Larvicidal “Trojan-horse”: Experimentally Developing a Novel Low-Cost and Eco-Friendly Mosquito Vector Control Treatment

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Mosquitoes, particularly the Aedes genus, are responsible for the transmission of Zika, Dengue, West Nile, and Malaria, which have no vaccines/treatments available. These result in 700million reported cases and over one million deaths annually, making mosquitoes the deadliest animal on earth. The overuse of toxic synthetic larvicides has resulted in widespread resistance and the few available alternatives are cost-prohibitive. Essential oils (EOs) have been proposed as eco-friendly alternatives, but their volatility, high lethal concentrations, and UV/heat sensitivity reduce their efficacy. This research proposes a novel application of EOs by encapsulating them in S. cerevisiae cells. Five common EOs were each loaded into baker’s yeast cells, lyophilized, then evaluated for larvicidal activity after 24, 48, and 72hrs at 10 concentrations and compared to EOs alone. Cinnamon(LD50=23.7mg/L), garlic(LD50=30.8mg/L), and orange(LD50=34.2mg/L) encapsulated-yeasts showed exceptional mortality. Unexpectedly, no surviving cinnamon-yeast exposed larvae pupated at all concentrations and other loaded yeasts caused significant developmental inhibition. The observation of 7 unique morphological/behavioral alterations indicated multiple mechanisms of action, which prevents resistance selection. Of these, 3 new larvicidal mechanisms of action were serendipitously discovered targeting the tracheal trunks, Malpighian tubules, and chitinous cuticle. The novel larvicides showed no significant lethal effects in Daphnia and microalgal ecotoxicity assessments. The treatments were also tested on Tx. rutilus larvae, an Aedes predator, and no significant mortality was recorded. The treatment synthesized offers an inexpensive, sustainable, and readily scalable solution to mosquito-borne diseases.

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Second Award of $2,000

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