

Synthesis and characterization of cinnamon bark oil – encapsulated alginate microcapsules

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The encapsulation of essential oils derived from plants has gained significant attention in the food industry due to their instability and sensitivity to environmental factors such as heat, light, and oxygen. Cinnamon bark oil (CBO) is mainly composed of cinnamaldehyde, which offers potent antimicrobial and antioxidant properties, but cannot be utilized directly on food because of its volatility, degradation, and interference with the physical integrity of the food material. This study focuses on the synthesis and characterization of alginate-based microcapsules incorporating CBO. Microcapsules were synthesized using the ionotropic gelation method with sodium alginate as the encapsulating polymer. The formation of microcapsules was achieved through cross-linking with calcium ions, resulting in stable gel structures. The prepared alginate-cinnamon bark oil microcapsules (AL-CBO-MCs) were characterized using Fourier Transformed Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), and Thermogravimetric Analysis (TGA). AL-CBO-MCs were spherical in shape with an average particle size of around 1.9 μm . The encapsulation

efficiency (EE) was determined to be $94\pm1\%$ with 0.5 g CBO, 0.3% (w/v) alginate (100 ml), and 0.05% CaCl_2 . The loading capacity (LC) was $30\pm2\%$. FTIR analysis showed characteristic peaks corresponding to both alginate and CBO, confirming successful encapsulation of CBO inside the alginate matrix. TGA confirms the protective effect of the alginate matrix in reducing volatilization and enhancing thermal stability compared to free oil upon encapsulation. Overall, the synthesized AL-CBO-MCs exhibited good structural integrity and reproducibility under selected preparation conditions. In conclusion, alginate-based encapsulation provides a simple, efficient, and reproducible method for the incorporation of CBO into stable microcapsule systems. This study provides a strong foundation for further exploration of alginate -based CBO microcapsule systems in functional applications.

Keywords:

Alginate, CBO, Encapsulation, Ionotropic gelation, Stability.