ULTRASOUN-INDUCED CHANGES IN THE ABSORPTION SPECTRA OF MAGNESIUM AND COPPER CHLOROPHYLLINS

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Ultrasound is commonly used to influence the aggregation or self-assembly of molecules in solution, thereby directly affecting their nanostructure and optical properties.[1] However, there is limited data on how ultrasound exposure actually alters the absorption of metal-based chlorophyll derivatives such as chlorophyllins. The purpose of this study was to determine whether ultrasound treatment had any effect on the absorption spectra of magnesium (Mg-Chl) and copper (Cu-Chl) chlorophyllins. Furthermore, we wanted to test whether the central metal ion or solvent affected their stability and propensity for aggregation during sonication. Mg-Chl and Cu-Chl were selected as model metal-containing, photoactive chlorophyll derivatives to assess the influence of the central metal ion on spectral stability under ultrasonic conditions.

Absorption spectra were recorded using UV–Vis absorption spectroscopy in the wavelength range of 300–900 nm. The spectra were obtained before and after a defined ultrasound treatment of working solutions of Mg-Chl and Cu-Chl prepared in distilled water and in phosphate-buffered saline (PBS). Temperature of solutions was controlled during ultrasound treatment to reduce thermal artifacts. The influence of ultrasound treatment and solvent environment on spectral stability was evaluated by comparing pre- and post-exposure absorption profiles.

The results showed that the solvent environment had minimal impact on the spectral response of Cu-Chl to ultrasound. In both distilled water or PBS, the effect was nearly identical: a slight drop in Soret band intensity and a more noticeable decrease and broadening of the Q-bands. In contrast, Mg-Chl was much more sensitive to the choice of medium and was characterized by significantly greater reduction of the Soret band in PBS than in water. While Mg-Chl showed a larger overall drop in the Soret region compared to Cu-Chl, its Q-band maximum remained largely unchanged, which is quite different from what we observed with the copper derivative. These findings provide a basis for selecting the right chlorophyllin for ultrasound-assisted nanostructure formation, depending on whether distilled water or PBS is used as the solvent.

[1] J. H. Bang and K. S. Suslick, “ChemInForm Abstract: Applications of Ultrasound to the synthesis of nanostructured Materials,” ChemInform, vol. 41, no. 18, Apr. 2010, doi: 10.1002/chin.201018217.