Multifunctional Red Blood Cells (RBCs) Substitutes

Oxygen Transport, Anti-Oxidation and Fluorescent Properties in a Single Platform

Cun, Xingli; Jansman, M.M.T.; Liu, X.; Thulstrup, Peter W.; Hosta-Rigau, L.

Publication date:
2022

Document Version
Publisher's PDF, also known as Version of record

Multifunctional Red Blood Cells (RBCs) Substitutes: Oxygen Transport, Anti-Oxidation and Fluorescent Properties in a Single Platform

X. Cun[a], M. M. T. Jansman[a], X. Liu[a], P. W. Thulstrup[b], and L. Hosta-Rigau[a]

[a]*Department of Health Technology, Technical University of Denmark, Kgs. Lyngby, Denmark*
Email: xincu@dtu.dk
[b]*Department of Chemistry, University of Copenhagen, Copenhagen, Denmark*

Keywords: Antioxidant Properties; Artificial RBCs; Oxygen Carrier

The administration of donor RBCs has important drawbacks such as the need for blood typing and matching before use, short storage lifetime and the possibility of pathogens infection. Therefore, artificial RBCs that are compatible with all blood types, have long storage shelf time and low risk of infection have attracted a lot of attention. Among them, haemoglobin (Hb)-based oxygen carriers are one of the most prominent systems. However, the autoxidation of Hb into methemoglobin (metHb), which lacks oxygen-carrying ability, is an important limitation.

Herein, we address this challenge by synthesizing a composite of Hb and gold nanoclusters (Hb@AuNCs) that takes advantage of both systems (**Figure 1A**). Hb@AuNCs display the oxygen-carrying ability of Hb and the antioxidant and autofluorescent properties of AuNCs. After preparation, Hb@AuNCs could reversibly bind and release oxygen (**Figure 1B**) and emitted a red fluorescent when excited at 494 nm, potentially allowing them to be tracked in vivo. Besides, the Hb@AuNCs also showed antioxidant properties which could protect Hb from being oxidized to metHb (**Figure 1C**). Notably, the three features (oxygen-carrying, antioxidant and autofluorescent properties) are maintained after storage as a freeze-dried powder. Overall, the as-prepared Hb@AuNCs have the potential to be multifunctional blood substitutes applied in the near future.

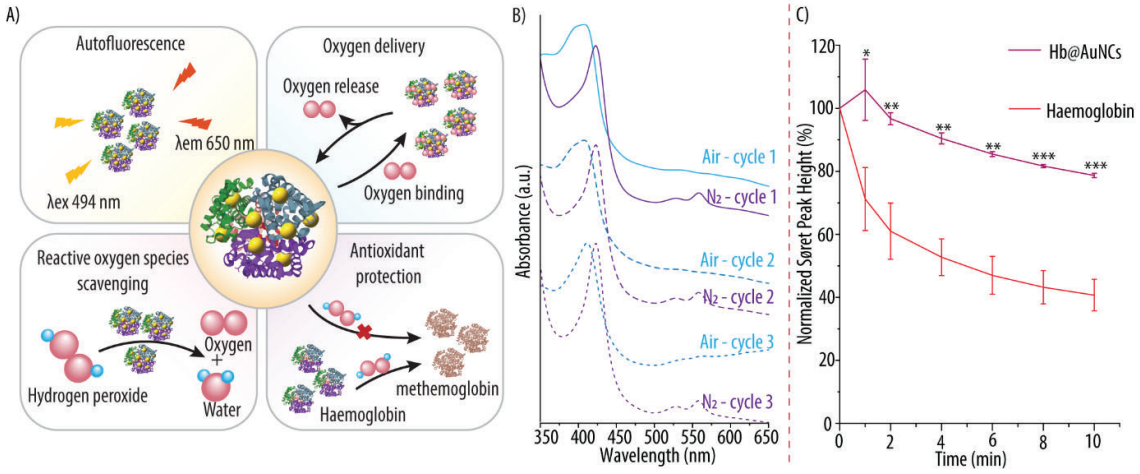

Figure 1. A) Schematic of the multifunctional Hb@AuNCs. B) Oxygen transport capacity of Hb@AuNCs. C) Antioxidant properties of Hb@AuNCs. *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001. Data represent mean ± SD (n = 3).

Supported by Novo Nordisk Foundation