

Antioxidant Properties of Melanin Nanoparticles in Model Lipid System

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Melanin - a common pigmentary macromolecule has been postulated to act as a cellular antioxidant. This is based on observations that melanin quenches electronically excited states,¹ sequesters redox metal ions² and scavenges free radicals.³

Being a cellular antioxidant, melanin should inhibit free radical reactions thus, shielding the polyunsaturated phospholipids against oxidative modification. Polyunsaturated lipids are the major components of the biological membranes and their alteration is considered as a background of various neurodegenerative diseases including Parkinson's disease and Alzheimer's disease.

In this research, we synthesized the size-controllable nanoparticles with a recently reported method, through neutralization of dopamine hydrochloride with sodium hydroxide, followed by spontaneous dopamine oxidation.⁴ We investigated the antioxidant activity of obtained nanoparticles as their ability to scavenge peroxy radicals in model zwitterionic (DMPC) and anionic (DMPG) lipid bilayers. Experiments were performed on phospholipids / methyl linoleate mixed unilamellar vesicles with varied surface charge, which were exposed to the elevated oxidative stress. Autoxidation of lipids was evaluated by monitoring the oxygen uptake in a system (oxygen electrode measurements).

We report results of studies on kinetics of melanin's antioxidant action and describe the relation between the rate of lipid peroxidation in the presence of melanin and a composition of lipid membrane.

¹ Pilas B, Sarna T 1985. Quantitative determination of melanin in pigmented cells by electron spin resonance spectroscopy. In: Bagnora, J., Klaus, S.N., Paul, E., Schanti, M. (Eds.), Proceedings of the 12th International Pigment Cell Conference, Giessen, University of Tokyo, Tokyo, pp. 97–103.

² Zareba M, Bober A, Korytowski W, Zecca L, Sarna T, 1995. The effect of a synthetic neuromelanin on yield of free hydroxyl radicals generated in model system. *Biochim. Biophys. Acta* 1271, 343–348

³ Rozanowska M, Sarna T, Land EJ, Truscott TG 1999. Free radical scavenging properties of melanin interaction of eu- and pheo-melanin models with reducing and oxidising radicals. *Free Radic. Biol. Med.* 26, 518–525.

⁴ Ju K Y, Lee Y, Lee S, Park S B, Lee J K 2011 Bioinspired polymerization of dopamine to generate melanin-like nanoparticles having an excellent free-radical-scavenging property. *Biomacromolecules* 12: 625-632.