State of the Art and Current Advances on Protein Cross-Linking by Irradiation: Protein Based Nanocarriers and Bioactive Nanoparticles

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The highlighted role of protein and peptide based delivery systems relies upon the possibility to develop biocompatible drug carriers featuring site specific delivery, biological affinity among unique advantages. Recently, a technique for protein nanostructuring by the use of radiation has been recently reported by our group. Advantages of the use of radiation over conventional methods are related to the possibility to achieve protein cross-linking and sterilization in a single step, as well as the capacity to allow the design of nanocarriers without the need of monomers or toxic cross-linkers. This work reports the use of high energy irradiation towards the design of size-controlled protein-based nanocarriers and bioactive nanoparticles, using bovine serum albumin (BSA) and papain as model protein and protease, respectively, including the state of the art and current advances of the technology. The technique implies on protein desolvation/solvation techniques followed by cross-linking by EB radiation or γ-irradiation alone, although nanoparticles were also achieved in absence of the cosolvents. Size-controlled BSA nanocarriers were manufactured up to 80 nm and papain bioactive nanoparticles up to 12 nm, as determined by dynamic light scattering. Nanocarrier morphology was evaluated by and negative staining transmission electron microscopy. Protein cross-linking and changes in aromatic the amino acids were evaluated by fluorescence measurements. Biocompatibility experiments were also performed by means of cytotoxicity and cytokines production. The potential of the systems for the delivery of radiopharmaceuticals or chemotherapeutic agents were also assayed, using technetium or Paclitaxel respectively. In conclusion, the technique allowed the production of biocompatible and bioactive protein nanoparticles suitable for the administration of radiopharmaceuticals and chemotherapeutic agents.