The current SARS-VoV-2 pandemic has shown how dangerous coronaviruses are and how dramatic impact on the world can have emergence of a new pathogen. One important lesson from latest months is that we should change our attitude towards microbiological threats and improve our readiness to potential outbrakes of new viruses. This applies mainly to rapidly evolving viruses and those whose reservoirs are animals that are in frequent contact with humans, such as influenza virus or coronaviruses. By conducting research on both: basic biology of these pathogens but also available strategies to fight them we increase the chance to better face the next epidemic (or pandemic).

The aim of this project is to create a virus-like particle (VLP) vaccine that protects cats from feline infectious peritonitis (FIP). This dangerous disease is rare in domestic cats but poses a serious threat to animals kept in catteries or shelters. Unfortunately, the available treatment is not always effective and the FIP virus infection is usually fatal. Previous attempts to create a vaccine have failed because traditionally used immunization with inactivated virus brought about the opposite effect: the vaccinated animals continued to be infected and the course of the disease was even more severe than when unvaccinated. This phenomenon is due to the so called “antibody-dependent enhancement” (ADE) – a rare situation when the infection is strengthened by specific antibodies created by prior contact with the virus or administration of the vaccine. It is worth noting that ADE is also postulated to be associated with SARS-CoV-2 infection. It is thus an important issue and attempts to overcome it may contribute to the development of an effective and safer vaccine protecting against other coronaviruses.

One solution to eliminate the undesired ADE may be creation of a virus-like particle designed to outwit the immune system by inducing immunity, but without dangerous (in this case) antibodies. This can be achieved by including immune response tuning elements in the VLP structure. Moreover, by creating modular virus-like particles, we can obtain a universal vaccine platform that allows rapid "substitution" of immunogenic epitopes, which would be extremely beneficial in the case of a new virus strain emergence.

Importantly, virus-like particles, being structures with spatial organization identical to viruses, stimulate the immune system as effectively as "native" viruses. Therefore, VLPs are excellent vaccine candidates. A well-known example of a successful VLP vaccine used in humans is the one that protects against human papilloma virus (HPV) infection and, as a consequence, cervical cancer. Many other VLP-based vaccine models are under investigation.

In this light, the planned research will contribute constitute a proof of concept that could not only find application in the immunoprophylaxis of cats, but also make an important contribution to the development of vaccines protecting against other coronaviruses, including SARS-CoV-2.