Eukaryotic Algicide: Environmental Remediation of Harmful Algal Blooms via Microencapsulation for Bioactivation of Programmed Cell Death

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The anthropogenic release of greenhouse gases and nutrient loading has contributed to the proliferation of harmful algal blooms. The overgrowth of diatoms and dinoflagellates creates hypoxic dead zones, threatening marine biodiversity, human health, and global economies. Conventional methods of controlling blooms through algicides are expensive and environmentally toxic. This project aims to find a sustainable eukaryotic algicide to remediate HABs. Phase I investigated flavonoid activators for the initiation of apoptosis. Delivery of apigenin, chrysin, and quercetin via aqueous dissolution activated initiator Caspases-like 8 protease and executioner Caspases-like 3 protease in diatom and dinoflagellate colonies to propagate PCD. These flavonoids served as stressors for the intrinsic apoptotic pathway, targeting the caspase recruitment domain and causing dimerization and cellular cleavage. Phase II examined polyelectrolyte and counterion solutions for the microencapsulation of HAB treatment. Ionotropic gelation solutions of sodium alginate and calcium chloride, carboxymethyl cellulose and calcium lactate, and pectin and calcium carbonate encapsulated the optimal flavonoid for the controlled release in ecosystems. Phase III performed microwave-assisted extraction to isolate the flavonoid from parsley for in-situ evaluations in ponds. Spectrophotometric assays of cell density, chlorophyll a, and DNA fragmentation discovered that apigenin was the most effective activator, and a 6% apigenin concentration improved efficacy. Cellulose microcapsules exhibited desirable biodegradability and non-phytotoxic and non-toxic qualities, functioning consistently between in-vitro and in-situ. The project developed an environmental and economical HAB treatment that stops marine blooms.

Awards Won:
Third Award of $1,000