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Electrochemical enzyme biosensors for medical application

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Background/Aim. Electrochemical biosensor is an integrated enzyme-transducer device, which can convert a biological signal into a measurable electrical response. Because of its important features like sensitivity, linearity, selectivity, reproducibility, stability, and low cost, biosensors have a wide range of applications, including medical purposes. In this presentation, our achievements in the development of electrochemical enzyme biosensors have been reviewed, including their medical application. **Methods.** For development of biosensors, a different detection schemes include amperometric, potentiometric and conductometric transduction modes were used. As bioselective elements we used various enzymes such as glucose oxidase, urease, creatinine deiminase, lactate oxidase, pyruvate oxidase, glutamate oxidase, arginine deiminase, *etc.* **Results.** A number of electrochemical enzyme biosensors for quantitative detection of different substances (urea, glucose, lactate, pyruvate, creatinine, arginine, glutamate *etc.*) have been designed and developed, their experimental prototypes were fabricated and thoroughly tested for possible medical applications. For example, the developed amperometric biosensor based on co-immobilization of two enzymes (glucose oxidase and hexokinase) enabled successful detection of ATP with linear range 25–200 μM and glucose with linear range 0.01–3 mM simultaneously. By using the urease biosensor based on pH-sensitive field-effect transistor we could measure urea in blood samples with linear range 0.01–5 mM. In case of the conductometric biosensor based on arginine deiminase, the minimum detection limit was 2 μM of L-arginine with linear operating range from 20 to 750 μM L-arginine. The improvement of analytical characteristics of these biosensors for work with real samples could be achieved using differential mode of measurements, specific working solution with different buffer concentrations and chemical agents added, nanoparticles of different nature, some charged additional membranes, *etc.* These approaches make it possible to reduce the influence of the buffer capacity on the sensor response in order to increase the sensitivity of biosensors and expand their dynamic ranges. **Conclusions.** It is noteworthy that the developed electrochemical enzyme biosensors are adaptable to the technologies of large-scale production. Concerning further wide applications of these biosensors, the obtained results demonstrate the possibility to modulate their main characteristics to comply with the specific requirements for potential medical application.

Keywords: electrochemical biosensors, enzymes, medical application, express analysis.