Investigation of the role of gold nanoparticles in radiation induced oxidation of amino acids and proteins.

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Proteins are one of the most important building blocks of life and are also one of most accessible target for oxidative damage by reactive oxygen species (ROS). Under normal circumstances, there is a well-managed balance between formation and neutralization of ROS so that there is minimal modification of biomolecules. Under oxidative stress conditions, biomolecules become subjected to attack by excess ROS and significant molecular and physiological damage can occur¹. Nanoparticles are being increasingly used in the field of biomedicine as drug carrier and also for imaging purpose. Detailed investigation of the interaction of NPs with biomolecules has there fore gained momentum.

We synthesized gold nanoparticles by using Creighton’s chemical reduction method². The effect of free radical induced oxidation in bovine serum albumin and the role of gold nanoparticle in the oxidation mechanism was investigated using UV–visible spectroscopy, fluorescence, Fourier transform infrared spectroscopy (FTIR), circular dichriosm(CD), sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and DTNB assay.

The γ-irradiation of the protein causes the disruption of the ordered structure of protein. The CD study shows that % α helix after irradiation in presence of AuNPs is more (61%) as compared to when irradiated in absence of AuNPs (53%). SDS-PAGE study shows that the degradation of protein on irradiation was prevented partially in the presence of gold nanoparticles. Estimation of thiol content after irradiation suggest significant protection of the thiol groups against radiation induced oxidation in presence of AuNPs. To understand in detail, the role AuNPs in these oxidation reaction, tyrosine, one of the two fluorescent amino acid in BSA was selected. *OH induced oxidation of tyrosine leads to the *OH adduct, 3,4-dihydroxy phenylalanine (DOPA) or dityrosine (via one e⁻ oxidation pathway)³. In our study it was observed that the reaction leading to formation of DOPA is less in the presence of AuNPs, as is evident from G(Tyr) calculated from our steady state experiments interestingly our product analysis studies (LC-MS, UV-Visible) have revealed that the pathway leading to the formation of DOPA is influenced by the presence of AuNPs. The concentration of DOPA formed in presence of AuNPs was found to be lower than that irradiated in absence of AuNPs. The mechanism of the *OH induced oxidation of Tyr and the effect of AuNPs on this mechanism will be discussed in detail.

Figure 1: a) linear plot area Vs dose (Gy) of tyrosine irradiated at different dose in presence and absence of AuNPs from HPLC.

References

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