Antioxidant Nanoreactor Based on Superoxide Dismutase Encapsulated in Superoxide-Permeable Vesicles

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We designed and tested an antioxidant nanoreactor based on encapsulation of Cu,Zn superoxide dismutase in amphiphilic copolymer nanovesicles, the membranes of which are oxygen permeable. The nanovesicles, made of poly(2-methyloxazoline)â^'poly(dimethylsiloxane)â^'poly(2-methyloxazoline), successfully encapsulated the protein during their self-assembling process, as proved by confocal laser-scanning microscopy and fluorescence-correlation spectroscopy. Electron paramagnetic resonance spectroscopy and circular dichroism analyses showed that no structural changes appeared in the protein molecules once inside the inner space of the nanovesicles. The function of this antioxidant nanoreactor was tested by pulse radiolysis, which demonstrated that superoxide dismutase remains active inside the nanovesicles and detoxifies the superoxide radical in situ. The membrane of our triblock copolymer nanovesicles plays a double role, both to shield the sensitive protein and to selectively let superoxide and dioxygen penetrate to its inner space. This simple and robust hybrid system provides a selective shielding of sensitive enzymes from proteolytic attack and therefore a new direction for developing drug delivery applications.

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