

## Formulation of $\beta$ -Cyclodextrin Nanosponges by Polycondensation Method: Application for Natural Drugs Delivery and Preservation.

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**ABSTRACT** — Nanosponges are a novel class of encapsulating nanosystems based cross linked polymeric materials with a porous surface, used as a promising delivery system of synthetic and natural bioactive molecules. The aim of the present work was to prepare a stable nanoemulsion based on  $\beta$ -cyclodextrin nanosponges for enhance physicochemical stability of *salvia officinalis* essential oil. In first, new  $\beta$ -cyclodextrin nanosponges were synthesized by polycondensation using naphthalene dicarboxylic acid as cross-linking agent, the latter system was characterized by FTIR spectroscopy, BET and powder XRD. afterwards, nanoemulsion stabilized by nanosponges was prepared, its physicochemical properties were determined (particles size, zeta potential, viscosity, turbidity and essential oil content) and its stability was studied at different storage temperatures (4°C, 20°C and 40°C) during 30 days. Finally, pharmaceutical application of prepared nanoemulsion was investigated by in-vitro antimicrobial activity. Reaction yield of nanosponges based  $\beta$ -cyclodextrin and 2,6-naphthalene dicarboxylic acid was 42.51%. Characterization of nanosponges by FTIR, BET and XRD showed the enhancement of their porosity and solubility compared to natural  $\beta$ -cyclodextrin's ones, these results clearly demonstrated their high capacity to encapsulate hydrophobic substances. Oil-in-Water nanoemulsion of *salvia officinalis* essential oil stabilized by these nanosponges presents a very high stability; this nanoemulsion presents very high stability at all storage temperatures (4°C, 20°C and 40°C) during storage period (30 days), these results permit to broaden the industrial applications of sage essential oil. Investigation of pharmaceutical application of this engineered nanoemulsion by in-vitro antimicrobial activity study proved the increase of essential oil bioactivity.

**Keywords:** *Nanosponge,  $\beta$ -cyclodextrin, Polycondensation, Nanoemulsion, Sage essential oil, Physicochemical stability, in-vitro antimicrobial activity.*

### I.Introduction

Cyclodextrin-based nanosponges can be obtained by cross-linking different types of cyclodextrins with a carbonyl or a dicarboxylate compound as cross-linker agents [1].

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They are biocompatible nanoporous nanoparticles with spherical morphology and the capacity of encapsulating active molecules due to the cooperation of cyclodextrin cavities and cross-linker network [2-5].

Natural  $\beta$ -cyclodextrins have been the most widely used of all the cyclodextrins [6].  $\beta$ -cyclodextrins and nanosponges based on  $\beta$ -cyclodextrins are encapsulating type of nanoparticles which encapsulates the natural and synthetic drug molecules within its core for