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Carbopol hydrogel loaded with nanosponges as an approach for enhancing activity of a natural antifungal: Factorial design analysis, characterization and *in vivo* evaluation

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Lemongrass oil is a volatile oil extracted from the leaves of *Cymbopogon citratus* that has various pharmacologic and clinical effects. The oil suffers from low aqueous solubility and instability of its major active constituent, citral. These drawbacks could lead to reduced effect, volatilization and consequently, skin irritation. To overcome these problems, this research aims at enhancing the antifungal activity and reducing irritation of lemon grass via the formulation of topical hydrogel loaded with ethyl cellulose-based nanosponges containing lemongrass. The minimal inhibitory concentration and minimal fungicidal concentration of LGO against *Candida albicans* strain ATC 100231, determined using the broth macrodilution method, were found to be 2 and 8 µL/mL, respectively. Nanosponges were prepared using the emulsion solvent evaporation technique. The nanosponge dispersions were then incorporated into 0.4% carbopol hydrogels. Nine formulations were prepared according to a 3^2 full factorial design. Ethyl cellulose: Polyvinyl alcohol ratio and stirring rate were studied as independent variables. The prepared formulations were characterized for particle size, citral content and in vitro release. Results revealed that all the nanosponge dispersions were in the nano range with satisfactory citral content and sustained release profiles. Both independent variables have significant effects on particle size and percentage released after 6 hours; however, the effect of the stirring rate was more prominent on both responses. Morphological investigations for the selected hydrogel formulation, F9, revealed that the nanosponges possess a spherical uniform shape with a spongy structure that preserved their integrity after incorporation into the hydrogel. Furthermore, the in vivo evaluation proved the non-irritancy and the effective antifungal activity of the selected formulation against *C. albicans*.

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Acoustic spectroscopy for the characterization of pharmaceutical nanosystems

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Acoustic spectroscopy is one of the emerging technologies developed to minimize processing, maximize quality and ensure the safety of pharmaceutical, food and chemical products. The operating principle of acoustic spectroscopy is the measurement of the ultrasound pulse intensity and phase after its propagation through a sample. The main goal of this technique is to characterize concentrated colloidal dispersions without dilution, in such a way as to be able to analyze non-transparent and even highly structured systems. After a simplified explanation of the theory behind acoustic spectroscopy and a brief discussion on the 2 types of instruments that can be found on the market, the presentation describes what type of information can be obtained from different dispersed systems for pharmaceutical use. More precisely, it is shown as acoustic spectroscopy can give the particle size distribution of micelles and other types of self assembled systems, or emulsions and microemulsions. The case of poloxamer 407 water system and that of an entire ternary diagram are given. At the same time, microrheological considerations about the structure of the system can be done. Then, some examples of transitions that can be monitored by acoustic spectroscopy are shown: thermal self assembling and thermogelling, liposomes thermal transitions, dissolution kinetics of polymers in water, mucoadhesion of polymers.

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