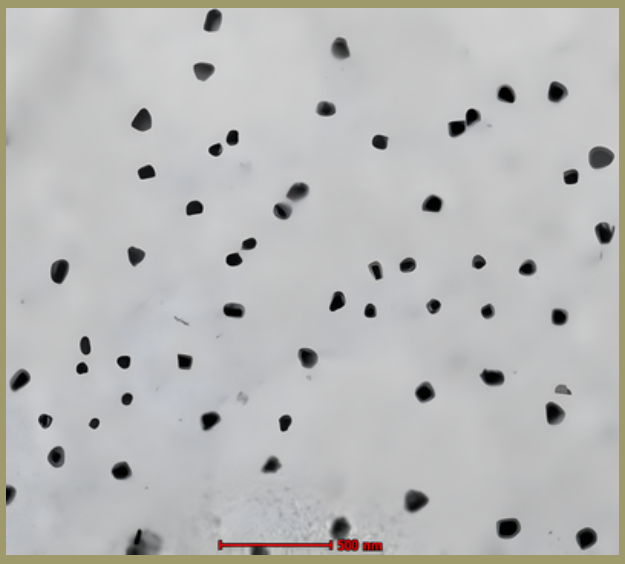
Unraveling drug transport mechanisms of prednisolone-loaded solid lipid nanoparticles infused with superparamagnetic iron oxide for improved transdermal drug delivery system

The primary goal of any prescribed treatment plan is to achieve specific and desirable patient outcomes, and patient adherence is crucial to this endeavour. Even the most meticulous and scientifically grounded treatment plan will not result in its therapeutic benefits if patients do not adhere to the prescribed medication regimen. Adherence to steroid treatments can be difficult, particularly for patients with chronic illnesses due to factors such as frequent dosages, the prolonged duration of treatment, and potential side effects [1]. Consequently, nonadherence to steroid medication has become increasingly prevalent among these patients, leading to significant consequences, including medication waste, disease progression, mortality, and rising healthcare costs.

Transdermal delivery offers an effective solution to this difficulty. This drug delivery system uses the skin as a medium to transport drug molecules from the surface into the circulatory system, bypassing first-pass metabolism and allowing for prolonged medication release. This facilitates the adjustment of drug formulation and concentration to ensure controlled drug release over an extended period [2]. As a result, the frequency of medication doses can be reduced, mitigating problems associated with dosage frequency.

In this study, we identify prednisolone as a suitable drug candidate for the transdermal delivery of solid lipid nanoparticles (SLN) infused with superparamagnetic iron oxide nanoparticles (SPION). Prednisolone is a commonly prescribed corticosteroid characterised by its low molecular weight, moderate lipophilicity, anti-inflammatory properties, and immunosuppressive effects [3]. While oral corticosteroids are typically administered for one to two weeks to manage severe symptoms, prolonged corticosteroid therapy may last for months or even years for certain chronic health conditions.

Current research on the use of SPION for topical or transdermal drug delivery is limited to applications in skin tumours [4]. Therefore, we aim to expand the potential application of SPION for transdermal drug delivery across skin layers and into the circulatory system. By combining SLN with SPION for transdermal drug delivery, we anticipate a synergistic effect. Understanding the drug transport mechanisms of this novel system will provide insights into how it can be optimised for the improved transdermal delivery of prednisolone, thereby enhancing the efficacy of long-term corticosteroid therapy.



Transmission electron microscopy (TEM) micrograph of the obtained nanoparticles with cuboidal shapes.

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