

## **Preparation and characterization of neem oil nanoemulsion formulations against *Sitophilus oryzae* and *Tribolium castaneum* adults**

### **ABSTRACT**

This study aimed to improve the efficacy of azadirachtin (*Azadirachta indica*, A. Juss) against two serious pest species of stored products, *Sitophilus oryzae* (L.) and *Tribolium castaneum* (Herbst), through nano-emulsion formulations. Pseudoternary phase diagrams were constructed consisting of an emulsion system of an active ingredient (neem oil), surfactant (polysorbate or alkylpolyglucoside), and water. Isotropic regions were formed in the pseudoternary phase diagrams, and four formulations were selected from the isotropic regions and characterized according to particle size, particle aging, zeta potential, stability and thermostability, surface tension, viscosity, and pH. The selected formulations showed particle sizes of 208–507 nm in diameter. The result of contact toxicity demonstrated excellent mortality of *S. oryzae* and *T. castaneum* adults, with a mortality range of 85–100% and 74–100%, respectively, at a 1% azadirachtin concentration after only 2 days of exposure. Compared to non-formulated neem oil, the nano-emulsion formulations significantly increased the mortality of the tested species.

**Keyword:** Nano-emulsion formulation; Neem oil; Nonionic surfactant; *Tribolium castaneum*; *Sitophilus oryzae*; Azadirachtin