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Spectroscopic Investigation on the Interaction of Curcumin with Phosphatidylcholine Liposomes

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Abstract

Interaction between curcumin and liposomes, prepared from soy phosphatidylCholine (SPC), hydrogenated soy phosphatidylcholine (HSPC) and dipalmitoylphosphatidylcholine (DPPC) were separately investigated by way of absorption and fluorescence spectroscopic techniques. 30 mol % cholesterol was used in combination with the phosphocholines in order to maintain the rigidity/fluidity of the bilayers. Curcumin was used as a model drug for its versatile medicinal properties. Size and zeta potential of the liposomes in the absence and presence of curcumin were recorded as a function of liposome concentration with an aim to investigate the effect of hydrodynamic diameter and surface charge on interaction mode. The effect of the size and electrostatic forces were insignificant in the interaction process. Increase in intensity along with progressive blue shift in both the absorption and emission spectra were observed with the increasing concentration of liposomes. Results suggest the incorporation of curcumin into less polar environment, *i.e.*, onto the palisade layer of liposomes. Both the ground and excited state interaction constant of curcumin in SPC liposomes were found to be higher than HSPC which were even higher than DPPC. Binding constant, by means of absorption spectroscopic method, was evaluated at four different temperatures (298–323 K) to assess different thermodynamic parameters, *viz.,* changes in the standard Gibbs free energy ($\triangle G°$), enthalpy ($\triangle H°$) and entropy ($\triangle S°$). Interaction processes were spontaneous as all the $\triangle G°$ values were negative. Negative $\triangle H°$ values revealed the exothermicity in binding process. Negative changes in the entropy values indicate the formation of organized assemblies between curcumin and the liposomes. Interaction between curcumin and the liposomes were enthalpy controlled process. Hydrogen bonding played a major role during the interaction. Fluorescence anisotropy (r) and lifetime (τ) values were measured to gain further insight on the curcumin-liposome aggregates. The highest value of r and τ for curcumin loaded in SPC liposomes further supported the binding constant results.

Keywords: Anisotropy, Binding Constant, Curcumin, Lifetime, Liposome