Laboratory recipes for SARS-CoV-2 proteins

For the development of drugs or vaccines against COVID-19, research needs virus proteins in high purity. For most of the SARS-CoV-2 proteins, scientists at Goethe University Frankfurt and 36 partner laboratories have now developed protocols that facilitate the production of several milligrams of each of these proteins in high purity and make it possible to determine the three-dimensional protein structures.

The laboratory protocols and the required genetic tools are freely accessible to researchers throughout the world, who as a result can work in a fast and reproducible way on SARS-CoV-2 proteins as well as on the mutations that will emerge in the future. Researchers at Goethe University and TU Darmstadt already began networking at international level at the very start of the pandemic.

Their goal: to describe the three-dimensional structures of SARS-CoV-2 molecules by means of nuclear magnetic resonance spectroscopy (NMR). In NMR spectroscopy, molecules are first labelled with special types of atoms (isotopes) and then exposed to a strong magnetic field. NMR is then used to look in detail, even with high throughput, at how potential active compounds bind to viral proteins. This is done at the Biomolecular Magnetic Resonance Centre (BMRZ), among others. However, the basic prerequisite is the production of large quantities of the proteins with high purity and stability, and with their correct folding, for the large number of tests.

The network, coordinated by Professor Harald Schwalbe from the Institute for Organic Chemistry and Chemical Biology at Goethe University, was already able to make all important RNA fragments of SARS-CoV-2 accessible in 2020. With the expertise of 129 colleagues, they have now succeeded in producing 23 of the around 30 proteins of SARS-CoV-2 completely or in important parts "in the test tube". The research work continues to be funded by the German Research Foundation and the Goethe Coronavirus Fund. The high logistical effort and ongoing exchange of research results was supported by Signals, a spin-off company of Goethe University.

https://www.tinygu.de/sarsproteins

Photo: Uwe Dettmar, Goethe University Frankfurt

Dr Martin Hengesbach (left) and Dr Andreas Schlundt, NMR scientists from Goethe University, at the nuclear magnetic resonance spectrometer.

"University Teacher of the Year"

The two university teachers Professor Sandra Ciesek and Professor Christian Drosten have been awarded the title "University Teacher of the Year" by the German Association of University Professors and Lecturers (DHV) for their services as "explainers" of the coronavirus. This is the first time that the title has been awarded to two people.

In February 2020, at the start of the coronavirus pandemic, Norddeutscher Rundfunk, a German broadcasting company, launched the podcast "Coronavirus Update" in response to the public's considerable need for information on everything to do with SARS-CoV-2. The podcast takes a scientific approach to various aspects of the pandemic and delivers updates on ongoing research work and assessment of the current situation. Since the end of August 2020, Professor Sandra Ciesek, director of the Institute of Medical Virology in Frankfurt, has been a regular guest, alternating each week with Professor Christian Drosten, head of the Institute of Virology at Charité in Berlin. The association's justification for the award is that the two virologists present scientific findings in a competent and easily understandable way in their podcast and their weekly contributions on coronavirus research strengthen society's trust in science in times of crisis. The association praised Sandra Ciesek's and Christian Drosten's courage and consistency in stepping out of their scientific environment and sharing the "research adventure" with a broad public. In so doing, the association said, they had chosen a path that also brought them criticism yet had nonetheless remained committed to the search for truth and factual information.

https://tinygu.de/Hochschulverband (in German language)

Gestures, facial expressions, images: visual communication in focus

Speaking, writing, reading, listening – these are not the only channels of human communication. But what possibilities are there for conveying information outside spoken language? And how do they work? These are questions which a new priority programme funded by the German Research Foundation will address. The "Visual Communication" (ViCom) project is one of 13 new priority programmes that will be able to start their research work in 2022. The application for the collaborative project was submitted by Professor Cornelia Ebert (Goethe University) and Professor Markus Steinbach (University of Göttingen), both linguists. Goethe University heads the alliance.

The project centres on extra-linguistic channels of communication, such as gestures, facial expressions and images. The two researchers are looking at the topic from different perspectives: While Markus Steinbach is primarily studying gestures, Frankfurt semanticist Cornelia Ebert is focusing on the gestural extension of communication. School and education as well as therapeutic communication, gestural communication between animals and human-computer interaction are further topics that will play a role in the collaborative project at the two universities.

