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Antibacterial Effect of *Ziziphora tenuior* Essential Oil Incorporated with Zinc oxide (ZnO) nanoparticles

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Abstract

This study was carried out to evaluate the in vitro antibacterial activities of nanofluid based on *Ziziphora tenuior* essential oil and Zinc oxide (ZnO) nanoparticles against pathogenic bacteria in food, including two gram-negative and two gram-positive bacteria. The agar disk diffusion and micro-dilution methods were used to study the antibacterial activity. Results revealed that the highest zone of inhibition (19-23 mm) for the Nanofluid containing the ZnO (0.75 v/v-EO, 125 ppm-NP) compared to the control (without ZnO - 0.75 v/v EO). Minimum inhibitory concentration (MIC) against *Bacillus cereus*, *Staphylococcus aureus*, *Salmonella enterica* and *Escherchia coli* was determined respectively 0.015 %v/v-EO - 2.6 ppm-NP, 0.019 %v/v-EO - 3.3 ppm-NP, 0.061 %v/v-EO - 10.54 ppm-NP, 0.093 %v/v-EO - 15.62 ppm-NP. Minimum bactericidal concentration (MBC) against the mentioned bacteria were respectively 0.046 %v/v-EO - 8 ppm-NP, 0.061 %v/v-EO - 10.54 ppm-NP, 0.124 %v/v-EO - 20.83 ppm-NP, 0.187 %v/v-EO - 31.25 ppm-NP. *Bacillus cereus* was respectively the most sensitive specie while *Escherchia coli* was the least sensitive specie. ZnO nano-particles improved the antibacterial activity of the essential oil quite effectively, which shows the potent application of the particles in different systems based on the essential oils like food packaging, food systems and pharmaceutical.

Keywords: Antibacterial activity, Essential Oil, *Ziziphora tenuior*, Zinc oxide, Nanofluid, nanoparticles