DEVELOPMENT AND EVALUATION OF OREGANO ESSENTIAL OIL NANOEMULSIONS

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Introduction

Nanotechnology uses nanometric structures (<1000 nm) to improve physical and chemical properties [1]. Nanoemulsions (NEs), composed of two immiscible liquids with <500 nm droplets stabilized by surfactants, are used to incorporate lipophilic substances into water, offering high kinetic stability and optical transparency [2][3]. They can be produced by high-energy methods, involving mechanical devices, or low-energy methods, based on spontaneous formation [4].

Oregano essential oil (OEO), rich in carvacrol and thymol, exhibits antimicrobial and antioxidant properties, making it an alternative to natural preservatives. Oregano (*Origanum vulgare* L.) is valued for its culinary uses and grows mainly in Europe, North Africa, and Asia [5]. The aromatic effect of the essential oil is due to compounds such as carvacrol and thymol[6]. The objective of this study was the development of oregano oil nanoemulsions to preserve the .

Material and Methods

Tween 80 (polyoxyethylene sorbitan monooleate) and Span 80 (sorbitan monooleate) and Tween 20 (polyoxyethylene sorbitan monolaurate) were obtained from Mapric and Farmos, respectively. Oregano essential oil was purchased from Terra Flor. The flaxseed used for extraction and subsequent freeze-drying was provided by Arma Zen. Deionized water was used for general procedures.

The nanoemulsion formulations were prepared with a final mass of 2 g, consisting of 90% (w/w) deionized water and 10% (w/w) oil-phase (OEO and surfactants). OEO was homogenized at approximately 500 rpm by vortex stirring (model AP56, Phoenix) with nonionic surfactants (Tween 80 and Tween 20). Then, deionized water was added drop by drop to the oil phase under continuous homogenization.

Results and Discussion

The preliminary studies indicated that the most promising formulations had HLB values of 14.2, 13.2, and 12, using a 9:1 ratio of Tween 80 to Span 80, and OEO ratios of 9:1, 8:2, and 7:3, respectively. These formulations exhibited translucency and a bluish reflection.

The most effective nanoemulsions (NEs) from the preliminary test were further analyzed for stability over 1, 7, and 14 days, assessing color, transparency, and sedimentation and particle size. No significant changes were observed during this period. Particle sizes were measured using a Zetasizer.

Formulations with 1%, 2%, and 3% OEO had initial droplet sizes of 272.5 nm, 223.1 nm, and 170.2 nm, respectively, and remained more translucent throughout the evaluation. Over time, the droplet sizes changed. The 2% OEO formulation, though slightly cloudier than the 1%, achieved the smallest

droplet size, reaching 137 nm by day 14, with a low polydispersity index (0.154). The 3% formulation exhibited less variation in droplet size, indicating good stability.

Conclusion

Based on the results obtained, it can be concluded that the nanoemulsion formulations with varying concentrations of oregano essential oil (OEO) and specific HLB values (14.2, 13.2, and 12) demonstrated stability and desirable characteristics over the 14-day period. The 1% OEO formulation was the most promising, showing a balance of translucency, droplet size, and stability.

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