

Abstract

Present Ph.D. Thesis is focused on the development of electrochemical methods for determination of anticancer drugs using various types of membranes for their preliminary separation. Furthermore, this Thesis reports the study of transport mechanisms of heavy metals in the presence of phytochelatin across biological membranes.

Sodium anthraquinone-2-sulphonate (AQS) was used as a model compound for its similar structure with anthraquinone-based (AQ-based) anticancer drugs (doxo/daunorubicin) and also due to its better availability. All these compounds can be easily electrochemically oxidized and/or reduced.

Redox behaviour of AQS was investigated by cyclic voltammetry (CV) and differential pulse voltammetry (DPV) in a cathodic region on mercury meniscus modified (m-AgSAE) and polished silver solid amalgam (p-AgSAE) electrodes. Obtained results were used for the development of a micro-volume voltammetric cell (MVVC). Its applicability for voltammetric determination of anticancer drugs was verified by using doxorubicin (DX) as a model substance.

The second part of this Thesis deals with therapeutic monitoring of anticancer drugs in the blood circulation of the patients. For pilot experiments, a liquid-flow system with dialysis catheter and amperometric detection was used. The flow rate of carrier solution (0.9% NaCl solution – corresponding to the sodium chloride physiological saline (PS)) was 5 and 500 $\mu\text{L min}^{-1}$. Various working electrodes and arrangements have been tested and a dual glassy carbon electrode (dualGCE) was proved as the best option. Reduction potentials of -1200 mV and -900 mV were applied on the first and the second electrode, respectively. In this arrangement, the oxygen in the analysed solution was removed by reduction at the first electrode of dualGCE, on which also reduction of AQS occurred due to the applied highly negative potential of -1200 mV. Therefore, on the second electrode, AQS was oxidized/reduced in dependence on used liquid flow rate and the obtained signal of AQS was not influenced by the presence of oxygen.

The last part is devoted to monitoring of phytochelatin and to investigation of their transport across a model phospholipid membrane (PLM). The model PLM was prepared on a polycarbonate carrier placed between two Teflon cups and two glass tubes (containing 0.1 mol L^{-1} KCl and the investigated compounds), which mimicked extracellular and intracellular space. Constant potential of -100 mV was applied on the model membrane and

the dependence of the imaginary part of impedance on the real part of impedance has been measured (Nyquist plot). Concentrations of phytochelatin, Pb^{2+} ions, and Pb-phytochelatin complex have been monitored and determined by DPV and by chronopotentiometry on a hanging mercury drop electrode (HMDE) and by CV on a carbon paste electrode (CPE) modified by silica gel.