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| **Properties of Gold-Iron Oxide Nanohybrids and their Applications in Cancer Nanotheranostics** |
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| **Background:** Hybrid nanoparticles have been fingered as excellent candidates for various clinical, pharmaceutical and biomedical applications owing to their tunable properties and extensive applicability. The plasmonic property of nanogold is utilised in photothermal therapy, while the magnetic property of iron oxide nanoparticles makes them good contrast agents in cancer tumour imaging and in magnetic hyperthermia. The properties of these particles, such as size, morphology and stability, may be adjusted for specific applications. In this work, we demonstrate the dependence of the properties of gold-iron oxide ­­­­nanohybrids on the synthetic method adopted in their preparation. The synthesised nanohybrids will be utilised for the intratumoral delivery of gemcitabine modified with spermine for the treatment of pancreatic cancer. |
| **Methods:** A two-step approach was adopted for the synthesis of the gold-iron oxide nanohybrids was adopted: (i) synthesis of iron oxide nanoparticles by the co-precipitation of iron(II) and iron(III) salts to (ii) seeding of the magnetic iron oxide nanoparticles with nanogold, prepared by the reduction of chloroauric acid. Synthesis parameters, including the type, strength and concentration of reducing agents (ammonium hydroxide, sodium borohydride and sodium citrate), reaction time, and type of iron salts (sulphates and chlorides), and the ratio of Fe2+ to Fe3+ were varied. The synthesis steps were monitored by Zeta potential measurements, and all synthesised particles were characterised using DLS, UV-Vis spectrophotometry, TEM, and ICP-OES techniques. The thermal stability of the particles was determined using TGA. |
| **Results:** Hybrid gold-iron oxide nanoparticles (average zeta potential = +31.8 mV; DLS size = 184 nm; Polydispersity Index, PdI = 0.36) were successfully synthesised. Uv-vis spectroscopy of synthesised gold seeds gave a λmax of 525 nm. The studies revealed a strong dependence of nanoparticle properties on the synthesis parameters. The sizes of the iron oxide nanoparticles increased with reaction time. TEM images reveal that the morphology of the HNPs also suffered significant changes with the variations in the type and ratio of iron salts.  |
| **Conclusions:** The effect of synthesis parameters on the properties of hybrid nanoparticles has been established. Further studies, however, will reveal the impact these variations would have on the drug loading and release profiles of hybrid gold-iron oxide nanoparticles for the delivery of gemcitabine to pancreatic cancer tumours. |