BIST Barcelona Institute of Science and Technology

BIST Ignite Project Progress

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1. Title of the project

Artificial bacteria: a novel generation of bioinspired vaccines

2. Acronym

BioVac2

3. Names and centres of the PIs

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4. Abstract

By 2050, infectious diseases will cause the death of more than 12 million people per year worldwide. The reason is two-fold. First, antibiotics are becoming less and less effective due to the resistance developed by the bacteria to antimicrobial treatments. Second, there are still several infectious diseases for which most of the vaccines used nowadays, mainly based on live-attenuated pathogens or protein/polysaccharide subunits of pathogens, are still not effective. Therefore, the generation of new vaccine models that overcome both limitations has become a clearly defined challenge for 21st century society.

The goal of Biovac is to overcome this context with a novel and disruptive bioinspired approach. The hypothesis behind the project is that polymeric particles that mimic the size, shape and outer surface (antigens) of the target bacteria will trick the immune system by making it believe that there is a real threat. In this way, antigenmacrophage interactions are enhanced with respect to the administration of free antigens while avoiding the risks and limitations of introducing attenuated bacteria. On top of that, recent studies have demonstrated that antigens supported on differently shaped particles show synergic improvements on the different stages of the immune system

response, possibly due to a better exposure of the antigen and enhanced interactions with the surrounding environment.

To face such an ambitious objective, the collaboration between two complementary research groups with access to distinct backgrounds and techniques has been required and the results obtained are exceptional. The Nanosfun group (ICN2) is specialized in the synthesis, characterization, quantification and functionalization of micro-/nanoparticles and the BIAT group (IBEC) in the preparation, purification and characterization of antigens combined with their study in living organisms. Both groups together have tested different antigen-coated microparticles for in vitro and in vivo experiments demonstrating:

I)The system exhibits no toxicity,
II)Novel mixtures of antigens with synergistic immune responses have been found,
III)Immune cells internalize the antigen-coated microparticles with very high efficiency,
IV)Functionalized microparticles clearly exhibit an enhanced immune response with respect to the administration of free antigens

The breakthrough character of these findings definitely paves the way for further developments within this research area during a second stage of the project, including optimization of antigen mixtures with enhanced performances or testing novel infectious bacterial cells that nowadays still lack vaccines , among others. Results are pending confirmation for their publication and dissemination while the Business & Innovation offices have started to search for the patentability of the results.