Melanin nanoparticles as a biomacromolecular antioxidant. Studies in model lipid systems

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Abstract

Melanin, a naturally occurring biomolecule, exhibits interesting physical and chemical properties such as broadband ultraviolet and visible absorption, non-radiative relaxation of photoexcited electronic states,[1] metal and drug binding affinity,[2] antioxidant and free-radical scavenging behavior.[3]

As an endogenous antioxidant, melanin protects cell membranes from a deleterious effect of oxidative stress. Phospholipids are prone to oxidative modification, thus understanding the mechanism of antioxidant action of melanin and its relationship with melanin / lipid membrane interplay, is of crucial importance in preventing oxidative stress-mediated diseases.

Herein, with a novel synthetic method established,[4] we successively generated melanin nanoparticles and estimated their morphological features on the basis of microscopic analysis (SEM). The antioxidant capacity of the obtained nanoparticles, expressed as their ability to scavenge peroxyl radicals, was investigated in liposomal systems composed of lipids bearing a different headgroup charge (oxygen electrode measurements). To fully understand the melanin-induced inhibition of lipid peroxidation, we performed microcalorimetric studies (ITC, DSC) which consequently provided the thermodynamic description of melanin nanoparticles affinity to lipid membranes.

The presented combined kinetic and thermodynamic data allowed us to draw a full picture of melanin antioxidant behavior in model lipid systems.

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