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Thyme extract nanoemulsions stabilized by F127 and evaluation of antimicrobial properties

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Highlights

Thyme extract nanoemulsions stabilized with Pluronic F127 were developed. The 3% F127 system generated stable nanoemulsions (25–40 nm; −27 mV). They showed thermal stability and preliminary antimicrobial activity, making them promising carriers for natural agents.

Resumo/Abstract

Nanoemulsions are nanostructured systems that have attracted increasing interest as carriers for bioactive compounds due to their ability to improve solubility, stability and controlled release. Essential oils are particularly suitable for this type of encapsulation since their bioactivity is often limited by volatility and sensitivity to environmental conditions. In this work, nanoemulsions containing thyme (*Thymus vulgaris*) extract were developed using the thin-film hydration method and stabilized with the nonionic copolymer Pluronic F127 at concentrations of 1, 3 and 5% (w/v), while the oil fraction was fixed at 1% (w/v). The formulations were characterized by dynamic light scattering (DLS), which revealed particle sizes ranging from nanometric values below 50 nm to larger aggregates above 800 nm depending on surfactant concentration. Among the tested systems, the formulation containing 3% F127 presented the most favorable characteristics, with average particle diameters between 25 and 40 nm and zeta potential values close to –27 mV, indicating improved colloidal stability compared to the other compositions. Thermogravimetric analysis (TGA) confirmed the superior thermal stability of this optimized formulation, while scanning electron microscopy (SEM) supported the nanometric size and uniformity of the droplets. Stability tests under different conditions of pH, temperature and storage demonstrated that higher surfactant content was directly correlated with resistance to destabilization processes, reinforcing the role of Pluronic concentration in the performance of the nanoemulsions. Preliminary antimicrobial assays performed against *Staphylococcus aureus* and *Klebsiella pneumoniae* revealed inhibition zones for selected formulations, suggesting that the encapsulation of thyme extract not only protected the active compounds but also enhanced their antimicrobial effect. In conclusion, the results indicate that thyme extract nanoemulsions stabilized with 3% Pluronic F127 achieved the best balance between particle size, colloidal stability and thermal resistance, emerging as promising candidates for the development of natural antimicrobial systems with potential applications in the biomedical and food sectors.

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