

Design and production of virus-like particles as carriers of nanomaterials

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ABSTRACT

Viral capsids can be defined as natural protein nanocontainers. Small size, relatively simple structure, and in case of plant viruses no pathogenic properties for humans, these are the features that enable their use as safe carriers of biologically active substances, also those used in medicine. This paper is devoted to the issues related to the use of Brome mosaic virus (BMV) for the preparation of virus-like particles (VLP) and their use as carriers of nanoparticles.

The first stage of work was to create and optimize a new method of obtaining native BMV. The developed method was based on chromatographic techniques and allowed to completely omit the time-consuming ultracentrifugation process, previously standardized in such procedures. The evaluation of the quality of viral particles obtained with the new method included the measurements of virion size and the analysis of the second-order structure of capsid proteins (CP). The information obtained this way confirmed the high quality of the received preparations and formed the basis for further work aimed at using BMV capsids as carriers for nanoparticles.

The next stage of research focused on the issues related to the use of the obtained virions for the encapsidation of iron oxide nanoparticles. The nanoparticles were functionalized with poly (ethylene oxide) and dihexadecylphosphate (DHP) in order to introduce a negative charge to their surface. We decided that this procedure was necessary for the formation of capsids around nanoparticles. The work was successfully completed, i.e. obtaining a VLP with a magnetic core. Moreover, we found that both the charge on the surface of the encapsidated particle and the structure of the compound used for its functionalisation, play a very important role in the process of VLP assembly.

The aim of the last stage of the research was to obtain and characterize VLPs made from recombinant CPs produced in a bacterial expression system. In addition, we decided to find out what influence the structure of the polyanion (structured tRNA and unstructured polystyrene sulfonate (PSS)) and the mutations introduced into the CP have on the properties of the VLP. The obtained results revealed a significant influence of the polyanion and CP-CP interactions on the durability and structure of the VLP.