

Heparin-functionalized chitosan-poly(ϵ -caprolactone) nanoparticles loaded with quinine for selective targeting of infected erythrocytes and enhanced antiparasitic efficacy

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Abstract

Bats serve as reservoir hosts for numerous zoonotic pathogens of public health significance, including coronaviruses, lyssaviruses, and henipaviruses, while simultaneously playing critical roles in ecosystem function through pollination, seed dispersal, and pest control. The increasing frequency of bat-associated disease outbreaks has intensified research interest; yet standardized protocols for safe and effective bat sampling remain fragmented. We conducted a systematic review of bat sampling practices and synthesized comprehensive guidelines for capturing, handling, and sampling free-ranging bats for epidemiological surveillance and outbreak investigations. Our framework emphasizes three key elements, including (i) biosecurity measures to prevent pathogen spillover transmission from bats to humans, (ii) biosafety protocols to avoid spillback transmission, and (iii) welfare considerations to minimize the impact on bat populations. Through analysis of published literature and field protocols, we identified significant gaps between recommended and common practices in bat research. We present evidence-based recommendations for capture techniques, specimen collection, sample processing, and storage methods, with particular attention to maintaining sample quality while ensuring safety. Additionally, we provide detailed guidance for field laboratory setup, personnel training requirements, and emergency response procedures. The implementation of these standardized protocols will enhance the quality and compatibility of bat research data while protecting both human and bat health. This guide serves as a foundation for safe, ethical, and effective investigation of bat-borne pathogen epidemiology and ecology, particularly in resource-limited settings where disease emergence risks are often highest.

Keywords

Quinine; Polymeric nanoparticles; Polycaprolactone; Targeted drug delivery; Malaria; Heparin