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Elongated Flexuous Plant Virus-Derived Nanoparticles Functionalized for Autoantibody Detection

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Abstract: Nanoparticles derived from the elongated flexuous capsids of *Turnip mosaic virus* (TuMV) have been shown to be efficient tools for antibody sensing with a very high sensitivity if adequately functionalized with the corresponding epitopes. Taking advantage of this possibility, TuMV virus-like particles (VLPs) have been genetically derivatized with a peptide from the chaperonin Hsp60, a protein described to be involved in inflammation processes and autoimmune diseases. Antibodies against the peptide have been previously shown to have a diagnostic value in at least one autoimmune disease, multiple sclerosis. The functionalized Hsp60-VLPs showed their significant increase in sensing potency when compared to monoclonal antibody detection of the peptide in a conventional immunoassay. Additionally, the developed Hsp60-VLPs allowed the detection of autoantibodies against the Hsp60 peptide in an in vivo mouse model of dextran sodium sulfate (DSS)-induced colitis. The detection of minute amounts of the autoantibodies allowed us to perform the analysis of their evolution during the progression of the disease. The anti-Hsp60 autoantibody levels in the sera of the inflamed mice went down during the induction phase of the disease. Increased levels of the anti-HSP60 autoantibodies were detected during the resolution phase of the disease. An extension of a previously proposed model for the involvement of Hsp60 in inflammatory processes is considered, incorporating a role for Hsp60 autoantibodies. This, and related models, can now be experimentally tested thanks to the autoantibody detection hypersensitivity provided by the functionalized VLPs.

Keywords: VNPs; Hsp60; IBD; autoantibody; inflammation; diagnosis

1. Introduction

The use of viral nanoparticles (VNPs) for biomedical applications has become a new tool in theranostics. Specifically, VNPs derived from plant viruses offer advantages in terms of biosafety since they are only plant pathogens and also because of plant virus variability in nature, size, and structure, that allows a specific design of VNPs depending on the application [1–13]. We work with *Turnip mosaic virus* (TuMV), a virion with an elongated and flexuous structure, 700 nm long and 12 nm wide, with *ca*. 2000 copies of the coat protein in each particle, from which multifunctional VNPs can be