L.11: Photodynamic Action of Rose Bengal Silica Nanoparticle Complex on Breast and Oral Cancer Cell Lines

Although Rose Bengal (RB), has good singlet oxygen ($^1O_2$) yield its use as a photosensitiser for photodynamic therapy PDT is limited due to its poor intracellular uptake. We have investigated the possibility of addressing this issue by using silica nanoparticles (SiNPs) as carriers. Electrostatic and covalent complexes of the drug and SiNPs were prepared and after validating these by spectroscopic techniques their relative phototoxicity was investigated using oral (4451) and breast (MCF-7) cancer cell lines.

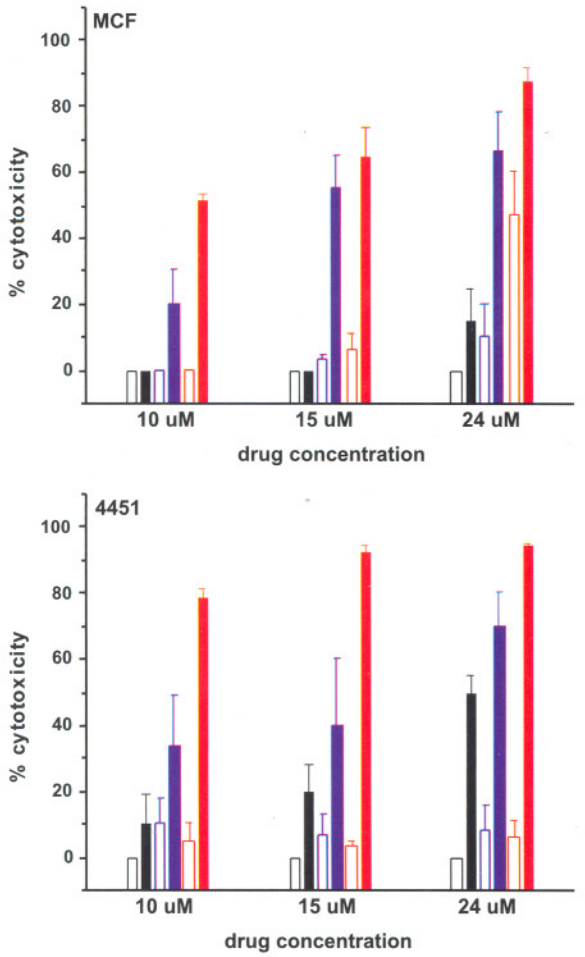

Fig.L.11.1: Percent cytotoxicity of RB and its SiNP complexes (electrostatic (Blue) and covalent (Red)) against breast (MCF) and oral (4451) cancer cell lines. The hollow bars represent dark toxicity and the solid bars represent phototoxicity.

In Fig.L.11.1 we show the cytotoxicity at different concentrations for the free drug and its complexes with SiNPs. While the free drug did not show any dark toxicity some dark toxicity (~10 %) were observed for both types of drug-SiNP complexes for higher concentrations. Both the complexes showed higher phototoxicity compared to the free drug, with the covalent complex having the highest phototoxicity. At a drug concentration of 10 μM, where the dark toxicity of both the complex was not significant, the RB-SiNP covalent complex shows an enhancement in the phototoxicity by ~2.5 and ~2.0 times in MCF-7 and 4451 cells respectively when compared to the electrostatic complex.

In order to understand the origin of the observed enhancement in the phototoxicity of the drug nanoparticle complex studies were carried out on cellular uptake, photostability and $^1O_2$ generation of the free drug and drug-nanoparticle complexes. The intracellular uptake of the drug was monitored by measuring the fluorescence of the drug in lysed cells after incubation. The relative changes in fluorescence intensity of the free drug and its nanoparticle complexes in the two cell lines are shown in Fig.L.11.2. It is clear that conjugating the drug to SiNP leads to an increase in its uptake and that the uptake is larger when the drug is covalently attached to the SiNP. In comparison, the photobleaching and the relative $^1O_2$ generation yield of RB and its complexes with SiNP under one hour photoillumination does not reveal any significant differences. (Photochemistry & Photobiology 87, 1146-1151, 2011)

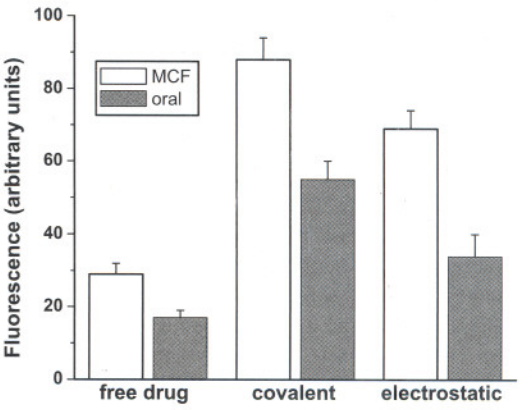

Fig.L.11.2: Cellular uptake of RB and its nanoparticle complexes in breast (MCF) and oral (4451) cancer cell lines by fluorescence method.

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