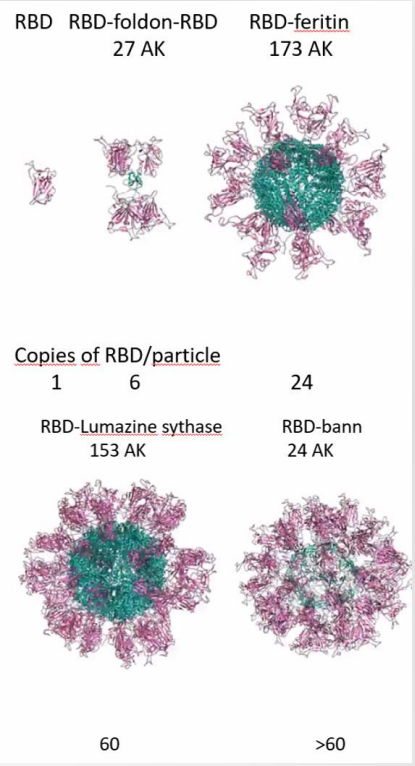
NATIONAL INSTITUTE OF CHEMISTRY

RESEARCH FIELD: Immunology, Covid-19

INDUSTRY: Pharmaceutical (vaccines)

COVID-19 VACCINE PLATFORM BASED ON FUSION OF ANTIGEN DOMAIN TO SMALL HYPOIMMUNE SCAFFOLD



Designed vaccine nanoparticles. Molecular models of five different types of COVID-19 vaccine, developed and tested at the NIC.

The Covid-19 pandemic is a major threat to the public health and economies. Effective vaccines based on new technologies represent the main hope to stop it. Recent announcements on vaccine results are very promising however multiple vaccines are needed and the stability of vaccines as well as the apparent attenuation of the response due to the vector (adenoviral) or scaffold immune response may limit the efficiency of vaccination. A new vaccine platform invented by the group led by Prof Jerala, Head of Department of Synthetic Biology and Immunology addresses both issues.

Technology

The novelty is the modification of viral protein antigen domain into self-assembling nanoparticles that resemble viral particles. The vaccine is based on highly stable plasmid DNA, coding for a domain of a viral protein, that triggers the production of antigen in human cells, inducing the formation of antibodies and protective T cells. The Covid-19 vaccine has been tested in the **mouse model with high antibody titers, viral neutralization and T cell response** and the patent application has been filed and submitted for publication. Further pre-clinical studies are ongoing on the hamster model.

Main advantages

- **DNA plasmid delivery** enables fast design, safety, low cost of production and high stability, thus no requirement for a cold chain.
- **Antigen is based on the RBD domain** of the Spike protein that directly interacts with the ACE2 receptor and antibodies therefore can neutralize viral binding, **non-neutralizing epitopes of the Spike protein are excluded**, some of which led in case of SARS to the antibody dependent enhancement (ADE) complication.
- A new type of nanoparticle has been designed based on the genetic fusion with RBD of the SARS-CoV-2 based on the short 24-residue beta annulus peptide (RBD-bann).
- **Immunization with DNA plasmid coding for RBD-bann resulted in >100 fold higher antibody titer** than monomeric RBD and superior viral neutralization in comparison to several other scaffolds often used constructs – ferritin, lumazine synthase and foldon
- RBD-bann resulted in **production of cytotoxic T lymphocytes and production of γIFN by RBD-specific T cells**.
- Scaffolds used to construct antigen nanoparticles as ferritin, foldon, lumazine synthase or adenoviral vectors elicit antibodies against the scaffold or vector which decreases the efficiency of the subsequent immunization. In case of **RBD-bann there was minimal cross-reactivity against the scaffold**. This represents an important advantage of this platform in comparison to other scaffolding platforms, which are currently at the cutting edge of the universal influenza vaccine and vaccines against HIV-I and malaria.
- Also immunization with isolated RBD-bann protein resulted in superior immunogenicity in comparison to monomeric antigen, confirming the universal advantage of this vaccine platform

Key words

Covid-19, Vaccine, Plasmid DNA, RBD

TYPE OF COLLABORATION

Spin-out formation with exclusive license, R&D collaboration

INTELLECTUAL PROPERTY

LU102016

DEVELOPED BY

Department of Synthetic Biology and Immunology

CONTACT

Knowledge Transfer Office
P: 00386 1 4760 529
E: knowledge.transfer@ki.si

MORE INFORMATION ABOUT THE INVENTION

The research was funded by the: erc, Virofight, Slovenian Research Agency, European Union European Regional Development Fund, Republic of Slovenia Ministry of Education, Science and Sport