

LEARNING FROM NATURE, DISCOVERING THROUGH SCIENCE: A NANOSYSTEM PLATFORM FROM NATURAL AND RENEWABLE RESOURCES

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Modern nanomedicine has revolutionized drug delivery by enabling high-precision targeted therapies. However, a critical sustainability paradox persists: many advanced delivery platforms still rely on synthetic polymers and energy-intensive chemical processes that generate hazardous waste. To address this challenge, we developed a versatile nanosystem platform (INVITE) derived from natural and renewable resources: Inulin, a natural hydrophilic plant polysaccharide, and Vitamin E, a potent natural hydrophobic antioxidant [1].

The amphiphilic INVITE conjugate was synthesized through a simple, cost-effective, one-step reaction. In aqueous solution, INVITE spontaneously self-assembles into stable nanomicelles (~10 nm) with a low Critical Aggregation Concentration, ensuring structural integrity upon systemic dilution.

INVITE micelles showed the ability to load and release hydrophobic drugs in a controlled manner [1,2] and to cross biological membranes [2,3]; long-circulation characteristics after i.v. administration [2]; and anti-angiogenic activity [4].

To achieve site-specific targeting, the platform's surface was further engineered by obtaining pH-sensitive micelles for intestinal site-specific and controlled release [5] or a dual-targeted nanosystem for brain delivery [6].

In conclusion, the INVITE platform establishes a versatile, easily customizable, and sustainable framework for advanced drug delivery, proving that renewable natural precursors can be engineered into high-performance, multi-targeted therapeutic systems.

REFERENCES:

- [1] Mandracchia D. et al. Carbohydrate Polymers, 103 (1), pp. 46-54. 2014.
- [2] Tripodo G. et al. Biomacromolecules, 16 (2), pp. 550-557. 2015.
- [3] Tripodo G. et al. Colloids and Surfaces B: Biointerfaces, 125, pp. 300-308. 2015.
- [4] Mandracchia D. et al. European Journal of Pharmaceutical Sciences, 93, pp. 141-146. 2016.
- [5] Mandracchia D. et al. Carbohydrate Polymers, 181, pp 570-578. 2018.
- [6] Riccobelli et al. Molecular Pharmaceutics, 23, pp. 3009–3022. 2026.