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Synthesis and Characterization of Radiolabelled Silver Nanoparticles

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Silver nanoparticles (AgNPs) have a wide range of applications in cosmetics, wound dressings, food packaging and also in medical sciences such as drug and gene delivery systems because of their effective antibacterial properties [1,2]. This wide usage increases environmental and human exposure to AgNPs which may cause undesirable biological and ecological effects. Recent studies showed that AgNPs have significant toxic effects on cells and the particle properties such as size, surface area, solubility etc. may alter the toxicity of the particles [2-4]. Therefore it is essential to investigate their behaviour in complex matrices. The chemical behaviour of silver and silver ions is in biological and environmental media is extremely complex due to
a)relative easy which silver may be oxidised or reduced
b)photochemical activity of both the metal and its salts
c)the large number of low solubility complexes or compound which may form with silver ions.
All of these factors can create many difficulties and uncertainties when attempting to achieve accurate and reproducible analysis of low levels of silver by conventional trace analysis methods such as ICP-MS. Many of these problems can be reduced or eliminated if silver detection, tracing and quantification can be done using radiotracers. Use of radioactive NPs as tracers has several advantages with respect to the high sensitivity and accuracy of radiolabelling techniques [5].
In this study radiolabelled AgNPs were synthesized by reduction of silver nitrate with sodium borohydride. The 105Ag and 110mAg were prepared by proton and deuteron irradiation of silver foils respectively at the JRC Scanditronix MC 40 Cyclotron, followed by dissolution in nitric acid and evaporation to dryness. Due to a higher production yield, 105Ag was used for radiolabeling studies. The characterization of the nanoparticles was performed using DLS, zeta potential and XRD analysis. The size distribution of the 105AgNPs was found to be centred around 20 nm according to the DLS measurements and were colloidally stable for at least 21 days. It was observed that size distribution and surface charge of the radiolabeled nanoparticles was very similar to those obtained by synthesis using a non-radioactive source of silver. Silver ion leaching and particles stability in different media were assessed.
References

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