology research center, Cardiology research center, N. N. Blokhin Research center, GosNII of highly

pure biological preparations, Institute of Transplantology, Institute of emergency medicine (IMEM), And others. Sklifosovskogo etc.

International scientific and technical cooperation
The Institute performs research within the framework of international programs such as the EU FP7 science and technology development Program, as well as the interstate program "Innovative technologies" of the EurAsEC countries. The Institute carries out joint projects with the companies "Ajinomoto" (Japan), "Novozaym" (Denmark), "Sinopharm" (China), Xichuan Institute of antibiotics, (China), etc. The Institute is a member of the world Federation of crop collections, the European Association of crop collections, The international yeast Commission, The international Committee on virus taxonomy, the European community for the study of human genetics, the Cluster of industrial biotechnology.

Contact information
1 Dorozhny proezd, Moscow, 117545; tel. 8 (495) 315-37-47; Fax 8 (495) 315-05-01
Website:*www.genetika.ru*
E-mail: *genetika@genetika.ru*

6. (SSC RF-IMBP RAS)

Brief information

Russia's leading scientific organization in the field of space biology and medicine, environmental physiology and extreme medicine. The main areas of scientific activity are space biology and medicine, gravitational physiology, environmental and extreme medicine; development of biological life support systems; cellular physiology and biotechnology; psychophysiology; medical and biological support of space flights, including radiation safety issues; research in the field of hyperbaric physiology, aviation and diving medicine, studying the mechanisms of adaptation of a healthy person to the impact of environmental factors. There is a Branch (Nalchik, Kabardino-Balkaria).

Background

Institute of biomedical problems (IBMP) was established on the basis of the Resolution of the CPSU Central Committee and USSR Council of Ministers dated 28 October 1963 and of the decree of the Minister of health of the USSR of 4 November 1963, as lead Agency of the country on the problems of space biology and medicine. In 1994 The Institute has been awarded the status of the State scientific center of the Russian Federation, which is confirmed every two years by Orders of the President of the Russian Federation. Since 2000, SSC RF – IBMP RAS is Russian Academy of Sciences.

Work on priority areas and critical technologies for the development of science, technology and engineering

Participates in the implementation of the priority direction "Living systems" and four critical technologies.

The Institute's developments are aimed at solving key tasks of ensuring effective and safe human work in extreme conditions, preserving human health and professional longevity, as well as studying the mechanisms of adaptation of living systems of various levels of organization to the action of extreme environmental factors.

Innovative project

Introduction into clinical practice of new means and methods of rehabilitation and treatment of patients with motor disorders, developed on the basis of space medical technologies. Development of technologies and creation of means of control and correction of functional reserves of the human body. Introduction of a new tool and method of rehabilitation and treatment of patients with motor disorders – the plantar support load simulator.

Research and experimental base

Stands and installations for studying the influence of various extreme factors and their combinations (space and aviation flights, deep-sea dives, intense physical exertion, stay in an altered gas environment, etc.) on the human body and other living systems; testing the effectiveness of created life support systems for activities and habitation in extreme conditions, protection against adverse effects, rescue and survival; for the implementation of medical and biological support programs for manned space flights; solutions to various problems of physiology and medicine, practical health problems: deep-sea diving complex, research centrifuge, block of inhabited compartments, center for physiological testing, etc.

Medico-biological research is carried out using space equipment and installations developed in the SSC RF – IMBP RAS on unpiloted spacecraft (such as "Bion", "Photon", etc.), on manned spacecraft and the space station

Availability of agreements with higher educational institutions

Faculty of fundamental medicine and psychology of Lomonosov Moscow state University, MAI, MIPT, faculty of Biology of Moscow state University.

Basic departments, scientific schools

4 basic departments, scientific school "Molecular and cellular effects of space flight factors", scientific and educational center "Efficiency".

Main partners

Institutes of the Russian Academy of Sciences, leading educational institutions of Russia, scientific organizations and enterprises of various industries (more than 100 organizations).

