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Fourier transform infrared spectroscopy as a tool for chemical analysis of nanoliposomes with aloe extract

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Introduction: Aloe or *Aloe vera* (L.) Burm. f. (Asphodelaceae family) has been known and used for centuries for its health, beauty, medicinal, and skin care potential. The plant contains 75 potentially active constituents: enzymes, sugars, lignin, saponins, anthraquinones, salicylic acid, amino acids, vitamins, and minerals. *A. vera* possesses healing, anti-inflammatory, antiseptic, laxative, antiviral, immunostimulant, moisturizing, anti-aging, and antitumor properties. With the aim to protect its bioactives from degradation and contribute to control release technology, as well as the development of better-quality formulations, aloe extract can be encapsulated in liposomes. Encapsulation is defined as a process that entraps substances, particularly thermosensitive or bioactive compounds in liquid extract, into a shell of wall material or matrix to produce particles with different sizes, ranging from nanometres to millimeter scale.

Experimental: Extraction from aloe leaves was done on the shaker at 80°C, using a solid-to-solvent ratio of 1:30 g/mL and 70% v/v ethanol for 30 min. The liposomes with encapsulated extract were developed in the proliposome procedure. A mixture of lipids (1 g) and *A. vera* extract (4 mL) was stirred at 50°C. After cooling to 25°C, 20 mL of the aqueous phase was transferred and stirred for 2 h. To investigate the influence of UV irradiation on the extract-loaded liposome, a liposomal population (5 mL) was UV-irradiated by UV-C irradiation at a wavelength of 253.7 nm in a quartz tube at 25°C for 30 min. Then, the non-treated and UV-irradiated liposomes were freeze-dried at -75°C (in a vacuum) for 24 h. Fourier transform infrared (FT-IR) spectra were recorded in a range of 400 to 4000 cm⁻¹.

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Results: FT-IR spectroscopy is used to get insights into the occurrence of interaction between extract compounds and phospholipids, as well as changes in the obtained liposomes caused by UV irradiation. One of the most dominant peaks of the FT-IR spectra of aloe leaf extracts-loaded liposomes is at 2922 cm^{-1} (asymmetric stretching vibration in the CH_3 groups). The dominant mode at 1735 cm^{-1} represents the stretching vibrations of the $\text{C}=\text{O}$ functional group. The bands at 1240 and 1171 cm^{-1} correspond to the symmetric and asymmetric stretching of the PO_2^- functional groups, respectively, whereas the peak at 1055 cm^{-1} is related to the C-O-P-O-C stretching. The bands at 968 and 923 cm^{-1} are associated with the symmetric and asymmetric stretching of the C-N bonds, respectively. At the same time, the mode at 721 cm^{-1} corresponds to the C-N symmetric stretching of choline.

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