WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 10, Issue 13, 498-505. Review Article ISSN 2277– 7105

GEL FORMING OCCLUSIVE FILM FOR TOPICAL AND TRANSDERMAL DRUG DELIVERY SYSTEM

Manisha R. Chavhan*, Ashvini Y. Parbat, Farheen A. Shah, Sudhakar M. Jagtap, Manisha D. Kitukale and Anil V. Chandewar

Pataldhamal Wadhwani College of Pharmacy, Yavatmal- 445001, MS, India.

Article Received on
16 Sept 2021,

Revised on 06 October 2021,
Accepted on 26 October 2021

DOI: 10.20959/wjpr202113-22035

***Corresponding Author**
Manisha R. Chavhan
Pataldhamal Wadhwani College of Pharmacy, Yavatmal- 445001, MS, India.

ABSTRACT

Skin is considered as an important route of administration of drugs for both local and systemic effects. The polymeric solution is applied to the skin as a liquid and forms an alomost invisible film in situ by solvent evaporation. Transdermal drug delivery system and dermal drug delivery system can provide some desirable performance over conventional pharmaceutical dosage formulations, such as avoiding gut and hepatic first-pass metabolism, improving drug bioavailability, reducing dose frequency and stabilizing drug delivery profile. The aim of this review was to search for alternative to conventional forms in order to reduce skin irritation, improve skin adhesion properties, enhance the drug release and increase the patient acceptability from an aesthetic perspective. The polymeric gels are beneficial in terms of ease of preparation, ease of application, produce site specific drug delivery for local and systemic effect, increase the duration of drug action.

KEYWORDS:- Film forming polymers, Topical drug delivery, Gelling agents.

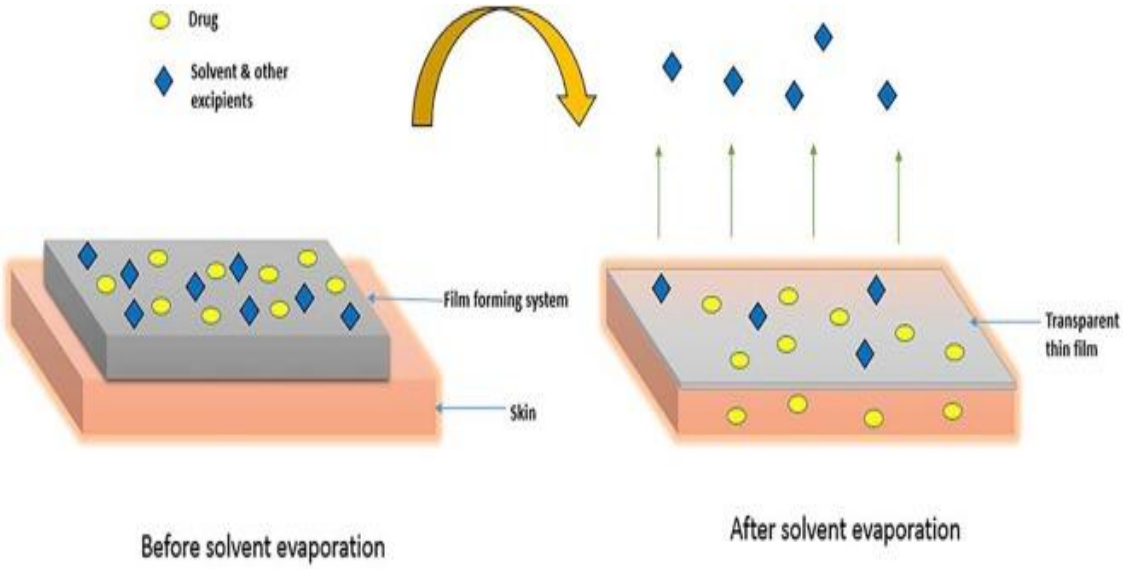
INTRODUCTION

The skin is the most readily accessible organ of the body and acts as a barrier against the micro and macromolecules of the environment because of its low permeability to such substances.[1] The skin of an average adult body has approximately 2m 2 surface area and it receives about one-third of the total blood circulating throughout the body.[2] Percutaneous absorption of drug through skin mainly occurs via stratum corneum. Stratum corneum is made up of dead, keratinized epidermal cells having thickness of 10 m and acts as a barrier for permeation of drugs. Therefore transport of drug molecules across the skin is difficult.[3] The goal of drug administration through skin is for topical treatment of skin diseases or for

