

Polymer-grafted magnetic mesoporous silica nanocarriers as smart multifunctional nanocarrier for controlled delivery of resveratrol

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Stimuli-responsive nanocarriers have emerged as a promising strategy to overcome the intrinsic limitations of natural bioactive compounds, such as resveratrol (RV), in biomedical applications, including poor solubility, low bioavailability, and lack of targeting¹. In this work, we report the development of polymer-gated magnetic mesoporous silica nanocarriers (MMS-Px) functionalized with thermoresponsive and pH-sensitive poly(N-isopropylacrylamide-co-methacrylic acid) [p(NIPAM-co-MAA)] for tunable RV delivery. By systematically varying the MAA content (0, 20, 40 μ L), the lower critical solution temperature (LCST) of the copolymer was adjusted from 41 to 50 °C, enabling precise control over the gating behavior. The prepared nanocarriers (MMS-P0, MMS-P20, and MMS-P40) exhibit a core-shell structure, superparamagnetic properties, and mesoporosity. RV loading remained significant (~5 wt%) despite partial pore occupation. Release studies demonstrated clear dual-responsive behavior, with minimal RV leakage under physiological conditions (pH 7.4, 25 °C) and accelerated release under tumor-like environments (pH 5.0, 50 °C), driven by polymer conformational changes. Fluorescence analysis confirmed that RV is encapsulated within the mesopores without covalent bonding. Furthermore, DPPH assays showed that the antioxidant capacity of RV remained stable after 30 days of encapsulation, demonstrating the protective effect of the nanocarriers. In addition, MMS-Px samples exhibited low cytotoxicity toward peripheral blood mononuclear cells (PBMCs). These results highlight the potential of stimuli-responsive nanocarriers for drug delivery applications of natural compounds, advancing the development of smart and controllable nanomedicine platforms.

REFERENCIAS

1. Peralta, M. E. et al. *Journal of Colloid and Interface Science* 544 (2019) 198–205