

Eco-Friendly Gold Nanoparticle-Hypericin Conjugates for Antibody-Mediated Breast Cancer Phototherapy

Wednesday, 25 March 2026 11:00 (20 minutes)

Abstract

Photodynamic therapy employing Hypericin has gained attention as a potential alternative for breast cancer treatment, yet its clinical utility remains limited by poor solubility, low selectivity, and non-specific cellular uptake. To address these challenges, we developed a targeted nanoplatfom integrating green-synthesized gold nanoparticles (AuNPs), Hypericin, and monoclonal antibody functionalisation for enhanced PDT in MCF-7 breast cancer cells.

AuNPs were synthesized using an aqueous extract of *Kniphophia porphyrantha*, providing a biocompatible and environmentally sustainable route. Hypericin was subsequently loaded onto the AuNP surface, followed by conjugation with a monoclonal antibody to yield a bionanoconjugate with improved targeting capacity. Characterization via UV-Vis spectroscopy, dynamic light scattering, and transmission electron microscopy confirmed nanoparticle formation, photosensitizer loading, and successful antibody attachment.

Therapeutic performance was evaluated through cellular uptake imaging and cytotoxicity assays (MTT, LDH, ATP) alongside flow cytometry following irradiation with a 594 nm diode laser. Free Hypericin reduced cell viability by ~50%, whereas the antibody-conjugated Hypericin-AuNP nanoplatfom decreased viability to below 30%. ATP levels dropped by 70% in targeted-nanoconjugate-treated cells compared to only 20% in free Hypericin-treated cells, highlighting enhanced metabolic disruption.

These findings demonstrate that antibody-mediated targeting significantly improves photodynamic efficacy, establishing this green nanotechnology-derived Hypericin-AuNP nanoplatfom as a promising candidate for selective breast cancer therapy.

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Session Classification: Medical Biophysics

Track Classification: Biophotonics