transdermal absorption of drugs in the systemic circulation. The topical route offers a large and varied surface in addition to the ease of application via self administration and provides an alternative to oral delivery of drugs as well as hypodermic injection.[4] The rate and extent of drug absorption through skin depends on the skin physiology and physicochemical properties of drugs as well as the delivery system. The current dosage forms, i.e. patches, ointments, creams, etc., are associated with several limitations. Patches have various disadvantages, most commonly skin irritation,[5] because of their occlusive properties causing obstruction of sweat ducts, which in turn prevents loss of water vapour from skin surface, difficulty in applying on the curved surfaces, pain while peeling off and poor aesthetic appeal .Semisolid preparations like creams and ointments overcome some of these drawbacks but have other limitations. These do not ensure persistent contact with the skin surface and can be easily wiped off by patient's clothes.[6] Hence repeated application is required incase of chronic diseases like athlete's foot, ringworm and candidiasis.[7] Also these leave a sticky and greasy feel after application leading to poor patient compliance.[8,9] Therefore there is a need for development of a dosage form which allows less frequent dosing by maintaining an in depth contact with the skin for prolonged period of time thereby improving the patient compliance. Film forming system (FFS) is a novel approach which can be used as an alternative to conventional topical and transdermal formulations. It is defined as non-solid dosage form that produces a film in place, i.e. after application on the skin or the other body surface. These systems contain the drug and film forming excipients during a vehicle which, upon contact with the skin, leaves behind a film of excipients along side the drug upon solvent evaporation. The formed film can either be a solid polymeric material that acts as matrix for sustained release of drug to the skin or a residual liquid film which is rapidly absorbed in the stratum corneum.[10]

Mechanism of film Formation and Permeation[11]

Film forming system is applied directly to the skin and it forms a thin, transparent film in situ upon solvent evaporation as shown in Fig. 1.



After application of the formulation to the skin, the composition of the film forming system changes significantly thanks to the loss of the volatile components of the vehicle which ends up in formation of residual film on the skin surface. In this process the concentration of drug increases, reaching saturation level and with the likelihood of reaching super saturation level on the skin surface. Super saturation leads to the improved drug flux through the skin by increasing the thermodynamic activity of the formulation without affecting the skin's barrier, thereby reducing the side effects or irritation. The concept of super saturation can be explained by the modified form of Fick's law of diffusion. Fick's law of diffusion is given by Eq. (2.1):

$$Jh = DKCv \quad \text{.....(2.1)}$$

where

J = rate of drug permeation per unit area of skin per unit time (flux)

D = diffusion coefficient of drug

Cv = concentration of drug

h = thickness of barrier to diffusion

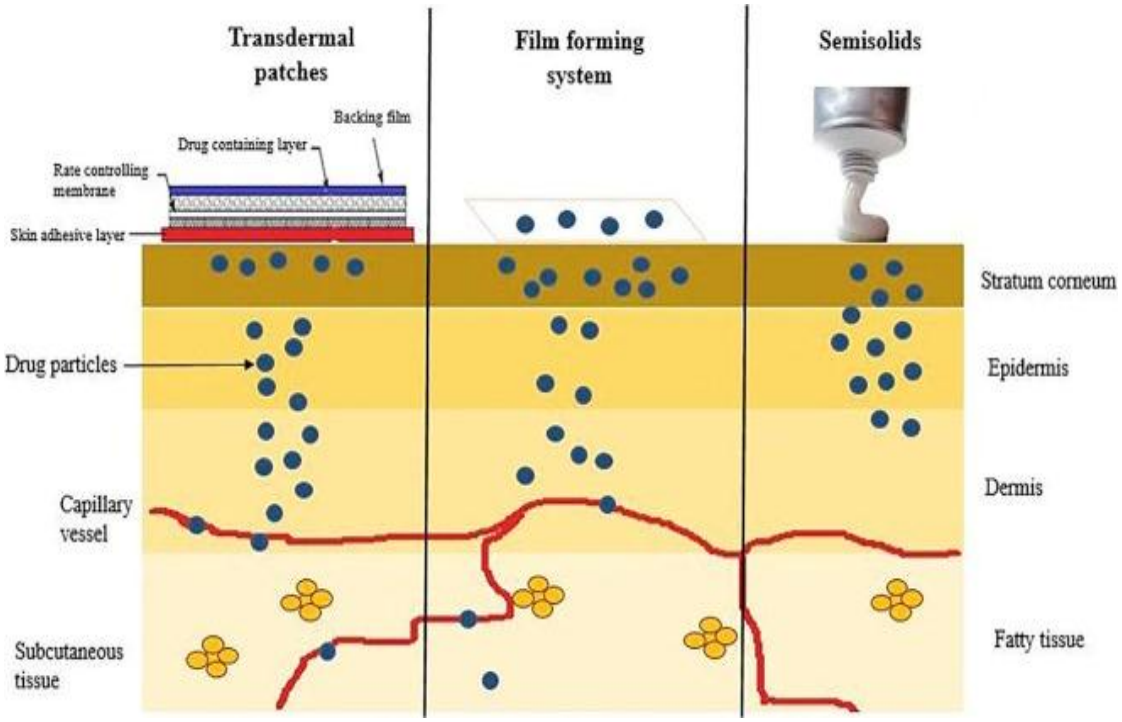
From this equation, it's clear that the speed of drug permeation across the skin is proportional to the concentration of the drug. However this is often true when all the drug is dissolved within the vehicle. Equation (2.2) describes the modified sort of Fick's law of diffusion:

