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Bio-Functionalized Nanoparticles – A Boon for Nano-drug Therapy

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Bio-functionalized Nanoparticles

Bio-functionalization of nanoparticles has received enormous attention due to reduced toxicity as well as stability in colloidal state which prevents the nanoparticles from aggregation [1,2]. The biomolecules being used for functionalization vary from simple to complex macromolecules [3]. Starch, a natural polymer widely used in many industries as raw material was chosen for synthesis of silver nanoparticles as well as for functionalization. The one-pot synthesis was an easy procedure for both synthesis and functionalization [4]. The aldehyde group of starch serves as the functional group which attaches to the synthesized nanoparticles, thereby preventing aggregation. This stabilizes the nanoparticles, and no aggregation was visible for more than three months. A study was done to check the function and structure of starch using hydrolysis. The results were quite interesting in that the structure had no major deformities while still maintaining functionality [5].

Since the substrate starch is being fixed onto the surface of silver nanoparticles (AgNPs), the enzyme-substrate complex reaction was proceeding faster than expected. The blue-black colour disappeared 1.5X faster in the presence of AgNPs. The AgNPs were also functionalized with other enzymes to assess structural and functional properties. Lysozyme and amylase from different sources were functionalized over the AgNP, and the corresponding substrates were added and assessed. An increase in the enzymatic activity of enzymes was reported, and lysozyme along with AgNPs was found to have higher bactericidal properties than the free/unbound enzyme [6].

In all these studies recorded using various spectroscopic techniques, the structure of enzymes showed few modifications, whereas the function (enzyme activity) was unchanged while being pronounced in the presence of AgNPs [7]. Thus, bio-functionalization not only prevents aggregation but also helps in the immobilization of nanoparticles thereby improving the overall enzyme efficiency [8].

In summary, the immobilization of enzymes over the surface of AgNP has yielded a nano-bio-conjugate with synergistic antibacterial and catalytic properties. This strategy opens the door for the development of potential nano-drug delivery systems wherein the bio-functionalized nanoparticles are an immediate option availed in administration of drugs.

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