

Title : Development and characterization of eucalyptus oil-encapsulated nanocarriers as antibacterial and antioxidant agents

Author(s) : Ms. Narasamon Tongmeung

Student ID : 640510109

Major : Biochemistry and Biochemical Innovation

Advisor(s) : Dr. Pattanapong Thangsunan

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ABSTRACT

Eucalyptus oil is a natural compound that gained attention due to its antibacterial and antioxidant properties. However, the utilization of eucalyptus oil is limited by its low stability and short duration of active compound release. The development of nanoencapsulation technology is an alternative to overcome these challenges. This study aimed to develop and characterize eucalyptus oil-encapsulated nanocarriers. Four nanoparticle formulations containing different concentrations of eucalyptus oil (0%, 0.5%, 1%, and 2%) were prepared. After testing the stability over a 15-day period, the formulation containing 2% eucalyptus oil showed the highest stability. Therefore, this formulation was selected for further characterization. Dynamic Light Scattering (DLS) analysis revealed that the developed nanoparticles had an average size of 142.1 ± 2.2 nm, a polydispersity index (PI) of 0.2 ± 0.041 , and a zeta potential of -73.9 ± 1.3 mV. Antibacterial activity tests using disk diffusion and agar dilution methods revealed that the nanoparticles were unable to inhibit the growth of *Escherichia coli* and *Staphylococcus aureus* in comparison to 100% pure eucalyptus oil and gentamicin, which inhibited the growth of these bacteria. Antioxidant activity test using the DPPH assay indicated that the 2% eucalyptus oil-encapsulated nanoparticles did not exhibit free radical scavenging ability, while 100% pure eucalyptus oil demonstrated a limited capacity to scavenge free radicals compared to the standard antioxidant Trolox. Furthermore, in the ATBS antioxidant assay, the nanoparticles showed no antioxidant activity, whereas 100% pure eucalyptus oil exhibited the ability to inhibit free radicals at an IC_{50} of 0.241%. However, further investigation on the optimal concentration of encapsulated eucalyptus oil is required to improve the antibacterial and antioxidant activities of the nanoparticles.

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