TIME-DEPENDENT STABILITY AND OPTICAL PROPERTIES OF RIBOFLAVIN AND MAGNESIUM CHLOROPHYLLIN MIXTURE IN SOLUTION

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The increasing prevalence of antibiotic-resistant foodborne pathogens highlights the urgent need for novel, non-toxic antimicrobial approaches. Antimicrobial photodynamic inactivation (API) is one such technology that is effective against a variety of pathogens that traditional disinfectants and preservatives have trouble with. API relies on three main components: a photosensitizer (PS), molecular oxygen, and light of an appropriate wavelength that corresponds with the absorption spectrum of the PS. Upon photoexcitation, the PS becomes photochemically active, generating reactive oxygen species (ROS) that cause lethal oxidative damage to microbial cellular components [1]. Since API performance hinges on PS physicochemical stability, shifts in absorption or aggregation behavior can directly compromise ROS generation, underscoring the importance of long-term stability. The present work aims to analyse how these conditions influence the spectral profiles of RF/Mg-Chl mixture, studying filtered and unfiltered aqueous systems and allowing the observation of aggregation effects as well as the influence of solution homogeneity on the recorded absorption spectra.

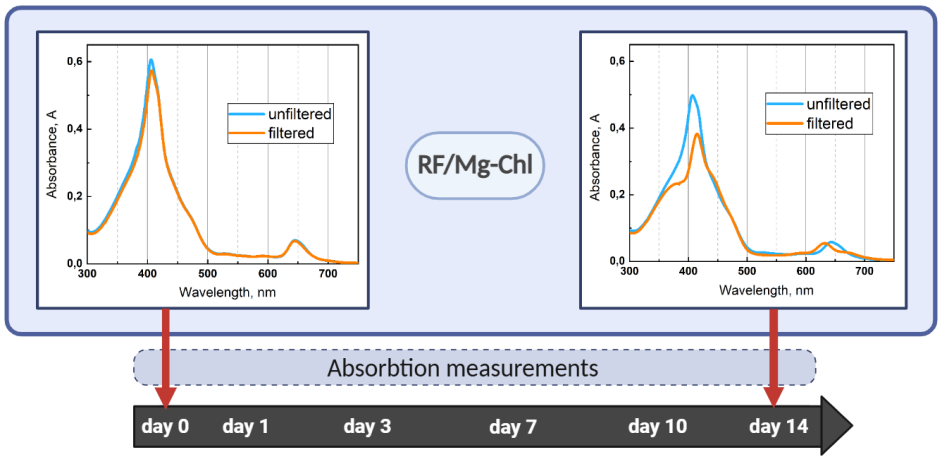

Fig. 1. Scheme of RF/Mg-Chl mixture absorption spectra monitoring in filtered and unfiltered systems over time.

To evaluate the stability of RF, Mg-Chl and their mixture, separate stock solutions of each PS were prepared in distilled water using compound-specific dissolution condition [1]. The stock solutions were used either after sterile filtration (0.22 µm) or without filtration. RF/Mg-Chl mixtures were then prepared from the corresponding filtered or non-filtered stocks and diluted to working concentration. Samples were stored under dark, low-temperature conditions and analysed over time. Spectrophotometric measurements were performed on days 0, 1, 3, 7, 10, and 14 to track the stability and changes in spectral peak positions, band shapes, and absorption spectra of RF/Mg-Chl mixture. On day 0, filtered RF/Mg-Chl solutions exhibited slightly reduced absorption compared to unfiltered samples, consistent with reduced scattering and partial removal of larger aggregates. After 14 days, absorbance decreases in both filtered and unfiltered solutions, indicating time-dependent aggregation processes. Filtered samples also showed small shifts in peak positions and modifications of the Soret band shape over time. These findings are essential for the design and standardization of preparation and handling protocols for PSs in future API studies.

Keywords: Photosensitizers, riboflavin, magnesium chlorophyllin, Antimicrobial Photodynamic Inactivation (API)

[1] I. Buchovec, E. Vyčaitė, K. Badokas, E. Sužiedelienė, and S. Bagdonas, “Application of Antimicrobial Photodynamic Therapy for Inactivation of Acinetobacter baumannii Biofilms,” International Journal of Molecular Sciences, vol. 24, no. 1, p. 722, Dec. 2022.