

**Development and Biological Evaluation of a Polymeric  
Nanoformulation for the Bioactive Extracts of *Ephedra alata* L.**

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**Abstract**

The study explored the potential of *Ephedra alata* L. grown in Jordan for treating breast cancer due to its anticancer properties. Extracts were prepared using different methods and solvents and fully characterized. The results showed that the hydroalcoholic extract contained phenolic phytochemicals ( $79.93 \pm 5.76$   $\mu\text{g}$  gallic acid equivalents (GAE)/mL), and the antioxidant activity for hydrophobic extract was ( $1.06 \pm 0.02$   $\mu\text{g}/\text{mL}$ ). Then, the extracts were encapsulated in polymeric nanoparticles (NPs) to facilitate their administration. Characterization of the NPs revealed that poly(ethylene glycol)-poly(lactide-co-glycolide) (PEG-PLGA) NPs were highly promising as a nanoformulation for the extracts, with high stability and sustained release properties. Cell viability assays showed that the hydrophilic extract-loaded NPs displayed a significant cytotoxic effect on MDA-MB-231 with  $\text{IC}_{50}$  (0.37 mg/mL). Overall, the results highlight the promising potential of the encapsulation of *Ephedra alata* L. extracts within PEG-PLGA as a novel nanoformulation for the bioactive extracts.

**Keywords:** Breast cancer, *Ephedra alata* L., PEG-PLGA, Nanoparticles, Release.