SCIENTIFIC SECTION ABBREVIATION EXPLORING THE ELECTROCHEMISTRY OF SURFACE ACTIVE REDOX SYSTEMS IN VOLTAMMETRIC ANALYSIS OF DRUG-DRUG INTERACTIONS

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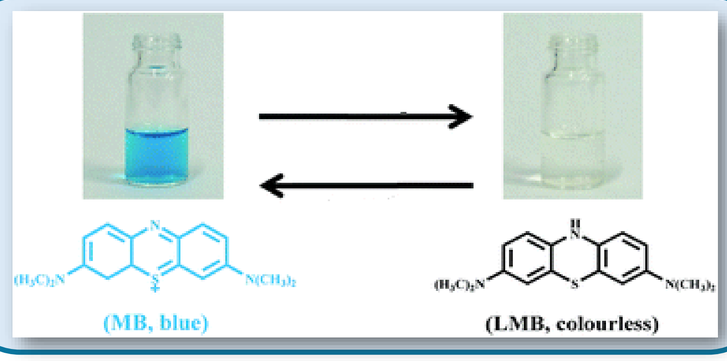
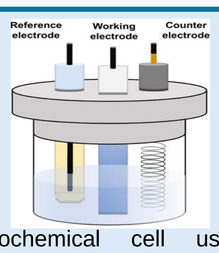
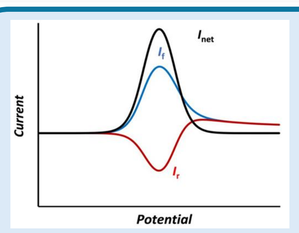
INTRODUCTION

Methylene blue is a model-like surface-active redox system, suitable to study various effects related to chemical interactions involved in voltammetry of surface electrode mechanisms. The redox transformation of methylene blue (MB) described by $2e^-/2H^+$, whereby MB switches between the oxidized form (blue-MB) to a reduced form called leuko-methylene blue (MBH_2).





Electrochemical cell used in voltammetric experiments



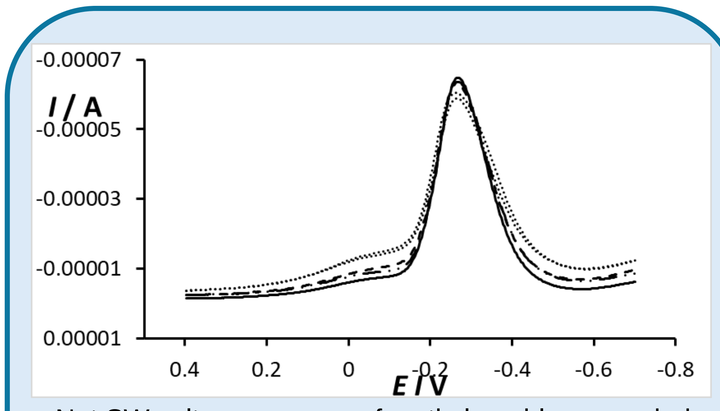
A typical square-wave voltammogram

EXPERIMENTAL

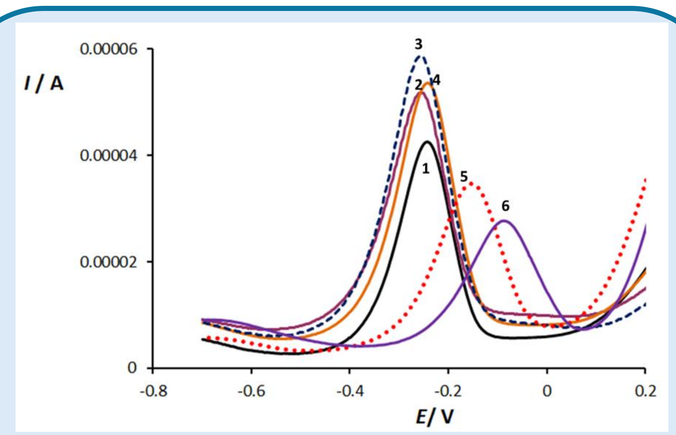
In this work, we explored SWV for making voltammetric analysis of surface-active systems. The modern electro-analytical system for voltammetric measurement usually consists of 3 modules: potentiostat, electrochemical cell and computer.In The electrochemical cell phosphate buffer pH = 7.40 was placed. All drugs used were used as pure substances. In addition, a three-electrode configuration consisting of a glassy carbon, Ag / AgCl (saturated KCl solution) was the reference electrode, while platinum wire with a large surface area was used as an auxiliary electrode. The concentration of the electrochemically active substance methylene blue (redox drug) in the electrochemical cell was constant and was 0.5 mmol/L. When examining the interactions between methylene blue and defined drugs, the concentration of the second drug in the electrochemical cell increased between 1 mmol/L and 1 mol/L.

RESULTS

From square-wave voltammograms of methylene blue recorded in the absence and presence of ibuprofen dissolved in the electrochemical cell it can be seen that there are no significant changes in either the magnitude of the peak current, and there is no shifting in the position of the methylene blue peaks as the ibuprofen concentration in the electrochemical cell increases. This voltammetric behavior implies that in this situation there is no interaction of methylene blue with the drug ibuprofen. Identical situations were observed in situations where potential interactions of methylene blue with other drugs and supplements were investigated. A significantly different situation is observed in the presence of vit C in the electrochemical cell when analyzing SWV responses of methylene blue in the absence and in the presence of vit C. At lower concentrations of vit C in the electrochemical cell, an initial increase in the net current of the SW voltammetric peak of methylene blue is observed. With further increase in vit C concentration, the height of the net-SWV voltammetric peak decreases sharply. At the same time, increasing the concentration of vit C is followed by shifting the potential of the net-SWV peak from methylene blue to more positive values in presence of vit C.



Net SW voltammograms of methylene blue recorded in absence and in presence of ibuprofen in concentrations in the range from 0.1 mmol/L to 5 mmol/L.



Net-SW voltammograms of methylene blue recorded in absence of vitamin C (curve 1), and in presence of vitamin C

CONCLUSION

Square-Wave Voltammetry (SWV) is an electrochemical method that offers some advantages for mechanistic insights, and it is most powerful voltammetric technique in respect to kinetic measurements and analytical sensitivity.

The results of theoretical and experimental analyzes are useful in designing new electrochemical methods in drug analysis, as well as in designing appropriate experimental methods through which a quantitative number of drugs can be analyzed, but also to determine relevant kinetic and thermodynamic parameters from interactions between defined drugs.

REFERENCES

1. Gulaboski, R.; Janeva, M.; Maksimova, V. New aspects of protein-film voltammetry of redox enzymes coupled to follow-up reversible chemical reaction in square-wave voltammetry, *Electroanalysis* **2019**, 31 (2). 1-12, 10400397. DOI: http://dx.doi.org/10.1002/elan.201900028
2. Janeva, M.; Kokoskarova, P.; Maksimova, V.; Gulaboski, R. Square-wave Voltammetry of Two-step Surface Electrode Mechanisms Coupled with Chemical Reactions – A Theoretical Overview, *Electroanalysis*, **2019**, 29. (1-20), 1040-0397. DOI: http://dx.doi.org/10.1002/elan.201900416