



Combined Chemotherapy and Enhanced Photodynamic Therapy, Mediated by Microalgal Drug Delivery System, Exerted Synergic and Potent Effects in an Orthotopic Osteosarcoma Model*

Osteosarcoma (OS) is considered the most frequent type of primary malignant bone tumor. Currently, radiotherapy, photodynamic therapy (PDT), and other therapies for osteosarcoma are limited by tumor hypoxia, single efficacy and severe side-effects.

In this study, spirulina was used as a carrier to load the chemotherapeutic drug, doxorubicin (DOX). It was developed into a multifunctional drug delivery system, DOX-loaded Spirulina (SpiD) for OS treatment. *In vitro* results demonstrated that SpiD could effectively produce oxygen, enhance ROS generation through photosensitization, and synergistically induce death of OS cells (MNNG/HOS) with DOX. *In vivo* experiments demonstrated the feasibility of SpiD to achieve tumor fluorescence imaging and the ability of long-term accumulation in OS. In addition, SpiD-mediated combined chemotherapy and enhanced PDT not only effectively inhibited the growth of OS, but also reduced the damage done to the tibia. Histological evaluation showed that SpiD + Laser down-regulated the hypoxia inducible factor-1 α (HIF-1 α) and increased ROS generation of OS. It shows antitumor effects by inhibiting tumor cell proliferation, suppressing tumor associated angiogenesis, and inducing tumor cell apoptosis. Finally, both the blood chemistry test and histological evaluation confirmed the biosafety of SpiD, with no obvious toxic or side-effects. Overall, a microalgal drug delivery system SpiD enabled fluorescence-image-guided OS synergistic therapy. Using the biological advantages of Spirulina, SpiD could alleviate tumor hypoxia, promote the efficacy of combined chemotherapy and PDT, and reduce the side-effects of tumor treatment. Together, the potential of using the microalgal drug delivery approach provides a multifunctional platform for oxygen and drug delivery and a novel therapeutic strategy for treating OS.

Dr. Toshi Ide, Sr. Technical Division Manager mentions that "This is a great research publication that spirulina is used as drug carrier loaded with known chemotherapeutic drug and the drug delivery system under laser irradiation exerted synergistically killing tumor cells with released chemotherapeutic drug. More interestingly, this system could reduce the side-effects caused by chemotherapy, including blood and tissue safety. This natural biomaterial-based drug delivery strategy successfully overcomes the limitations of traditional tumor therapy and nanodrug delivery systems and may provide novel insight into the treatment of osteosarcoma."

Reference

An, X. et al (2024). Doxorubicin-Loaded Microalgal Delivery System for Combined Chemotherapy and Enhanced Photodynamic Therapy of Osteosarcoma. *ACS Appl. Mater. Interfaces*.
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* These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure or prevent any disease.

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