Analytical Expression of Concentrations and Current in Enzyme-Based Two-Compartment Model of Amperometric Biosensors for Steady-State Condition

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In this paper, the two-compartment mathematical model of the amperometric biosensor for the steady-state condition is studied. This model relies on a nonlinear reaction-diffusion system with Michaelis-Menten kinetics. A novel new approach of the homotopy perturbation method (HPM) is used in the enzyme and membrane layer to solve nonlinear reaction-diffusion equations. The simple and closed-form of analytical expressions of concentrations and biosensor current is derived. This paper presents the approximate analytical expression of sensitivity and resistance of a two-compartment model of amperometric biosensors. Furthermore, in this work, the numerical solution of the problem is also reported using the Maple program. The obtained results are compared with the numerical and previous available limiting case results. The analytical result provided is effective and precise in understanding the behaviour of the system.

Keywords: Mathematical modelling; Amperometric biosensor; Two-compartment model; Nonlinear reaction diffusion equation; Enzyme kinetics.

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