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NANOEMULSIFIED L-CARVONE AND MENTHA SPICATA ESSENTIAL OIL AS POTENT DOSE-DEPENDENT ANTIFUNGAL AGENTS AGAINST THE WHITE ROT PATHOGEN SCLEROTIUM CEPIVORUM

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The increasing demand for sustainable plant disease management has intensified interest in bioactive natural compounds, particularly essential oils (EOs), which are incorporated into nanostructured delivery systems to overcome the limitations of volatility and solubility. *Mentha spicata* EO and its major substance *L-carvone*, are known for *in vitro* antifungal properties; however, their efficacy against *Sclerotium cepivorum*, the etiological agent of white rot in *Allium* spp., remains unexplored. This study reports the dose-dependent antifungal activity of oil-in-water nanoemulsions containing *M. spicata* EO (NEOE) and *L-carvone* (NEOC) against *S. cepivorum*. Nanoemulsions were prepared via high-energy emulsification (Ultra-Turrax, 15,000 rpm, 5 min) with polyoxyethylene (20) sorbitan monooleate (Tween 80) at an oil:surfactant ratio of 1:2. Physicochemical characterization by dynamic light scattering revealed particle sizes of 33.53 nm (PdI = 0.432) for NEOE and 78.91 nm (PdI = 0.1591) for NEOC, indicative of stable, monodisperse systems. *In vitro* bioassays were performed on potato-dextrose agar (PDA) plates at concentrations from 100 to 4000 $\mu g \cdot mL^{-1}$. Controls included blank nanoemulsions (Tween 80 + water) and the synthetic fungicide iprodione. The mycelial growth area (cm^2) was quantified after incubation. NEOC achieved complete inhibition at 400 $\mu g \cdot mL^{-1}$ (MIC), whereas NEOE required 1600 $\mu g \cdot mL^{-1}$ for the same effect. Both formulations significantly reduced mycelial growth in a concentration-dependent manner ($p < 0.05$). These results align with previous findings, such as Kedia et al. (2014) on carvone's suppression of *Aspergillus flavus* and Maswanganye et al. (2025) on spearmint nanoemulsions inhibiting *Penicillium* spp. in postharvest fruit. The present study is the first report demonstrating the complete *in vitro* suppression of *S. cepivorum* by nanoemulsified *L-carvone* and *M. spicata* EO, highlighting their promise as biofungicidal agents for *S. cepivorum* management. The authors gratefully acknowledge CNPq and FAPEMIG for financial support, as well as Universidade Federal de Viçosa – *Campus* Rio Paranaíba (UFV-CRP) for technical assistance.

Keywords: *Mentha spicata, L-carvona, nanoemulsions, essential oils, Sclerotium cepivorum.*

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