



Molecular dynamics simulation study of Protein- Nanoparticle Interactions

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Abstract: Glutathione (GSH) is a tripeptide antioxidant protects tissues from reactive oxidative species (ROS) and other types of oxidative damages^{1,2}. GSH interacts with transmembrane proteins located in the brain which are involved in the active transport of certain substances across the BBB. Drug delivery systems conjugated with GSH provide for an interesting route of potential therapies directed towards the brain³⁻⁵. However, even a damaged and more permeable BBB can pose serious challenges to protein or drug delivery into the brain. The use of nanoparticle (NP) formulations able to carry molecules with therapeutic value, while targeting specific transport processes in the brain vasculature, may enhance drug transport through the BBB in neurodegenerative/ischemic disorders and target relevant regions in the brain for regenerative processes. Study has shown silver nanoparticles (AgNPs) can enter cells and increase A β amyloid deposition in response to the changes of gene expression in inflammatory response, oxidative stress and A β degradation⁶⁻⁸. It is suggested that AgNPs-induced neuroinflammatory response and A β deposition might evolve the progress of neurodegenerative disorders and Glutathione functionalization of Ag-NPs may improve their biological activity. In this study, the interaction between proteins (GSH) and Ag nanoparticle as a drug carrier was investigated by molecular dynamics simulation for understanding the molecular mechanisms of the interactions between proteins and NPs in order to predict the structural, functional, and/or nanotoxic consequences of these interactions. The interaction energy between (GSH) and (Ag-NPs), complex was about -20.0 kcal mol⁻¹. We found that the interaction energy due to electrostatic was insignificant -0.4 kcal mol⁻¹ and Van der Waals interaction -19.6 kcal mol⁻¹ played a crucial role in the molecular encapsulation.

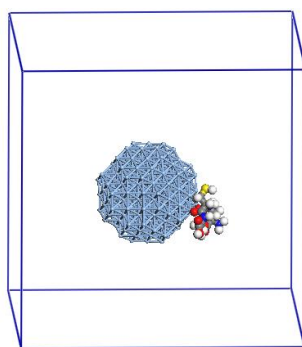


Fig. 1 Snapshot of a MD simulation of (GSH) and (Ag-NPs)

Keywords: Glutathione; silver nanoparticles; oxidative species; Alzheimer's disease; Molecular dynamics simulation