Abstract of thesis

The work focuses on the application of electrooxidation of guanine for quantifying antioxidative activity with the use of specifically developed voltammetric technique, and for guanine trace analysis in nanomolar concentrations on electrodes modified by a polymer strongly interacting with the analyte. The first part is devoted to the determination of guanine solubility in water, the value that has never been correctly obtained before. Using thermodynamic principles and known pK_a values, it was proven that the solubility of the neutral form of guanine is constant and independent of pH. The least square fit gave the concentration value equal to 25.4 μM for the neutral form of guanine. The solubility of guanine as a function of pH can be calculated as a total concentration of all the guanine species present in the solution. The individual concentrations can be calculated based on the pK_a values. However, dissolution of guanine powder leads to the formation of guanine nanoparticles, which is not evident and was apparently the main cause of obtaining too high solubility data published in the literature.

In the second part a new electrochemical method was developed for the evaluation of antioxidants activity based on their ability to inhibit 8-oxoguanine production. It appeared that the antioxidative activity vs. antioxidant concentration follows the exponential decay. Among the applied antioxidants, resveratrol and gallic acid with the exponential decay coefficients of 142.6 mM^{-1} and 91.37 mM^{-1}, respectively, were found the best antioxidants at pH 7. Pyrogallol showed a mixed pro-antioxidative behaviour at pH 9. Ascorbyl phosphate did not show any antioxidative activity even in the presence of a huge amount of it at pH 9.

The last, main part, is devoted to the development of a new electrochemical sensor for trace analysis of guanine. To this end, the surface of a glassy carbon electrode (GCE) was modified by a polymer. The best result was obtained by oxidative electropolymerisation of citrazinic acid, and by swelling the polymer layer in a tetrahydrofuran solution containing iron tetraphenylporphyrin. The limit of detection for this biosensor is about 5 nM. In further studies it was shown that this polymer is capable of forming special multiple hydrogen bonds with guanine which resemble triple H-bonds between guanine and cytosine in DNA. Magnetic susceptibility measurements proved that this polymer is a complex antiferromagnetic compound. Elemental analysis demonstrated that the polymer consisted of linked substituted pyridyl units mixed with considerable amounts of water and inorganic phosphates.

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