International scientific and technical cooperation

Cooperation with the space agencies of the USA, Europe, Japan and Canada, as well as with scientific institutions of the USA, France, Germany, Canada, Japan, Austria, Italy, Bulgaria, Hungary, China and a number of other countries.

Contact information

76A Khoroshevskoe shosse, Moscow, 123007; tel. 8 (499) 195-15-73; Fax 8 (499) 195-22-53, ***Website:*** *www.imbp.ru* ***E-mail:*** *info@imbp.ru*

7. SMORODINTSEV INFLUENZA RESEARCH INSTITUTE OF THE MINISTRY OF HEALTH OF RUSSIAN FEDERATION

Background

Research Institute of Influenza (RII) was founded in 1967 as a lead institution under the Ministry of Public Health of the USSR to explore the «Influenza and Influenza-Like Illnesses (ILI) problem». The area of research included virology, immunology, and epidemiology of influenza and other acute respiratory infections (ARI), and designing means for their prevention and therapy. During 1992–2010 the Institute was incorporated into the Russian Academy of Medical Sciences (RAMS).Since the end of 2010, the activities of RII were continued under the Ministry of Health and Social Development of the Russian Federation (RF MPHSD).

The founder and first director of the Institute was Dr. Anatoly Alexandrovich Smorodintsev: member of the USSR Academy of Medical Sciences; an outstanding Russian virologist; creator of the nation’s first virology laboratories; and one of the founders of the domestic school of virologists. He made invaluable contributions to solving the problems of medical virology, microbiology, and epidemiology. Under his leadership, a number of live and killed antiviral vaccines were developed against mumps, measles, rubella, tick-borne encephalitis, and other infections. His studies of the poliomyelitis vaccine, including gathering data about its safety, were truly outstanding. These investigations, conducted in collaboration with his colleague Mikhail Petrovich Chumakov, contributed to the eradication of poliomyelitis all over the world.

Later, the Institute was headed (1973 to 1976) by Professor Mikhail Petrovich Zykov. During the 1976 to 1988 period, Professor Georgiy Ivanovich Karpukhin was the director, and from 1988 to 2015, the Institute of Influenza was headed Russian Academy of Sciences member Oleg Ivanovich Kiselev, a well-known specialist in the field of molecular virology and biochemistry.

Dr. Kiselev headed the "Influenza and Influenza-like Infections" Problem Commission (Russian Academy of Sciences), the Interdepartmental Commission for Vaccines and Diagnosis of Strains (Russian Ministry of Health), and the St. Petersburg Branch Council of the Russian Society of Biochemists and Molecular Biologists (Russian Academy of Sciences). He was also a WHO expert and served on the editorial boards of scientific

and medical journals. Professor Kiselev established a school of molecular biologists and genetic engineers, and he trained four doctors of science and 10 candidates of science. The results of his scientific research are reflected in 12 monographs, over 200 publications, and in 48 patents.

Over its existence, Institute employees have made significant contributions in a number of areas: fundamental and applied problems in the field of influenza evolutionary variability (Prof. T. Y. Luzyanina, Prof. D. B. Golubev); antiviral immunity (Prof. R. Y. Polyak, Y. S. Shvartsman); development of diagnostic tools for viral infections (Prof. A. A. Sominina, Candidate of Medical Sciences L. E. Kamforin); as well as studies of the molecular basis of virus attenuation and obtaining the first reassortant vaccines (Prof. G. I. Aleksandrova). In the Institute's clinic, under the direction of Professors D. M. Zlydnikov and P. D. Starshov, new etiotropic and pathogenetic approaches to the therapy of severe and complicated forms of influenza and other acute respiratory diseases were validated. The team made significant contributions to the field by creating new therapeutic and prophylactic pharmacological drugs.

On April 19, 2018, the Institute was *renamed in honour of its first director, and USSR Academy of Science member, Dr. Anatoly Alexandrovich Smorodintsev. Today, the Institute is officially: the Smorodintsev Research Institute of Influenza.

