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Preparation and characterization of bioactive microcapsules of neem oil and clove oil

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Neem and clove oil are well known for their valuable medicinal properties such as antibacterial and antioxidant activities. However, direct usage of these oils on a daily basis is limited because of their strong odor, taste and oiliness. Microencapsulation of these oils helps to overcome these fore stated problems and allows the controlled release of the encapsulated oil under desired conditions. During this research, efforts were made to encapsulate clove and neem oils using gelatin-gum Arabic wall materials. Optical microscope was used to observe the morphology of the synthesized microcapsules and both neem and clove oil microcapsules appeared to be spherical. The amount of encapsulated oil was found to be 0.30 ± 0.03 µl/mg for neem microcapsules and 0.16 ± 0.01 µl/mg for clove microcapsules. A comparison of the UV visible, FT-IR and GC-MS spectra of pure oils and crushed microcapsules confirmed the successful encapsulation of each oil inside the microcapsules. A significant increase in the UV absorbance was seen once the microcapsules were crushed. Assays were carried out using Folin-Ciocalteu reagent to investigate the antioxidant (AO) activity of the prepared microcapsules. It was found that the AO activities were preserved in the encapsulated oils. The AO capacity of crushed clove microcapsules (126 ± 2 µg pyrogallol equivalents PGE/mg) was significantly higher than that of crushed neem microcapsules (8 ± 1 µg PGE/mg). Antibacterial activity of the clove microcapsules investigated using the disk diffusion assay indicated significant antimicrobial activity against *Staphylococcus aureus* and *Bacillus cereus*. For both pure and encapsulated clove oil, the diameters of inhibition zones (DIZ) were 2.9 ± 0.4 cm against *S. aureus,* whereas the DIZ were 2.6 ± 0.3 cm and 1.9 ± 0.4 cm against *B. cereus* respectively. A smaller zone of inhibition was observed for pure neem oil but an inhibition zone was not observed for the crushed neem microcapsules, possibly due to the low antimicrobial activity of pure neem and lower amount of neem oil released from crushed microcapsules. Upon subjecting the microcapsules to a range of temperatures and pHs, it was observed that the encapsulated oils retained the bioactivities exhibited by the original oils. In conclusion, neem oil and clove oil were successfully encapsulated using gelatin–gum arabic as coating materials. Both clove and neem microcapsules retained the antioxidant activities of the pure oils. Clove microcapsules indicated significant antibacterial activity similar to its pure oil. Neem microcapsules did not show any significant antimicrobial activities against the tested species similar to pure neem oil used in this study. Both types of microcapsules did not hold a strong odor as the pure oils.

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