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Harnessing Nature's Fury: Hyptis Suaveolens Loaded Bioactive Liposome for Photothermal Therapy of Lung Cancer

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Abstract : Photothermal therapy, a subset of nanomedicine, takes advantage of light-absorbing agents to generate localized heat, selectively eradicating cancer cells. This innovative approach minimizes damage to healthy tissues and offers a promising avenue for targeted cancer treatment. Unlike conventional therapies, photothermal therapy harnesses the power of light to combat malignancies precisely and effectively, showcasing its potential to revolutionize cancer treatment paradigms. The combined strengths of nanomedicine and photothermal therapy signify a transformative shift toward more effective, targeted, and tolerable cancer treatments in the medical landscape. Utilizing natural products becomes instrumental in formulating diverse bioactive medications owing to their various pharmacological properties attributed to the existence of phenolic structures, triterpenoids, and similar compounds. Hyptis suaveolens, commonly known as pignut, stands as an aromatic herb within the Lamiaceae family and represents a valuable therapeutic plant. Flourishing in swamps and alongside tropical and subtropical roadsides, these noxious weeds impede the development of adjacent plants. Hyptis suaveolens ranks among the most globally distributed alien invasive species. The present investigation revealed that a versatile, biodegradable liposome nanosystem (HIL NPs), incorporating bioactive molecules from Hyptis suaveolens, exhibits effective bioavailability to cancer cells, enabling tumor ablation upon near-infrared (NIR) laser exposure. The components within the nanosystem, specifically the bioactive molecules from Hyptis, function as anticancer agents, aiding in the photothermal ablation of highly metastatic lung cancer cells. Despite being a prolific weed impeding neighboring plant growth, Hyptis suaveolens showcases therapeutic benefits through its bioactive compounds. The obtained HIL NPs, characterized as a photothermally active liposome nanosystem, demonstrate a pronounced fluorescence absorption peak in the NIR range and achieve a high photothermal conversion efficiency under NIR laser irradiation. Transmission electron microscopy (TEM) and particle size analysis reveal that HIL NPs possess a spherical shape with a size of 141 ± 30 nm. Moreover, in vitro assessments of HIL NPs against lung cancer cell lines (A549) indicate effective anticancer activity through a combined cytotoxic effect and hyperthermia. Tumor ablation is facilitated by apoptosis induced by the overexpression of ɣ-H2AX, arresting cancer cell proliferation. Consequently, the multifunctional and biodegradable nanosystem (HIL NPs), incorporating bioactive compounds from Hyptis, provides valuable perspectives for developing an innovative therapeutic strategy originating from a challenging weed. This approach holds promise for potential applications in both bioimaging and the combined use of phyto-photothermal therapy for cancer treatment.

Keywords : bioactive liposome, hyptis suaveolens, photothermal therapy, lung cancer
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