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A Lactate Biosensor Based on L-Lactate Dehydrogenase Immobilized onto Carboxylated Multiwalled Carbon Nanotubes/Polyaniline/Pencil Graphite Electrode

Dilek Alagöz*[a], Nazlı Ece Varan[b], Gökmen Sığircik[b], Ali Toprak[c], Deniz Yildirim[d], Tunç Tüken[b], S.Seyhan Tükel[b]

[a] Cukurova University, Imamoglu Vocational School, Adana, Turkey

[b] Cukurova University, Sciences & Letters Faculty, Chemistry Department, 01330, Adana, Turkey

[c] Nevsehir Haci Bektas Veli University, Acigol Vocational School, Nevsehir, Turkey

[d] Cukurova University, Ceyhan Engineering Faculty, Chemical Engineering Department, Adana, Turkey

** alagozdilek@yahoo.com/dalagoz@cu.edu.tr*

L-lactate dehydrogenase (LDH) catalyzes the conversion of L-lactate to pyruvate using NAD as a cofactor. The determination of lactate is vital in the areas of clinical diagnostic, fermentation, and food analysis[1,2]. Therefore, determination of lactate is very important for food and health applications Currently biosensor technology provides this kind of sensitive and selective measurements.

In this study, a lactate biosensor was developed based on covalent immobilization of L-Lactate dehydrogenase (LDH) onto carboxylated multiwalled carbon nanotubes(cMWCNT)/polyaniline (PANI) hybrid film electrodeposited on the surface of a pencil graphite electrode (PGE). Electrochemical polymerization was carried out using a three-electrode cell configuration via cyclic voltammetry (CV). Electropolymerization of PANI in 0.1 M HCl/aniline aqueous solution system at a scan rate of 100 mV s^{-1} on PGE (up to 50 cycles). The modified electrode was characterized by scanning electron microscopy (SEM), and electrochemical experiments. Experimental parameters affecting the sensor responses, such as applied potential, pH, and lactate concentration, were assessed and optimized. Optimal pH for L-LDH biosensor was determined as 7.0. It was determined that the response of the biosensor increased as the lactate concentration (from 0.1 to 1.1 mM) increased. The obtained current values were 0.026 $mAcm^{-2}$ and 0.038 $mAcm^{-2}$ at 0.2 V for 0.1 and 1.1 mM lactate solution with NAD^+ as a cofactor, respectively. We determined that the biosensor using carbon nanotube was more sensitive than the biosensor without carbon nanotube.

After this study, we may offer that the L-LDH biosensor for lactate determination was successfully performed.

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References:

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