Radiation-Induced Synthesis of Protein Nanoparticles for Radiopharmaceutical Applications

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Combining nanotechnology with nuclear technology has revolutionized medicine, particularly in oncology diagnostics and therapies. Nanoparticles offer a versatile platform for developing multifunctional agents capable of providing therapeutic and diagnostic properties. Among the various approaches to nanoparticle synthesis, physical, chemical, and biological methods have been extensively explored. Metallic nanoparticles, for example, are traditionally synthesized by chemical methods and are known for their surface properties, which allow easy conjugation with biomolecules and their use as contrast agents in imaging and as drug carriers. However, green synthesis via ionizing radiation, such as gamma irradiation and electron beams, emerges as a promising alternative due to its ability to precisely control nanoparticle size without using toxic chemical reagents [1,2].

Our research group has been dedicated to developing an innovative platform that utilizes gamma irradiation and electron beams to produce protein nanoparticles with potential applications as radiopharmaceuticals [3,4]. The proposed technology offers refined control over the nanoparticle size distribution, which is a crucial factor for the successful use of nanoparticles in biomedical applications. Additionally, this method preserves the structural and functional integrity of the proteins. During the synthesis process, variables such as irradiation dose, protein concentration, and buffer composition are carefully adjusted to optimize the characteristics of the nanoparticles [5]. The results show a controlled size distribution, dependent on the irradiation dose and protein concentration. Radiolabeling studies reveal high radiochemical yields, demonstrating that the synthesized nanoparticles are suitable for nuclear medicine applications. This approach highlights the potential of gamma irradiation and electron beam-induced synthesis in the production of protein-based nanoradiopharmaceuticals, opening new perspectives for targeted diagnostics and therapies in oncology and other areas of medicine. The proposed technology not only facilitates the development of new diagnostic and/or therapeutic agents but also promotes significant advances in the field of nanotechnology applied to health, especially in terms of safety and quality control, as sterilizing the vial's interior occurs during the process.

References:

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