Research Directions

Research activities at the Federal Smorodintsev Research Institute of Influenza (div. Russian Ministry of Health) focus on finding solutions to fundamental and applied problems in the fields of virology, epidemiology, and infectious disease. The Institute aims to preserve and strengthen human health, to develop health care, and to advance medical science.

Main Areas of Scientific Research:

- Improvement of epidemiological and etiological monitoring of influenza and other acute respiratory infections in Russia. Expansion of collaboration with the World Health Organization.
- Molecular genetic and phylogenetic analysis of influenza viruses circulating in Russia. Prediction of variability trends in influenza and other viral agents.
- Identification and classification of genetic determinants behind the pathogenicity of existing and emerging viruses. Development of methods for the proper placement or clarification of new viruses taxonomically.
- Study of the molecular mechanisms underlying the pathogenesis of viral infections and the morphology of viruses.
- Creation of a new generation of reagents based on nanotechnologies. Development of viral infection diagnostic reagents, including reagents which characterize the status of cytokines and other immunity factors. Incorporation of such reagents into healthcare practice. Creation of oligonucleotide and protein microchips, test systems, and rapid diagnostic preparations.
- Development of approaches to the creation of new generation influenza vaccines. Use of nanotechnology in order to obtain effective and modern means of protecting the population from influenza and other dangerous infections.
- Search for new antiviral drugs of both natural and synthetic origin. Directional synthesis of compounds and comprehensive study of inhibitory (antiviral) effects.

- Experimental and clinical study of the safety, immunogenic properties, and efficacy of drugs for the prevention of viral infections.
- Study of severe and complicated forms of influenza and other acute respiratory infections (in both children and adults) in terms of pathogenesis and improvement of treatment regimens.
- Development of biological repository systems. Expansion and curation of collections: influenza viruses; acute respiratory infection pathogens; cell cultures; and hybridomas for monoclonal antibody production.

Recent Activities:

The Institute is one of the leading scientific centres tasked with handling urgent issues in virology, epidemiology, viral pathogenesis, and clinical manifestations. The Institute also develops highly sensitive diagnostic reagents and effective drugs for the protection of the population from influenza and other dangerous viral infections.

The principle scientific activities of the Institute involve research on the molecular-genetic and phylogenetic characteristics of existing viruses, as well as the development of methods capable of predicting future variation patterns in influenza and other viral agents. Studies are underway to identify genetic determinants behind the pathogenicity of current and emerging viruses.

The Institute has developed a biochip infrastructure, including hardware and methods, which permits a wide range of studies. Protein and DNA biochips, and their associated protocols for use, have been developed. Enzyme immunoassay methods are being improved, and new highly sensitive diagnostic test systems for the detection of influenza and other acute respiratory infection pathogens are being developed. Those systems, including rapid diagnosis reagents based on monoclonal antibodies, are being developed and manufactured.

COVID related activities

Scientists of the influenza research institute of the Ministry of Health of the Russian Federation sequenced the first complete genome of a new coronavirus in Russia. Besides this, scientists from the Institute jointly with their colleagues from Saint-Petersburg Polytechnic University created a mathematical model for the spread of coronavirus.

Contact Information

- Acting Director: Dr. Dmitry Lioznov
- Website: https://www.influenza.spb.ru

8. (FSBI “SSC INSTITUTE OF IMMUNOLOGY” FMBA OF RUSSIA”)

Brief Information

Leading scientific organization in Russia in the field of immunology and allergology. Conducts research on the fundamental and applied problems of immunology: immunogenetics; physiology of the immune system; molecular genetic and cellular basis of immunity; molecular and cellular mechanisms of allergy; immune nano- and biotechnology: vaccines of a new generation, therapeutic immunomodulating drugs, diagnosticums; prevention, diagnosis and treatment of allergic diseases; monitoring

the immune status of the population, personnel of hazardous industries; immunopharmacology and immunorehabilitation.