Photo: Dean Drobot/shutterstock

Language is not everything in communication – many things are also visual. The "ViCom" project is exploring this.

The interest in visual components of communication is relatively new in linguistics, the focus otherwise lying more strongly on spoken language. Other areas of cultural studies and the humanities are already dealing with visual phenomena in communication – for example in film studies, psychology or computer science. The purpose of the priority programme is to bring these perspectives together in order to jointly develop a new communication model that can capture the peculiarities and complexity of multimodal communication. The programme should also help to advance methodological, technological, therapeutic and didactic innovations in this field.

Overall, the Senate of the German Research Foundation was able to select from among 47 proposals from all scientific disciplines. The 13 successful priority programmes, among them the Frankfurt-Göttingen programme, will together receive a total of around € 82 million for an initial three years.

Cornelia Ebert has been a researcher and lecturer at Goethe University since 2019, primarily in the field of semantics. She studied computational linguistics in Potsdam and came to Frankfurt after several academic posts elsewhere. In 2020, she was awarded a Goethe Fellowship at the Forschungskolleg Humanwissenschaften in Bad Homburg.

https://vicom.info

Second mechanism of action of remdesivir

When a cell is infected, SARS-CoV-2 not only causes the host cell to produce new virus particles. The virus also suppresses host cell defence mechanisms. The viral protein nsP3 plays a key role here. By means of structural analyses, researchers at Goethe University, in cooperation with the Paul Scherrer Institute in Switzerland, have now discovered that a degradation product (GS-441524) of the virostatic agent remdesivir binds to nsP3. This points to a further, previously unknown mechanism of action of remdesivir that might be important for the development of new drugs against SARS-CoV-2 and other RNA viruses.

Professor Stefan Knapp from the Institute of Pharmaceutical Chemistry explains: "Our structural analyses are laying important groundwork for the development of new and more potent antiviral drugs, also against alphaviruses such as the chikungunya virus."

https://www.tinygu.de/remdesivir

Remote learning – same effect as summer holidays

How effectively do children and teenagers learn in remote classes? A study by the Department of Educational Psychology at Goethe University delivers a sobering answer – at least for the spring of 2020: Learning progress not only advanced more slowly due to the coronavirus-induced school closures but even went into reverse – like after six weeks of summer holidays.

Despite efforts to continue school operations as far as possible with the help of remote learning and digital formats, enormous learning deficits have emerged, says lead investigator Professor Andreas Frey. With the help of scientific databases, he says, studies have been identified that have calculated the effects of school closures on performance and skills. According to the review, such learning deficits are particularly pronounced among school students from socially disadvantaged households.

https://www.tinygu.de/remotelearning

Melting ice due to iodine particles over the Arctic

When sea ice melts and the water surface area increases, more vapours containing iodine rise from the sea. Scientists from CLOUD, an international research alliance, rapidly form from such iodine vapours, which can serve as condensation nuclei for cloud formation.

They fear a mutual intensification of sea ice melt and cloud formation – a vicious circle that could accelerate the warming of the Arctic and Antarctic. CLOUD member Professor Joachim Curtius from the Institute of Atmospheric and Environmental Sciences says: "The mechanism we've found can now be integrated in climate models because iodine possibly plays a dominant role in aerosol formation, above all in the polar regions, and this could improve climate model predictions for these regions."

https://www.tinygu.de/iodine

How the 3D structure of eye lens proteins is formed

The lens of the human eye gets its transparency and refractive power from certain proteins being densely packed in its cells. These are mainly crystallins. If this dense packing is not preserved, for example due to hereditary mutations in the crystallins, the result is lens opacities, known as cataracts, which are the most common cause of vision loss worldwide.

