

Assembling Multifunctional Drug Capsules From Safe and Accessible Materials for Selective Cancer Treatment and Diagnosis: Synergizing Fluorescent and Iron-Based Magnetic Therapy

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Each year, over 10,000,000 people lose their lives to cancer. Many current cancer therapies cause deleterious side effects for patients and have an inordinate cost, ultimately leading to patients making decisions that compromise the quality of their cancer care. This project creates multifunctional drug capsules that can be used to deliver therapeutic and diagnostic agents to tumors, while sparing healthy tissue from toxic side effects. Microspheres were made from a hydrogel that gave them fluorescent and magnetic properties, which can be used for hyperthermia treatment. The microspheres showed potential for sustained release of drugs in tumors. In vivo tests with *Drosophila melanogaster* showed no significant sign of toxicity in response to the hydrogel. It was found that the combination of photothermal therapy and magnetothermal therapy had therapeutic effects on triple-negative breast cancer cells (reducing metabolic activity and increasing apoptosis levels), while having minimal to no effects on healthy cells, acting as a selective cancer treatment based on cancer cells' lessened heat capacity. It was observed that the hydrogel selectively increased levels of oxidative stress on cancer cells. The microspheres showed the ability to hold liposomes inside of them, for use in improving chemotherapy and radiotherapy delivery. It was also found that the microspheres can hold iodinated contrast for simultaneous diagnostic imaging and treatment, allowing for monitoring of tumor progression. The magnetic properties of the microspheres can be used to direct treatment to tumors through external magnetic control. All materials used for creating the microspheres were benign and inexpensive, creating a healthcare option based on patient accessibility and affordability.

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