

Development of a new electrochemical device for the determination of dopamine auto-oxidation

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Oxidative stress, caused by reactive oxygen species (ROS), is responsible of the dopaminergic neuronal death at nigro-striatal level, as it occurs in Parkinson's Disease (PD, Serra et al. 2002). During PD, ROS are responsible of the non enzymatic oxidation of dopamine (DA, so called auto-oxidation) but, at the same time, this process enhances the production of ROS with an amplification of dopaminergic pathways damage. Both, the non-enzymatic dopamine auto-oxidation and the enzymatic one, mainly mediated by monoamine oxidase enzyme (MAO), determine the formation of the corresponding ortho-quinone with the production of anion superoxide (O_2^-) and hydrogen peroxide (HP). In this study we have developed a novel electrochemical device able to monitor the auto-oxidation of DA, induced by HP, exploiting the different catalytic properties of the materials used as electrochemical transducers. The system consists of an electrochemical cell in which there is a buffer solution at pH 7.4, reproducing the cerebral extracellular environment, an Ag/AgCl pseudoreference electrode, an auxiliary electrode and two working electrodes, one made with epoxy/carbon (Ilinoiu et al. 2013) and the other one with platinum/iridium (Pt/Ir, Calia et al., 2015). Both sensors were coated with a poly-dopamine (poly-DA) permselective polymer (Zhou P. et al. 2014) able to record the redox interactions between the DA and the HP in a homogeneous phase and in the presence of interfering molecule such as ascorbic acid (AA) or other electroactive anions (DOPAC, UA, 5-HIAA, etc.), normally present in the fluids of the central nervous system (Calia et al. 2009). The developed system, optimized during the study, allowed the oxidation of DA and HP at platinum surface while the only DA was oxidized at carbon surface. This relative selectivity of the electrochemical transducers allowed us to discriminate between HP and DA and record their changes in the homogeneous phase by constant potential amperometry. The device, coupled with a dual-channel telemetric transmitter, has been used for studying the time course of DA auto-oxidation in the extracellular compartment of PC12 cells exposed to HP and the protective properties of several antioxidants.

Serra P. A. et al. (2002). *M. S. J. Biol. Chem.* 277, 34451–33461

Ilinoiu E. C. et al. (2013). *Sensors (Basel)*. 13(6):7296-307.

Calia et al. (2015). *Analyst*. 140(10):3607-15

Zhou P. et al. (2014). *PLoS One*. 9(11):e113087

Calia et al. (2009). *Sensors (Basel)*. 9(4): 2511–2523.