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Electrochemical biosensors based on creatinine deiminase for creatinine detection

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Background/Aim. The index of creatinine in plasma (serum) of blood, due to simplicity and low cost of its determination, is widely used in routine medical practice to determine the glomerular filtration rate, an integral indicator of renal excretory function. To determine the content of creatinine, various methods have been processed, including the well-known color reaction of Jaffe. The proposed traditional methods require significant time consumption, lengthy and complex sample preparation, expensive reagents, highly qualified personnel and, most importantly, do not provide the possibility of real-time analysis. Therefore, the development of biosensors for creatinine analysis is of great interest. The aim of this work was to study the influence of immobilization method and transduction mode on the analytical characteristics of the biosensors for creatinine determination. **Methods.** For the development of biosensors for creatinine detection, different detection schemes include amperometric, potentiometric and conductometric transduction modes were used. As bioselective element we used creatinine deiminase which was immobilized by different methods, such as photopolymerization in PVA/SbQ matrix, immobilization in the glutaraldehyde vapours, and immobilization in the glutaraldehyde solution. **Results.** Three different methods of creatinine deiminase immobilization on the surface of electrochemical transducers were compared. The best results were obtained for immobilization in glutaraldehyde solution, but other immobilization methods were also acceptable. Main analytical characteristics of the biosensors based on different transduction mode have been studied under different conditions, such as pH, buffer capacity, ionic strength *etc.* The dynamic and linear ranges of the developed biosensors, reproducibility, operational and storage stability were compared. Thus, it was determined that the optimal buffer is 5 mM phosphate buffer solution with pH 7.2. The main analytical characteristics of the all developed biosensors were similar and were follows: linear range — 0.01–4 mM, limit of detection — 7 μM, response time — 1–2 min. The biosensors were characterized by good reproducibility of results (for 20 measurements, the RSD was 8 %) and operational stability, retaining 80 % of the initial response after two weeks of continuous use. Moreover, they demonstrated good reproducibility during long-term storage in buffer solution; after four month at a room temperature, the response was 90% of the initial one. **Conclusions.** The developed electrochemical enzyme biosensors could be adapted to the technologies of large-scale production. Depending on the purpose and conditions of application, one or another transduction mode can be used and the method of creatinine deiminase immobilization can be chosen. The obtained results demonstrate the possibility of their application in medical diagnostics for the detection of creatinine.

Keywords: electrochemical biosensors, creatinine deiminase, creatinine detection, enzyme immobilization.