Scholars LITERATURE

Nanotechnology and Nanomaterials Research

Short Communication

DOI: https://doi.org/10.47275/2692-885X-111
Volume 2 Issue 1

Applications of Quantum Dots (QD) in Medicine

Neelima Dandamudi*

Department of Pharmaceutical Analysis and Quality Assurance, Annamacharya College of Pharmacy, JNT University, Anantapur, India

Correspondence to: Neelima Dandamudi, Department of Pharmaceutical Analysis and Quality Assurance, Annamacharya College of Pharmacy, JNT University, Anantapur, India; E-mail: neelimadandamudi@gmail.com

Citation: Neelima D (2021) Applications of Quantum Dots (QD) in Medicine. Nanotechnol Nanomater Res, Volume 2:1. 111. DOI: https://doi.org/10.47275/2692-885X-111

Received: August 12, 2021; **Accepted:** August 21, 2021; **Published:** August 27, 2021

Introduction

Quantum dots (QDs) are one of the most significant materials that produce a ground between nanotechnology, and medicine assay. Their unique photoluminescence and electronic properties include broad and continuous absorption spectra, thin emission spectra from visible to near-infrared wavelengths, long light lasting, high brightness makes them some capable probe materials in biosensing or immunosensing platform [1]. They are considered effective fluorescent markers used in a drug delivery system for covering the metabolism process of drugs in the body owing to their special physicochemical characteristics. They can also be developed for a variety of biomedical operations, such as complaint discovery, and fluorescent assays for medicine discovery [1].

Quantum Dots in Medicine

QDs are reasonable candidates as theranostic platforms, as they can act as the main nanocarrier or be part of a more complex architecture as the fluorescent labels [2]. Presently, magnetic resonance imaging (MRI), optical, and nuclear imaging have been immense as crucial imaging ways in biological systems [3]. They vary substantially in terms of sensitivity, resolution, complexity, acquisition time, and functional cost. Still, these above-mentioned ways are reciprocal to each other [4]. A significant amount of research is aimed at using the unique optical properties of QDs in biological imaging. Important of optic bioimaging is grounded on traditional colorings.

Paclitaxel (PTX), an extensively conceded medicine choice for the treatment of colorful mortal cancers, along with CdTe@CdS@ZnS QDs were co-loaded in nanostructured lipid carriers to have a theranostic approach in cancer remedy [2]. Doxorubicin (DOX) was loaded onto pH-responsive ZnO QDs. They synthesized ultrasmall QDs (3 nm) functionalized with poly (ethylene glycol) (Cut) and hyaluronic acid to target the overexpressed glycoprotein CD44 in cancer cells and DOX as the model medicine for the study.

Compound (5-FU@FACS-MnZnS) was assessed in vivo in excrescence-bearing mice, where they contributed to lower excrescence size and lower events of metastasis in the lungs compared to the groups treated with just the 5-FU medicine. The in vitro results were also encouraging; the 5-FU@FACS-MnZnS NPs convinced advanced situations of apoptosis in bone cancer cells (MDA-MB231) compared to the effect of just the 5-FU medicine toward the same cell line [5]. Chiu SH, et al. (2016) [6], developed a nano theranostics platform grounded on carbon amount blotches (CQDs) unravel with S, N, and Gd (GdNS@CQDs). In order to have a targeted binary mode luminescence/MRI, the GdNS@CQDs were functionalized with FA through ECD/ Sulfo-NHS response and the targeting capability was estimated on two cancerous cells lines, HeLa and HepG2 [6].

Another instigative operation for GQDs has been reported in the fight against Alzheimer's complaint, where glycine - proline - glutamate- conjugated graphene amount blotches (GQDGs) was developed and estimated on in vitro and an in vivo murine model. The GQDGs had an inhibitory effect on the aggregation of amyloid-β fibrils, the number of recently generated neuronal precursor cells and neurons increased [7]. The use of QDs has negligible side goods as they can target the delivery system and can fluently distinguish ailing cells from healthy cells by essence affinity-driven tone- assembly between artificial polypeptides and the semiconductor core-shell QDs [4]. Nanoparticles of QDs have long blood rotation time, protection, large medicine-lading capacity, controlled medicine release profile, and integration of multiple targeting ligands on the face [8].

Photodynamic cancer remedy is a remedy in which cancer cells are destroyed with the generation of infinitesimal oxygen, which is cytotoxic. QDs are pervious nanoparticles that induce infinitesimal oxygen and are taken up by cancer cells, hence only cancer cells are destroyed when exposed to ray light [9]. QDs are extensively used as labeling examinations because of their unique parcels like high aspect rate, substantial optic and electrical signal modification, and unique coding capabilities [10]. Several essence oxides like TiO_2, MgO, and ZnO have been reported to present significant antimicrobial exertion, and they're much safer and further heat-resistant than conventional organic antimicrobial agents [11]. QDs have opto-electrical parcels. Their commerce with face plasmons can prompt photoluminescent intensities of QDs. Photoionic commerce between QDs and GNPs in separate structures is achieved by grouping CdSe – ZnS QDs with gold GNPs through DNA tone- assembly [12].

Conclusion

QDs have attracted tremendous attention as the most precious and promising campaigners in the areas of drug delivery, targeting, and imaging. The low toxin, low cost, and good biocompatibility make them excellent campaigners for in vivo bioimaging, gene/ medicine

delivery, and cancer discovery. This has created an important impact in colourful fields of complaint opinion, intracellular trailing as print sensitizers for treatment of cancer, biotechnology, and bioassays. The current advancement in the face chemistry of QDs has expanded their use in natural operations, reduced their cytotoxicity, and rendered QDs an important device for the exploration of distinct cellular processes, like uptake, receptor trafficking, and intracellular delivery. Some of them (ZnO) have also promised significant advances in the hunt for antibacterial agents, and the discovery of antigens and allergens, due to their isoelectric point.

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