Ewelina Socha

Summary of PhD dissertation: *"Conducting composite materials based on poly(3,4-ethylenedioxythiophene) with immobilized glucose oxidase."*

The aim of carried research was to examine the possibility to obtain biosensor giving a response to changing D-glucose concentration. Realizing the amount of issues associated with this task, I have decided to determine a number of intermediate stages.

The first stage was to modify platinum electrode surface with composite based on poly(3,4-ethylenedioxythiophene). It had to fulfil two basic conditions that were to be electrically conductive and provide free carboxyl groups on the surface. To meet the presented criteria, the second component of the composite was respectively polyacrylic acid (PAA) and anthranilic acid (AA). The final product of this stage were two electrodes modified with (PEDOT+PAA)/PSSLi and PEDOT/(PEDOT+AA)/PSSH composites.

The second step of carried measurements was to immobilize glucose oxidase (GOD) on the surface of the composite modified electrode. Immobilization of the enzyme was occurred by forming a covalent bond between GOD and the composite. This was obtained using free carboxyl groups available on the surface. Immobilization process took three stages. The first one consisted in joining N-(3-Dimethylaminopropyl)-N'-ethylcarbodiimide (WSC) to the free carboxyl groups, and then to the whole, glucose oxidase was attached. The third stage was washing out unbounded GOD molecules. The activity of the immobilized glucose oxidase was confirmed spectrophotometrically with the procedure using o-dianisidine.

The obtained electrodes can operate both as first and as third generation glucose biosensor.

In the next step I have optimized the immobilization process of glucose oxidase, evaluating the influence of WSC and GOD concentration as well as the type and concentration of doping agent on the activity and stability of prepared biosensors. All carried measurements showed that any deviation from the optimal values results in decrease in enzyme activity and hence the reduction of measured currents. Prepared biosensors presented long-term activity of the immobilized enzyme (30 days).

Next I have fulfilled the characteristics of obtained electrodes working as first and third generation glucose biosensors. Unfortunately, the operating parameters of the third generation glucose biosensor did not meet the conditions of validation method, therefore I decided to

resign from statistical evaluation of this objects and its further use. I have conducted a complete validation of obtained first generation glucose biosensors.

Furthermore, I described the effect of the ascorbic acid concentration as an interferent to the received biosensors and on the quality of conducted determinations of D-glucose concentration. Unfortunately, even its small addition showed negative impact on the work of prepared biosensors.

An important stage was to use both obtained first generation glucose biosensors to determine D-glucose concentration in samples of natural origin such as apple juice, grape drink, energy drink and honey. The concentration values measured using both biosensors were similar. In addition, results for grape drink and honey were comparable to the values obtained with reference method. The glucose concentration values in apple juice obtained with biosensors were significantly lower than the concentration measured with reference method. In my opinion the difference was due to the greater sensitivity of prepared biosensors for ascorbic acid in apple juice. The higher concentration of D-glucose determined in energy drink by reference method in comparison with the biosensors was most likely related to the duration of the measurement. In the spectrophotometric method the time was up to 30 minutes, whereas for the biosensor it was about 5 minutes, which was a significant difference.

The final stage of the work was to obtain honeycomb type electrodes, which could be very interesting and good starting point for further research aimed at miniaturization and increasing the sensitivity of glucose biosensor. These electrodes have very good physicochemical parameters. All the electrodes were fully modified with microstructural honeycomb composite monolayer. On two of the honeycomb electrodes glucose oxidase immobilization took place. Prepared electrodes worked as first and third generation glucose biosensors, however its work was unsatisfactory and requires further optimization.

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