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NOVEL PLANT EXTRACT-LOADED LIPOSOMES FOR DERMOPHARMACEUTICAL AND COSMETIC APPLICATIONS: FORMULATION DEVELOPMENT AND PHYSICOCHEMICAL CHARACTERIZATION

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Abstract

Over the years, a wide variety of plant extracts have demonstrated relevant therapeutic and cosmetic application. Nevertheless, drawbacks such as chemical and/or enzymatic degradation, untargeted distribution, and low permeation through biological membranes often hinder their effects. To tackle these issues, nanotechnology can be of use, by providing drug protection, enabling controlled release, and increasing permeation. Although several types of nanosystems can be used for therapeutic or cosmetic purposes, liposomes are often regarded as the most adequate for incorporating plant extracts, whose bioactive compounds also often exhibit low stability, since they are phospholipid bilayer nanocarriers with both hydrophilic and hydrophobic regions, enabling the encapsulation of water-soluble compounds in their aqueous core, and fat-soluble compounds in their lipid membrane.

Hence, the purpose of this study was to investigate the potential of the nanoencapsulation of a plant extract for enhanced topical delivery, namely a never before encapsulated plant extract with demonstrated antioxidant, anti-inflammatory, antifungal, antibacterial, anticancer and psycho and neuroactive properties, with an additional distinctive fragrance, refreshing sensation, and calming effects on the skin, making it ideal for dermopharmaceutic and cosmetic applications.

The developed nanometric vesicles were produced using the thin-film hydration method, followed by ultrasonication and extrusion through a small pore membrane, in order to obtain a smaller and more homogeneous particle size. Several lipid 1: lipid 2 ratios (60:40, 75:25, 80:20) were tested and optimized, in order to obtain adequate particle size and polydispersity index (PDI) values, which were determined through dynamic light scattering, using a Zetasizer apparatus. The extract's encapsulation efficiency (EE%) was determined by a priorly developed quantification method, using UV-Vis spectrophotometry.

Results showed that liposomes without the extract (vehicle formulations) exhibited a mean particle size of 120.6 - 134.8 nm, with a corresponding PDI of 0.164 - 0.176, hence representing a highly homogeneous particle size distribution, and a particle size adequate for increased skin permeation and retention. After extract encapsulation (1 – 10 mg/mL), the mean particle sizes ranged from 106.5 to 136.3 nm, hence not being significantly different from the vehicle formulations, but PDI values increased substantially for some of the formulations, ranging from 0.180 to 0.434. For the formulation with the best particle size and PDI values (80:20 lipid 1: lipid 2 ratio) EE% was 37 - 71%, corresponding to 1.3 - 3.7 mg/mL of plant extract. The selected optimized vesicles exhibited optimal particle size characteristics (particle sizes below 200 nm,

PDI below 0.200), increasing the likelihood of increased formulation stability and effective skin permeation and retention, and an EE% up to 70%, which demonstrated effective encapsulation of the extract.

Hence, novel liposomal plant extract-loaded formulations were successfully developed. Further studies will assess these vesicles' stability, in vitro release, and in vitro bioactivity and safety, to support the potential use of these nanoformulations in pharmacological and cosmetic contexts.

Keywords:

Cosmetic, Dermopharmaceutical, Liposomes, Plant Extract