Investigations of the synergistic effects of nanoparticles on radiotherapy

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Recent advancements in cancer treatment underscore the potential of nanotechnology to enhance the efficacy of radiotherapy while minimizing damage to healthy tissues. However, a significant research gap persists regarding the optimal use of nanoparticles (NPs) synthesized from natural sources in cancer therapy. This study focuses on synthesizing Titanium Dioxide (TiO_2) NPs using extracts from four native Australian plants, serving as reducing agents in the synthesis process. Analysis of the plant extracts revealed the presence of various phytochemicals, including phenols, flavonoids, saponins, alkaloids, steroids, anthraquinones, tannins, oils, and resins. Total phenolic content ranged from 36.79 to 105.1 mg gallic acid equivalents (GAE)/g dry weight (DW), while total flavonoid content ranged from 134.25 to 352.52 mg quercetin equivalent (QE)/g DW.

The characterization of TiO_2 NPs synthesized through biosynthetic methods was conducted using various techniques including X-ray diffraction (XRD), Fourier Transform-Infrared Spectroscopy (FT-IR), Transmission Electron Microscopy (TEM), Dynamic Light Scattering (DLS), and Differential Scanning Calorimetry (DSC). Results revealed the successful formation of TiO_2 NPs in the pure anatase phase, with sizes consistently ranging from 110-130 nanometers for all synthesized samples. XRD analysis indicated characteristic peaks corresponding to the anatase phase with JCPDS card number 21–1272, including 2θ peaks at 25.3°, 37.8°, 48.0°, 53.9°, and 55.1°. FTIR spectroscopy demonstrated strong Ti-O stretching vibrations in the range of 400-800 cm^{-1}, along with peaks associated with organic compounds from phytochemicals, with specific peaks at 1630-1660 cm^{-1}. These findings suggest the potential involvement of phytochemicals in capping or stabilizing the NPs.

Further investigation will focus on evaluating the cytotoxic effects of these TiO_2 NPs on various cancerous cell lines, aiming to uncover their potential as a radiotherapy adjuvant.