USE OF TECTOMERS FOR THE IMMOBILIZATION OF A BIOSENSOR TO DETECT BIOGENIC AMINES TOWARDS THE DEVELOPMENT OF SMART FOOD PACKAGING

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Biogenic amines (BAs) are low molecular weight nitrogenous compounds that mainly result from the decarboxylation of free amino acids in food by microorganisms. At high concentrations, they cannot be metabolized by the body and pass to the blood stream, triggering intoxication processes.

Because of the growing concern in food security, the quality control in food requires the development of fast and economic methods for the detection of BAs. Most methods are based on HPLC-MS techniques, and usually require a previous derivatization, so that they are expensive and tedious.

The purpose of this work is the development of an optical sensor for the detection of BAs, as shown in Figure 1, where the enzymes amine oxidase (AO) and peroxidase (HRP), and a dye (ABTS) are immobilized on mica supports, so that the dye turns blue in presence of BAs.

Amino-terminated oligoglycines non-covalently self-assemble into two-dimensional (2D) nanostructures called tectomers (Figure 2a). Tectomers have been successfully used to coat negatively-charged surfaces, such as mica, due to the favorable electrostatic interactions established with protonated amino groups in tectomers [1]. Also, it has been shown that tectomers act as adhesives for a variety of nanomaterials including carboxylated carbon nanotubes and graphene oxide [2].

We here aim to explore the use of tectomers as adhesives for the immobilization of a biosensor to detect BAs. In order to establish the best procedure to retain the reagents on the support, initial studies were performed with albumin-fluorescein (A-F). Different methods of tectomer and A-F deposition were tested on a mica supports. Absorbance measurements allow calculating the amount of A-F retained after immersion in water. In absence of tectomers, 100% of the A-F was lost into the solution; on the opposite, when A-F and tectomer are previously mixed, only 25% was lost after thirty days. Likewise, the immobilization the enzymes and the ABTS dye using tectomer adhesives was achieved on mica (Figure 1b).

Furthermore, a variety of plastics have been studied as potential supports for this biosensor, which could be used for smart food packaging. The plastic container would be then coloured when food is contaminated by BAs. As mentioned above, the adhesion of tectomers to the support will be determined by the strength of chemical interactions. Thus, tectomers are expected to exhibit better adhesion properties in the case of plastics with electronegative groups. Thus, A-F/tectomers were immobilized on polylactic acid (PLA) and polyethylene (PE) supports, with and without electronegative

groups, respectively. As shown in Figure 2b, A-F immobilized on the PLA support was retained after immersion in water for 24h, in contrast to the PE support.

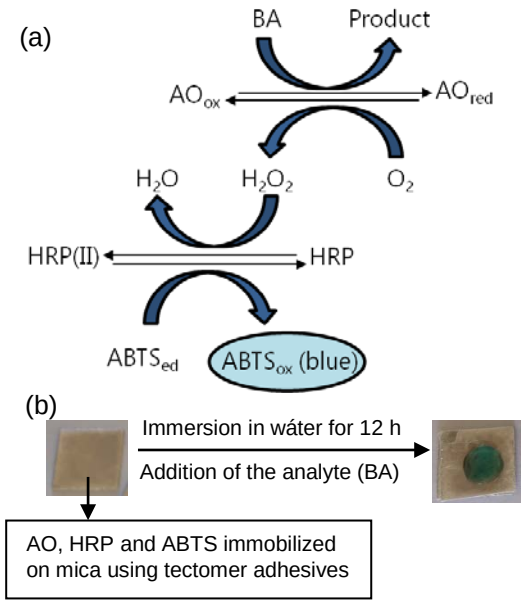

Figure 1. (a) Reaction system on which the developed biosensor is based. (b)The blue colour appears after the addition of the analyte (BA) to the AO, HRP and ABTS immobilized on mica using tectomer adhesives.

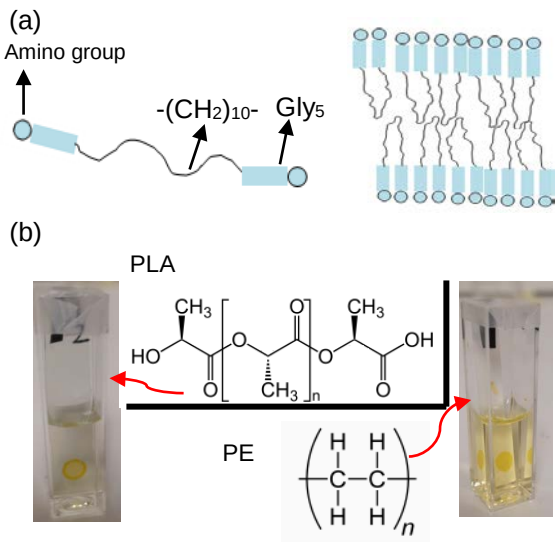

Figure 2. (a) Chemical structure of biantenary oligoglycine and its assembly, the so-called tectomer. (b) A-F/tectomers immobilized on PLA (on the left) and on PE, (on the right), after immersion in water for 24h.

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