

Nanoinsecticide toxicity of the essential oil of *Eucalyptus camaldulensis* toward date palm white scale insect *Parlatoria blanchardii*

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Abstract

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The date palm white scale insect *Parlatoria blanchardii* is a serious pest of date palm trees. Traditional chemical pesticides are ineffective as these pests hide under a thick cuticle layer that protects them from insecticides and other control factors. Therefore, the study aimed to formulate nanoemulsion of *Eucalyptus camaldulensis* essential oil utilising low energy method to prepare eco-friendly insecticide. One nanoemulsion phase diagram was constructed by employing mineral oil as the oil phase, span 80 and tween 80 as the non-ionic surfactants, and water. Six points were selected from the phase diagram and mixed with 20% of *E. camaldulensis* leaves and seeds essential oil, which was obtained by hydrodistillation. Two formulations exhibited high stability under centrifuge and storage conditions with good physical characterisations. These formulations were nanoemulsion formulations with particle sizes (65.44 to 54.65 nm). The toxicity of the leaves and seeds essential oil nanoemulsion formulations against *P. blanchardii* was higher than non-formulated essential oils. The toxicity increased with increasing concentration and exposure time. Depending on these findings, the nanoformulations of *E. camaldulensis* essential oil can present a promising, reliable alternative to conventional pesticides to control *P. blanchardii* as an eco-friendly insecticide.

Keywords: *Phoenix dactylifera*; nanoemulsion; formulation; mortality; toxicity

Introduction

Date palm *Phoenix dactylifera* trees are one of the most economically significant fruit trees spread widely in semi-arid and arid regions. Like all other trees, these trees are infested by numerous pests that lead to significant production losses in quantity and quality if they are not controlled (Ab-Elgawad et al., 2019). The date palm white scale insect (grey-scale insect) *Parlatoria blanchardii* is considered one of the most important agricultural pests. The species spreads on fruit trees, such as date palms and ornamental palms, particularly in regions that have a tropical or semi-tropical climate (Mahmoudi et al., 2008; Salman et al., 2012). This sap-sucking insect pest is covered with a thick cuticle-like

scale, and both adult females and nymphs are deleterious and damaging stages (Al-Dosary, 2009).

The damage occurs through sucking the sap from fruits and leaves using their stylets, in addition to injecting a harmful or toxic saliva substance into the host plant (Babaousmail et al., 2018). This pest infects wicker, raceme, and all fruit stages of date palms. The infestation is more severe on older and neglected date palm trees, especially in hot, dry areas (Al-Dosary, 2009; El-Shafie et al., 2017). The infestation causes serious damage to the tree in terms of growth and depleting nutrients, leading to increase transpiration, decomposition of the plant pigments, and impairing photosynthesis (Al-Dosary, 2009). Insects can infest the fruits, distorting their appearance and reducing their nutritional value. In ad-