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EVALUATION OF INSECT-REPELLENT ACTIVITY OF *PIPER LONGUM* (L.) BASED NANO-EMULSIONS FOR THE CONTROL OF *SITOPHILUS ORYZAE* (L.) (COLEOPTERA: CURCULIONIDAE)

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The rice weevils (*Sitophilus oryzae*) cause significant damage to grains and their milled products during storage, and the control of these insects relies on the use of synthetic insecticides. Due to the deleterious impact caused by these chemicals on biological systems, plant-derived essential oils (EOs) have been used as effective bio-insecticides for managing stored grain insects, providing a safer alternative. Therefore, this study aimed to develop nano-emulsions based on *Piper longum* EO to improve EO's efficacy and evaluate its repellent activity against *Sitophilus oryzae*. GC/MS analysis was conducted for *P. longum* EO, and two combinations, 1:2 and 1:2.5 (EO: Tween 80) of 6% EO concentration, were prepared. Physiochemical characterization of both combinations of *P. longum* nano-emulsions was conducted. Myristicine (61.42%), and caryophyllene (7.98%) were the major constituents of *P. longum* EO. Particle sizes of the nano-emulsions were 10.22 nm and 12.10 nm, polydispersity index (PDI) was reported as 0.438 and 0.292, and zeta potentials were -1.7 mV and -0.80 mV, respectively, for these two combinations. Median repellent concentrations (RC_{50}) for the formulated *P. longum* nano-emulsions of 1:2 and 1:2.5 combinations against *S. oryzae* were 0.019 μL cm^{-2} and 0.014 μL cm^{-2} respectively, whereas RC_{50} recorded for *P. longum* EO was 0.123 μL cm^{-2} within 24 hrs. Accordingly, the formulated nano-emulsions were superior over *P. longum* EO. Thus, it can be concluded that the prepared nano-sized *P. longum* EO can be effectively used as an eco-friendly alternative to harmful chemical insecticides to control insect pest infestations in stored grain food commodities successfully.

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