Antioxidative activity of dopamine – studies in model lipid systems.

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Dopaminergic neurons represent only a tiny proportion of all neurons, but even a slight changes in their activity may result in pathological events - depleted level of dopamine underlies Parkinson's disease and the Attention Deficit Hyperactivity Disorder (ADHD) while the increased synaptic release of dopamine may lead to schizophrenia.[1]

Presumably, disruption of neuronal homeostasis might be caused by enhanced reactivity of dopamine towards Reactive Oxygen Species (ROS). Polyphenols containing catechol moiety are considered to be strong antioxidants effectively acting in polar / non polar environments,[2] and we predict that dopamine may also behave as an endogenous phenolic antioxidant protecting the neuronal tissue from deleterious effects of oxidative stress. At low concentration dopamine promotes a long-time survival of neuronal cell culture by reducing the level of intracellular ROS and preventing apoptosis.[3] On the other side, high concentration of dopamine causes the increased production of ROS and cell death via apoptosis that can be attributed to the accumulation of catecholamine oxidation products, like semiquinones and quinones, in nervous tissue.[4]

Hereby we present the results of the studies on the kinetics of dopamine antioxidant / prooxidant action in several model systems including homogenous solutions, micellar systems and phospholipid membranes with different surface charge. In homogenous systems we performed stopped-flow measurements of dopamine reaction with model free radicals. This enabled us to suggest a mechanism of dopamine antioxidant activity. The applicability of such mechanism to physiological conditions was estimated through experiments in heterogeneous systems, i.e. micellar systems and model membranes. Peroxidation of lipid analogues in these heterogenous systems (initiated by water soluble azo-initiators) reveals the impact of microenvironment (including pH) on the ability of dopamine to silence or trigger the oxidative stress.

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