

## Electrochemical investigation of antioxidative properties of ivermectin in biological medium

Milan Selaković<sup>1</sup>, Mara M. Aleksić<sup>2</sup>, Jelena Kotur-Stevuljević<sup>3</sup>, Jelena Rupar<sup>2</sup>, Branka Ivković<sup>1</sup>

<sup>1</sup>Faculty of Pharmacy, Department of Pharmaceutical Chemistry, University of Belgrade

<sup>2</sup>Faculty of Pharmacy, Department of Physical Chemistry and Instrumental Methods, University of Belgrade

<sup>3</sup>Faculty of Pharmacy, Department of Medical Biochemistry, University of Belgrade

Oxidative stress is defined by an imbalance between an increased level of reactive oxygen species (ROS) and a low activity of antioxidant mechanisms, which can lead to damage to the cell structure and potentially destroy tissues (1). Antioxidant activity is usually analysed using spectrophotometric methods, which have their own drawbacks. Therefore, an electrochemical approach could be useful as an independent and comparative method to measure antioxidant activity. Electrochemical methods in drug analysis are widely used due to their low cost, high speed and ease of performance. Ivermectin (IVM) is a well-known anthelmintic but also a potential antitumor and antiviral drug (2) and is still being investigated today. The aim of this study was to investigate the redox activity of IVM in a human serum pool of healthy individuals not only using spectrophotometry, but also using a new electrochemical approach to confirm the results of the oxidative stress testing (Figure 1) and to suggest which part of the structure is responsible for the effect. The antioxidant activity of IVM was tested *in vitro* in a human serum pool and compared with a known antioxidant (Trolox) and pro-oxidant (tert-butyl hydroperoxide, TBH). Known spectrophotometric methods (PAB, TOS, TAS and SHG) were used to calculate the pro-oxidant, antioxidant and oxy-scores of IVM after 2 and 24 hours of incubation at 37 °C. Most of the studies using an electrochemical approach to measure antioxidant activity are designed to determine polyphenolic compounds, but our study took a different approach – estimating the antioxidant properties of IVM using differential pulse voltammetric (DPV) measurements in human serum samples after the incubation for different times. The recorded voltammetric peak parameters were compared with DPV results obtained with Trolox and TBH under the similar conditions. Electrochemical confirmation of the spectrophotometric analysis was performed in a small electrochemical cell (total volume of 1.5 mL) using a three-electrode system: glassy carbon electrode (GCE) as the working electrode, an Ag/AgCl as the reference electrode (3M KCl) and a Pt wire as the auxiliary electrode. Voltammograms were recorded after 0, 2 and 24 h incubation at 37 °C. The redox behaviour of IVM showed a noticeable antioxidant potential, similar to that of Trolox during short-term incubation, while a longer stay in the presence of TBH resulted in a loss of antioxidant activity. Electrochemical results suggest that IVM has similar antioxidant properties to Trolox after incubation in human serum samples, which is consistent with the spectrophotometric results (3). Since the antioxidant potential of IVM was confirmed by voltammetric methodology, which is proposed for the first time, the presented results show the possibility of the use of electrochemical methods in addition to the accepted methods in the analysis of the antioxidant properties of drugs.

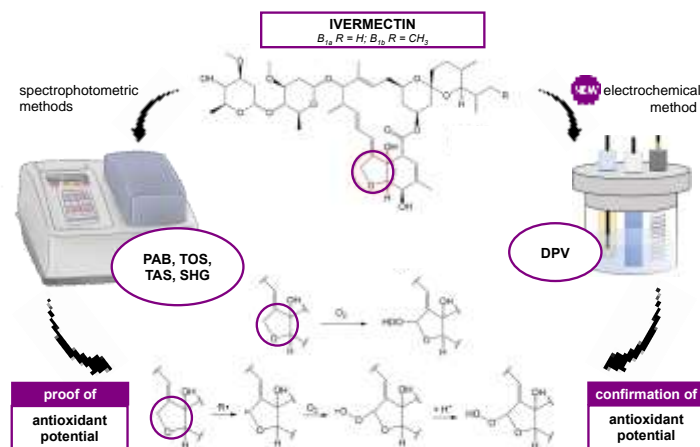


Figure 1. Graphical abstract of the study

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