Background

The institute was founded in 1979 and conducts research in the framework of the technology platform “Medicine of the Future” and “BioTech2030”.

The institute steers scientific medical platform "Immunology" and a participant in the scientific medical platform "Endocrinology" as part of the "Strategy for the development of medical science in the Russian Federation for the period until 2025."

The institute also participates in the implementation of the priorities of economic modernization and technological development “Medical Technologies and Pharmaceuticals”.

Innovative projects

Created, manufactured and widely used in medical practice: vaccines against the current strains of the influenza virus "Grippol", "Grippol plus", typhoid vaccine "Vianvak", vaccine against dysentery "Shigellvak". Preclinical studies of a complex vaccine against hemophilic infection have been carried out. Clinical trials of allergotropins Polpol, Timpol, Berpol, Flexner dysentery vaccine (phase 2) are being conducted, preparations are being made for the 2nd phase of clinical trials of the Vichrepol vaccine. Experimental technologies have been created and preclinical studies of new immunomodulators Peksim and PGSh-1, a genetically engineered drug for the treatment of osteoporosis, as well as drugs based on advanced technologies using antisense RNAs for the treatment of hepatitis C, have been carried out.

Original diagnostic devices, test systems and diagnosticums for assessing immune status indicators, automated systems (including mobile ones) for indicating and identifying infectious pathogens, typing HLA genes of class I, class II and genes that control the stages of the human immune response have been developed.

Research experimental base

A pilot line for the synthesis, purification and concentration of experimental series of immunobiological drugs, diagnostics and vaccines, which includes:
- experimental technological complex for chemical synthesis;
- experimental biotechnological complex; for the development of genetic engineering products
- An experimental technological complex for creating finished dosage forms.

A bank for storing unique mammalian and human cells used in biotechnology and monoclonal antibodies.

Availability of agreements with Higher Education Institutions

Department of Immunology and Allergology of the Institute for Advanced Studies of the Federal Biomedical Agency, Department of Immunology and the Department of Advanced Studies of the Russian National Research Medical University named after N.I.Pirogov Ministry of Health of the Russian Federation (RNIMU).

Basic departments, scientific schools
Research and Education Center FSBI “SSC Institute of Immunology” FMBA of Russia (REC “Immunologist”), uniting the Department of Immunology and Allergology of the Institute for Advanced Studies of the FMBA of Russia, RNIMU.

Main partners
NIIVS Mechnikova, State Research Center of Occupational Health and Safety, FMBA of Russia (St. Petersburg), NPO Vektor Novosibirsk, Research Institute of GPEC FMBA of Russia (St. Petersburg), LLC Scientific and Production Center Medical Immunology, LLC Gritvak, LLC NPO Petrovaks Pharm, LLC NPO DNA technology ”and other organizations. Federal State Budgetary Institution "Ural Scientific Research Center for Radiation Medicine" of the Federal Medical and Biological Agency of Russia, Federal State Budgetary Institution "State Scientific Center of the Russian Federation - A.M.Burnazyan. "

International scientific and technical cooperation

Participation in the European Academy of Allergology and Clinical Immunology (EAACI), the World Allergy Organization (WAO-IIAACI), the European Federation of Immunogenetics (EFI).

Expert Advisory Activities at WHO, Vaccine Advisory Committee (VAC) member of WHO, UNAIDS Scientific Council, Global HIV Vaccine Enterprise, European Commission on the Europrise, Euco-Net Projects on AIDS and Tuberculosis.

Collaboration with the Indian Medical Research Council (tuberculosis and HIV accompanying tuberculosis), the Indian-Russian Science and Technology Center (IRSTC) (new generation vaccines and immunoprophylaxis drugs), the European Society of Respiratory Diseases (ERS Long Term Fellowship).

Contact Information
115478, Moscow, Kashirskoye highway, 24, building. 2; tel: 8 (499) 617-78-44; fax: 8 (499) 617-10-27
Website:www.nrcii.ru
E-mail: institut@immune.umos.ru