Colorimetric sensor for ammonia based on silk protein films and curcumin

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Silk is a composition of proteins produced by the silkworm (Bombyx mori) used in the manufacture of cocoons. Composed of fibroin (SF, 70%), a fibrous protein responsible for mechanical strength; and sericin (SS, 30%), a globular protein that coats the fibers [1]. SF films stand out as platforms for environmental sensing due to transparency, biocompatibility and mechanical stability, being able to respond to variations in humidity, temperature, pH and gases, either by structural color effects or by incorporation of functional molecules [2]. In this context, the combination of SF and SS with active molecules represents a promising strategy in the development of sustainable optical sensors. Among these molecules, curcumin (Curc.) natural polyphenol extracted from Curcuma longa. One of its most relevant characteristics is the dependence of color as a function of pH, acquiring reddish coloration in basic medium, while in neutral or acidic medium it remains yellow [3]. In this work, SF and SS films incorporated with Curc. were prepared for detection of gaseous ammonia (NH_3), aiming the monitoring of food. The interaction between Curc and NH_3 promotes rapid and perceptible changes in the coloration of the films, configuring a low cost, biodegradable detection system applicable in intelligent packaging. SF was extracted according to the protocol available in the literature [4]. In a previous step, the cocoons were autoclaved for 1h and SS recovered. These solutions were then mixed, in the proportion of interest, and, in sequence, 50 µL of ethanolic solution of Curc. (20 mg/mL) previously prepared was added. The final mixture was dried on polystyrene plate for 24h and room temperature. Preliminary results indicate that the nature of the protein influences the response to the gas: SF films exhibit greater mechanical strength and stability, however lower sensitivity; while SS films, more porous and hydrophilic, favor the diffusion of NH_3 and intensify the chromatic response. Analyzing experiments carried out with the films and their behavior in different PH. The association of Curc. with silk proteins presents high potential for the development of simple, sensitive and sustainable optical sensors, suitable for monitoring of food. The prepared films react visibly to the presence of NH_3 gas, with color variation easily perceptible to the naked eye. The films with higher proportion of SS exhibited greater sensitivity, thanks to the hydrophilic nature of this protein.

Referencias

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