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Development of smart TiO_2 nanoparticles with photo-induced anticancer properties

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Abstract: The aim of this study is the synthesis of titanium dioxide (TiO_2) nanoparticles with photo-induced anticancer properties based on the mechanism of oxidative stress, under visible light irradiation. When TiO_2 nanoparticles are excited by light, the formed reactive oxygen species (ROS) can significantly damage cancer cells by inducing apoptosis and, thus, promoting TiO_2 as a promising photosensitizer against cancer. Surface modification by TiO_2 doping with nitrogen (N-doped), iron (Fe-doped) and co-doping with nitrogen and iron (N-Fe co-doped) is proved to improve TiO_2 photocatalytic activity, according to recent studies. This doping process is associated with the reduction of electron-hole recombination, resulting in efficient separation and stronger photocatalytic reactions. Furthermore, another important challenge is the encapsulation of commercially available TiO_2 Evonik P25, inside a structure synthesized by P-NiPam (N-Isopropylacrylamide) nanoparticle-network. This scientific approach allows the development of a thermo-responsive drug delivery system, with the potential of controlled release in a target-area. Thus, synthesis of N-doped TiO_2, Fe-doped TiO_2 and N-Fe co-doped TiO_2 and P-NiPam-TiO_2 was conducted, followed by surface and morphological characterization realized by XRD, micro-Raman, SEM, TEM, DLS techniques. Additionally, cultured MCF-7 and MDA-MB-231 breast cancer epithelial cells were irradiated, using visible light, in the presence of TiO_2 aqueous dispersion. Cell proliferation was estimated, and growth rates were prepared. Moreover, MTT colorimetric assay was employed to investigate the cytotoxicity. In conclusion, experimental findings indicate that an important percentage of cancer cell population loses their functionality, with a significant effect on cell proliferation.