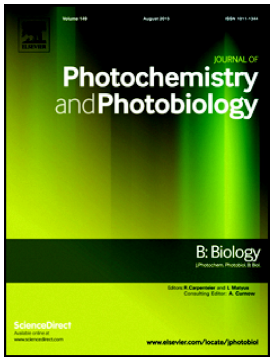

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Zinc Phthalocyanines Attached to Gold Nanorods for Simultaneous Hyperthermic and Photodynamic Therapies Against Melanoma *In Vitro*

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Abstract

Studies indicate that hyperthermic therapy using gold nanorods and photodynamic activity with many photosensitizers can present a synergistic effect, and offer a great therapeutic potential, although more investigation needs to be performed before such approach could be implemented. We proposed to investigate the effect of the attachment of phthalocyanines on the surface of gold nanorods (well-characterized devices for hyperthermia generation) for the elimination of melanoma, one of the most important skin cancers due to its high lethality. Following the synthesis of nanorods through a seed-mediated method, the efficacy of photodynamic therapy (PDT) and hyperthermia was assessed separately. We chose to coat the nanorods with two tetracarboxylated zinc phthalocyanines - with or without methyl-glucamine groups. After the coating process, the phthalocyanines formed ionic complexes with the cetyltrimethylammonium bromide (CTAB) that was previously covering the nanoparticles. The nanorod-phthalocyanines complexes were analyzed by transmission electron microscopy (TEM), and their singlet oxygen and hydroxyl radical generation yields were assessed. Furthermore, they were tested in vitro with melanotic B16F10 and amelanotic B16G4F melanoma cells. The cells with nanoparticles were irradiated with laser (at 635 nm), and the cell viability was assessed. The results indicate that the photodynamic properties of the phthalocyanines tested are enhanced when they are attached on the nanorods surface, and the combination of PDT and hyperthermia was able to eliminate over 90% of melanoma cells. This is a novel study because two tetracarboxylated phthalocyanines were used and because the same wavelength was irradiated to activate both the nanorods and the photosensitizers.

Keywords: Cancer, Nanorods, Gold, Porphyrin, Phthalocyanines, PDT, Hyperthermia