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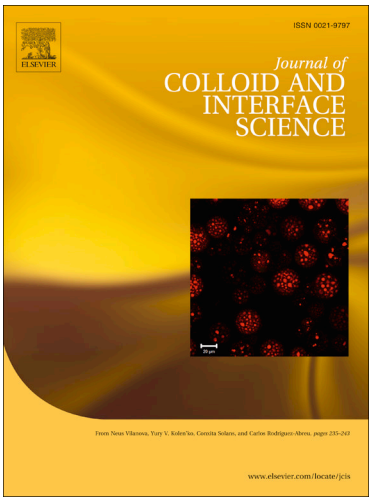

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Targeted photodynamic therapy of breast cancer cells using lactose-phthalocyanine functionalized gold nanoparticles

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Abstract

Gold nanoparticles (AuNPs), which have been widely used for the delivery of photosensitizers for photodynamic therapy (PDT) of cancer, can be dispersed in aqueous solutions, improving the delivery of the hydrophobic photosensitizer into the body. Furthermore, the large surface of AuNPs can be functionalized with a variety of ligands, including proteins, nucleic acids and carbohydrates, that allow selective targeting to cancer tissue. In this study, gold nanoparticles were functionalized with a mixed monolayer of a zinc phthalocyanine and a lactose derivative. For the first time, a carbohydrate was used with a dual purpose, as the stabilizing agent of the gold nanoparticles in aqueous solutions and as the targeting agent for breast cancer cells. The functionalization of the phthalocyanine-AuNPs with lactose led to the production of water-dispersible nanoparticles that are able to generate singlet oxygen and effect cell death upon irradiation. The targeting ability of lactose of the lactose-phthalocyanine functionalized AuNPs was studied *in vitro* towards the galectin-1 receptor on the surface of breast cancer cells. The targeting studies showed the exciting potential of lactose as a specific targeting agent for galactose-binding receptors overexpressed on breast cancer cells.

Introduction

Carbohydrates are present on the surface of human cells in the form of glycans; oligosaccharides either bound to proteins or lipids on the surface of the cells, or free within the tissue.[1,2] The surface of the cells also presents lectins, carbohydrate-binding proteins that recognize glycans in a specific manner *via* their carbohydrate-recognizing domain (CRD).[1–3] Glycans and lectins are involved in many important roles in an organism,[4] including embryonic development, cell growth, differentiation and adhesion, apoptosis, cell signaling, cell-cell