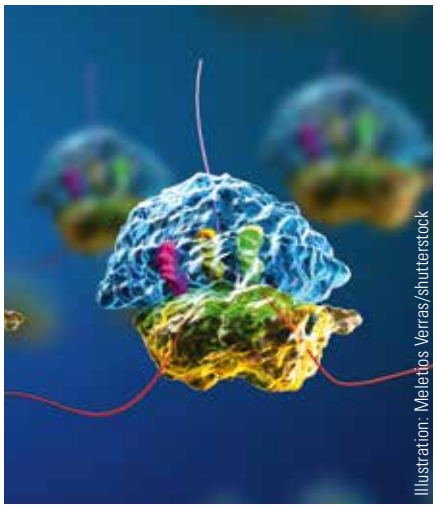
For crystallins to be densely packed in the lens fibre cells, the proteins must be folded correctly in three dimensions. For the correct folding of the protein gamma-B crystallin, certain bonds form, among others between individual amino acids of the protein, which are known as disulphide bridges. Contrary to previous assumptions, such disulphide bridges already form in parallel to the synthesis of the protein in the cell, as scientists from Goethe University, the Max Planck Institute of Biophysics in Frankfurt and the Institut de Biologie Structurale in Grenoble, France, have discovered.

Producing such disulphide bridges is not quite so easy for the cell, since biochemical conditions prevail in the cellular milieu that prevent or dissolve them. That is why, in the finished gamma-B crystallin protein, the disulphide bridges are shielded from the outside by other parts of the protein. During formation, a protected area of the protein synthesis complex, the ribosomal tunnel, takes over this function, as the German-French research team has discovered.

"We were able to show that the ribosomal tunnel provides sufficient space and shields the disulphide bridges against the cellular milieu," says Professor Harald Schwalbe from the Institute for Organic Chemistry and Chemical Biology at Goethe University. "Surprisingly, however, these are not the same disulphide bridges that are later present in the finished gamma-B crystallin. We conclude that at least some of the disulphide bridges are later dissolved again and then bond differently. The reason for this probably lies in the optimum timing of protein production: The 'preliminary' disulphide bridges accelerate the formation of the 'final' disulphide bridges when the gamma-B crystallin is released from the ribosome."

The researchers now want to test, in the framework of further studies, whether the synthesis processes in the slightly different ribosomes of higher cells are similar to those in the bacterial model system.

https://www.tinygu.de/eyelens



In the cell, ribosomes (blue/yellow) migrate along the mRNA (red "thread") and produce proteins, indicated here as purple threads.

Research Training Group "Configurations of Film" of the German Research Foundation can continue its work

What happens when film leaves the cinema and becomes available everywhere – out and about on mobile devices, or at home in the living room? The Research Training Group "Configurations of Film" at Goethe University has been researching the current transformation of film and cinema culture since 2017. The German Research Foundation has now given the project the green light to continue.

"We are very pleased that the German Research Foundation is continuing to place its trust in us and that we can continue our productive work in the RTG," says Vinzenz Hediger, professor of film studies and the RTG's spokesperson. In the framework of individual studies, in which researchers from philosophy, literary studies and theatre studies are also participating, the Research Training Group is examining a fundamental problem of film studies: the transformation of its objects through the progressive digitalisation of the production, distribution and perception of moving images.

How are Netflix and Co. changing the objects of film studies?

The Research Training Group at the Department of Theatre, Film and Media Studies started in 2017 with twelve doctoral candidates and two post-doctoral researchers. The second group, from Germany, India and Nigeria, has already started work. Topics range from the interpenetration of film and computer games to Bengali cinema of the 1950s and 1960s.

The Research Training Group is run in collaboration with the universities of Mainz and Marburg and the University of Art and Design in Offenbach.

https://www.tinygu.de/configuration

Severe progression of liver cirrhosis

The most frequent cause of death among patients with liver cirrhosis is acute-on-chronic liver failure (ACLF), where the progressive loss of function of the scarred liver can no longer be compensated for (acute decompensation). As a result, other organs such as the kidneys or brain fail.

Most frequently it is bacterial infections, hepatitis (liver inflammation) caused by alcohol abuse or a combination of both factors that triggers the acute decompensation of liver cirrhosis and ACLF. This was revealed when the PREDICT study, which was conducted by an international team of researchers, was evaluated. Lead investigator Professor Jonel Trebicka, gastroenterologist and hepatologist at University Hospital Frankfurt, is convinced: "This knowledge will help to develop diagnostic and treatment strategies for patients with this life-threatening condition."

https://www.tinygu.de/livercirrhosis