RESPONSIVE POLYMER-BASED NANOGELS FOR SMART DRUG DELIVERY

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Abstract:

Responsive multifunctional nanogels are considered to have smart targeted drug delivery, good biocompatibility, biodegradability, high-level of drug loading capacity, controlled & sustained release & good imaging function. These properties are crucial for anticancer, antidiabetic & antimicrobial applications. This research is focused on the synthesis of responsive polymer-based nanogels especially Chitosan (CS) with carbon-based material Carbon dots (Cdots). Chitosan is considered as a good candidate for drug delivery due to its biocompatibility, biodegradability, antibacterial, anti-inflammatory, anticancer, water absorption & retention & especially can be functionalized at the at the OH^- & the NH_2 groups on the CS backbone. It is also considered as pH responsive polymer. Moreover, Curcumin (CUR) which is the main component of turmeric, a polyphenol with low molecular weight has antitumor activity. However, the most significant problems restricting its use in therapy are the poor solubility, instability, rapid metabolism, systemic elimination, & inadequate tissue absorption of curcumin. Various approaches used to overcome curcumin-related issues, some of which are using nanocarriers such as polymeric nanoparticles. Glioblastoma multiforme (GBM) is one of the most complex, deadly, & treatment-resistant cancers. According to the WHO, GBM accounts for 49.1% of all 1^{ry} malignant brain tumors. It is estimated that > 10,000 individuals in the USA will have GBM every year. In this research, synthesized CS-Cdots nanogels will be encapsulated with CUR to increase the loading capacity & drug solubility. The drug release will be trigged by pH stimulus to be released in the tumor site. Different samples were prepared & tested for their morphology by Transmission Electron Microscopy (TEM), Size by Dynamic Light Scattering (DLS) & Charge by Zeta sizer. Drug loading content (DLC) & Drug loading efficiency (DLE) was determined by UV-Vis. spectrometry. Also, the entry of the encapsulated nanogels through the Blood Brain Barrier (BBB) *in-vivo* was performed upon Near-infrared (NIR) imaging. From preliminary results, it was found that the DLC reached 50% & with DLE was 82%. It was also confirmed that the nanogel formulation passed the BBB successfully. More research & studies are being performed to load more anticancer drugs such as Paclitaxel (PTX) & methotrexate (MTX). Also, *In-vitro* cell viability test (MTT) will be done. In addition, their antimicrobial activity, Antioxidant activities will be tested as well.

References:

1. Anooj, E. C., M ; Sharma, Vipin ; Vibala, B.V ; Gopukumar, S.T ; Jainab, S.I. Beema ; Vallinayagam, Sugumari, Nanogels: An overview of properties, biomedical applications, future research trends and developments. *Journal of molecular structure* **2021,** *1239*, 130446.

2. Hui Wang, S. M., Jinhui Yi, Probal Banerjee, Qianwang Chen, and Shuiqin Zhou, Biocompatible Chitosan−Carbon Dot Hybrid Nanogels for NIRImaging-Guided Synergistic Photothermal−Chemo Therapy. *ACS Appl. Mater. Interfaces* **2017,** *9*, 18639−18649.

3. Hui Wang, F. K., Anton Mararenko, Zengyan Wei, Probal Banerjeea and Shuiqin Zhou, Responsive polymer–fluorescent carbon nanoparticle hybrid nanogels for optical temperature sensing, near-infrared lightresponsive drug release, and tumor cell imaging†. *Nanoscale* **2014,** *6*, 7443–7452.