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Anti-cancer effects of C-phycocyanin in xenograft tumor implanted mice

Sivanesan Dhandayuthapani[1], **Miroslav Gantar**[2], **Corine Stinson**[1] and **Appu Rathinavelu**[1]
[1]Nova Southeastern University, USA
[2]Florida International University, USA

Blue-green algae (cyanobacterium) are one of the most primitive life forms on earth and some of them such as Nostoc, Spirulina and Aphanizomenon species are rich in various forms of nutrients. The C-Phycocyanin (C-PC) is one such nutrient that is produced by *Spirulina platensis* and *Limnothrix sp*. 37-2-1. For the first time we have tested the anticancer properties of C-PC from the cyanobacterial isolate *Limnothrix sp*. 37-2-1 using cancer cells and xenograft tumor model. Our preliminary studies confirms that C-PC from *Limnothrix* have antiproliferative activity against LNCaP prostate cancer cells. However, as expected the required concentration of phycocyanin for anticancer activity is well above the usual doses of anticancer drugs normally used. Therefore, we speculated that C-PC could potentiate the anticancer effects of certain therapeutic agents when used in combination treatment. Initially the cytotoxic effects of C-PC and Topotecan (TPT) were confirmed using cell viability assays in A-549 lung cancer cells. Also, it was determined that C-PC treatment could completely down regulate the levels of Bcl-2, an anti-apoptotic protein, to induce apoptosis. Furthermore, our *in vivo* experiments confirmed the efficacy of C-PC in potentiating the anticancer effects of Taxol, Topotecan and Cisplatin in athymic nude mice that were sub-cutaneously implanted with the xenograft tumors established from A549-*luc* (Lung) cancer cells. During the treatment period the experimental mice had free access to C-PC dissolved in drinking water at a dose of 100 mg/Kg body weight. All the other anticancer drugs were given as intraperitoneal injections (i.p.) at a dose of 1.0 mg/kg body weight twice a week for a period of 60 days. Tumor growth was assessed once in every two weeks using caliper measurements. As a result of the treatment period, the tumor growth in the treatment groups were found to be 54%, 46% and 33% less in Taxol; TPT and Cisplatin treated groups when compared to the control group. Interestingly C-PC + Taxol combination showed 75% inhibition while C-PC + TPT showed 51% and C-PC + Cisplatin showed 40% inhibition of tumor growth. Thus, the mice treated with the C-PC + Taxol combination showed an additional 28% tumor growth inhibition when compared to group treated with Taxol alone. Results from our study confirm that C-PC from *Limnothrix sp*. 37-2-1 can significantly enhance the anticancer activity of Taxol against the A549-*luc* tumor in athymic nude mice.