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Review

# Novel colloidal carriers for psoriasis: Current issues, mechanistic insight and novel delivery approaches

Madhulika Pradhan, Deependra Singh, Manju Rawat Singh *

*University Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh 492010, India*

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ABSTRACT

Psoriasis is an autoimmune disorder of the skin with relapsing episodes of inflammation and hyperkeratosis. Numerous approaches have been explored to treat this dreadful disease using different antipsoriatic drugs with different modes of action and routes of administration. But, till date there is no cure for psoriasis due to lack of an ideal carrier for safe and effective delivery of antipsoriatic drugs. Constant progression in the development of newer formulations utilizing colloidal drug delivery systems has led to effective treatment of psoriasis. Colloidal carriers include vesicular and particulate systems like liposome, transferosome, niosomes, ethosomes, solid lipid nanoparticles, microspheres, micelles, dendrimers *etc.* have gained unique position as drug cargoes. Present review is an attempt to contemplate on psoriasis in terms of pathogenesis, role of cytokines, major hindrances in psoriasis treatment, currently available treatment options pertaining to mode of action, pharmacokinetics, marketed products, side effects of individual antipsoriatic drugs and recent developments in the delivery of various antipsoriatic drugs through novel colloidal drug carriers.



**Contents**



* Corresponding author. Tel./fax: +91 771 2262832.
*E-mail address:* manjursu@rediffmail.com (M.R. Singh).

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## 1. Introduction

Psoriasis is an autoimmune disorder of the skin characterized by relapsing episodes of inflammatory lesions and hyperkeratotic plaques with worldwide occurrence of around 2–5% [1–3]. The classification of psoriasis is done on the basis of extent of inflammatory process, localization of rash, severity of the patient condition, and other clinical traits into chronic plaque, guttate, pustular, and erythroderma [4]. Amongst these, chronic plaque psoriasis (CPP) represents major occurrence proportion with equivalent likelihood in both sexes and early onset before the age of 40 years [5].

Psoriasis is a disease known to be caused by multitude of both genetic and environmental factors such as trauma, drugs, infection, alcohol, smoking and stress but its accurate origin is still not known [1]. It negatively spawns both physical and psychological impacts on patients' health related quality of life involving social disgrace, state of agony, distress, physical disability. This is further supported by the results of National Psoriasis Foundation survey indicating moderate to large negative impact on the quality of life of psoriatic patients [6]. This strained situation drives the patients to contemplate suicide amounting to around 30% cases which places psoriasis at parity with other major medical diseases such as depression, heart disease or diabetes [7].

Among the currently available treatments including topical therapy, phototherapy and systemic therapy, none of the treatment for psoriasis is found to be safe, effective and able to completely cure the disease [8]. Further, available treatment options are associated with both inappropriate cosmetic appearance and related toxicities leading to poor patient compliance in long term use. Therefore development of an ideal therapy for psoriasis is a great challenge.

The lack of effective and safe treatment for psoriasis has created needs to develop and implement novel approach with a view to make the therapy more useful and acceptable. Present review is written with a view to emphasize on the recent developments in the field of conventional and novel controlled drug delivery systems (NCDDS) concerning the treatment of psoriasis and future prospects in the therapy.

## 2. Pathogenesis

The exact mechanism behind eruption of psoriasis is still not clear [9].

Unlike normal skin, pathological progression of psoriasis is supposed to rely on multitude of coherent events involving the activation of circulating immune cells and their secreted signaling molecules like cytokines, chemokines and growth factors. All these events further progress to mark hyperkeratosis, congealing of epidermis and neovascularization (Fig. 1) [11].

### *2.1. Medical pathogenesis of psoriasis can be divided into 3 events and have been shown in detail in Fig. 2*

#### *2.1.1. T lymphocyte activation*

This step inscribes the role of antigen-presenting cells (APCs) residing in the epidermis and dermis to recognize and interact with any unidentified antigens. Steps involved are enumerated below:

- Formation of antigen-MHC (major histocompatibility complex) complex on the surface of APC to be carted to the lymph nodes.
- Facilitation of antigen binding to T lymphocyte receptor by MHC promoting T lymphocyte activation.
- Activation of T lymphocyte through non-antigen/cell-cell interaction through synapses between dendritic cell receptor and ligand on the T cell leading to co-stimulation. Major synapses are lymphocyte functional antigen (LFA)-3, B7 and Intracellular Cellular Adhesion Molecule-1 (ICAM-1) interacting with Cluster differentiation 2 (CD2), CD28 and LFA-1 respectively [12].

### *2.2. Exodus into the skin*

T-lymphocytes on activation can take up two pathways — either proliferates to produce memory effector cells or enter circulatory system to migrate to the inflamed skin [12].

#### *2.2.1. Function of cytokines*

Cytokines play an important role in progression of psoriasis. Major cytokines include tumor necrosis factor alpha (TNF-α), Interleukin-23 (IL-23) and IL-17 which aids in the production of other proinflammatory cytokines and psoriasis lesions formation [13]. Other potentially important cytokines in psoriasis with their roles have been discussed in Table 1.

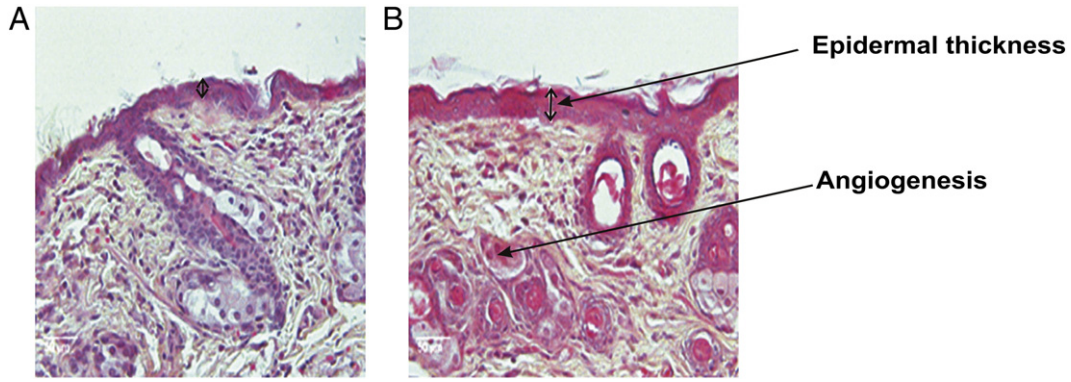


**Fig. 1.** Histological features of normal and psoriatic skin A) thickness of epidermis in normal skin and B) thickness of epidermis and angiogenesis in hyperproliferative (psoriatic) skin. Arrow indicates thickness of epidermis.
Adapted from Ref. [10].