Development of electrochemical biosensor for formaldehyde determination based on immobilized enzyme

Abstract

The newly formaldehyde biosensor developed that is based on coupled with enzyme (nicotinamide adenine dinucleotide, NAD +) and formaldehyde dehydrogenase (FDH) for the detection of formaldehyde in fish samples. To maximize the reaction rate, the enzyme acts as biorecognition immobilized with Nafion membrane which chemically modified on gold electrode. The enzyme required nicotinamide adenide dinucleotide (NAD +) as a cofactor which then reduced to NADH during enzymatic reaction. In the system, 0.1 M of potassium phosphate was used as the supporting electrolyte and 0.5 mM of NAD + was added as the coenzyme. The optimum scan rate was found at 0.1 V/s while the optimum pH was at 8 via cyclic voltammetry. A linear response was ranged from 1 to 10 ppm of formaldehyde, with correlation coefficient (R^2) equals to 0.9865 (RSD < 3.05%). The response time was found less than 1 min. Formaldehyde biosensor showed reproducibility with no significant different ($p > 0.05$) at 1, 5 and 10 ppm of formaldehyde (n = 10). For interferences study, it was showed that the biosensor response retained its specificity for formaldehyde and did not respond to equivalent additions of methanol and also ethanol and gave the percentage of formaldehyde recovered ranging from 99.0% to 99.8%. Thus, formaldehyde biosensor is a promising tool and has a potential application for simple, fast, reusability, reproducibility, sensitivity, storage stability, validity, interferences and convenient method for the determination of formaldehyde in fish samples.