Ligh-Induced Reactions: Insights into Riboflavin Photodegradation Kinetics in Model Wine

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Riboflavin (RF), or vitamin B_2, is a water-soluble compound undergoing light-induced degradation through two pathways depending on the presence of oxygen. RF concentrations in wine can reach levels of 150 µg/L or higher, attributable to the metabolism of *Saccharomyces cerevisiae*. When RF is exposed to light, particularly in the range of 370 – 450 nm, it reaches a high-energy state requiring two electrons to be fully reduced. In case methionine acts as an electron donor, certain volatile sulfur compounds (e.g., methanethiol, dimethyl disulfide) are formed, responsible for the wine fault known as light-struck taste. Bottling in clear glass can cause the development of this defect with a detrimental impact on the overall wine characteristics. While amber or dark bottles can protect the wine against this fault, consumer inclination towards the visible color of white and rosé wines prompts the use of clear bottles. Intelligent labels, designed to indicate photo-degradation or oxidation of specific wine compounds, could be a potential solution. Consequently, our study aimed to assess the photodegradation kinetics of RF in various aqueous solutions, including phosphate buffer (50 mM, pH 3.2), tartrate buffer (30 mM, pH 3.2), and a model wine solution (tartaric acid 5 g/L, 12% ethanol (v/v), pH 3.2). These solutions underwent exposure to two distinct LED light treatments with high emission in the absorption wavelength of RF (450 nm). The determination of RF apparent first-order rate constants revealed a proportional increase in the rate of RF photolysis with the rise in irradiance area (W/m^2) at 450 nm wavelength. Moreover, differences in the RF degradation rate were found depending on the light-exposed solutions as well as the overall spectra of light. The outcomes of our study could offer support in designing intelligent packaging strategies to mitigate light-induced reactions in food and beverages.

Keywords: *Light exposure, Model Wine, Photo-oxidation, Riboflavin*

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