$$JD\,h = \alpha\,\gamma \quad \text{.....(2.2)}$$

where α=thermodynamic activity of drug within formulation

γ=thermodynamic activity of drug within membrane

According to this equation, the flux of the drug is directly proportional to the thermodynamic activity of the system, which is related to saturation. However increasing the supersaturation increases thermodynamicinstability.

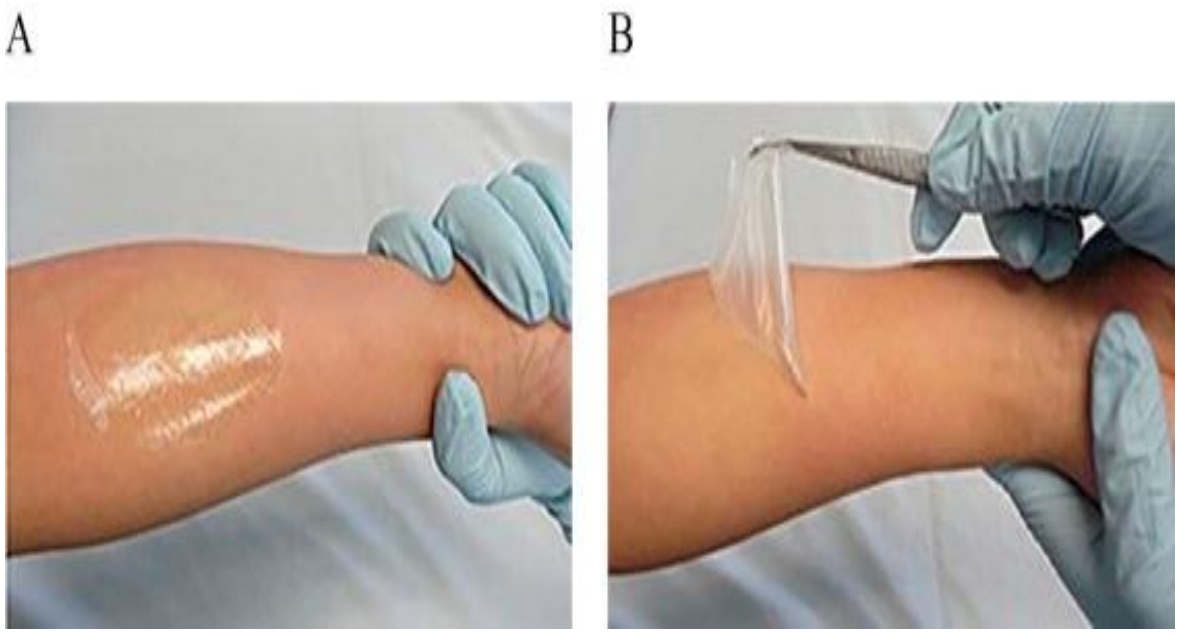


FFS creates supersaturated systems immediately after application to the skin, overcoming the problem of instability. Thus it improves the drug permeation through skin compared to other transdermal dosage forms. The delivery efficiency of the film forming solutions for ethinylestradiol was investigated. The permeation of ethinylestradiol from the film forming solution prepared with enhancer or without enhancer was compared to the permeation from the commercially available patch (EVRA®) through human epidermis in vitro. The film forming formulations showed a higher permeation than the commercial patch. Without enhancer the formulation transported more than double the ethinylestradiol than the marketed patch. With enhancer, the formulation delivered about seven times as much ethinylestradiol as that of the marketed patch. Thus these systems prove to be useful in enhancing the drug permeation.[12]

Properties of film forming system

The film forming preparation are often applied to the location no matter shape and area, and may be retained for an extended time as compared to standard semi-solid preparations.Fig.3(A) shows that FFS forms an almost completely transparent fast drying

film on application. Fig. 3(B) shows that after drying, a non-tacky, flexible and easily peelable film is formed. There is an excellent adhesion of the formed film to the skin, hence wipe off resistance. Therefore the danger of transfer of active ingredients to people or clothes is reduced.



Appearance of film forming system: (A) Formation of transparent film on application; (B) Non-tacky, flexible, easily peelable film after drying.

Fig. 3 depicts the drug permeation pattern of all the three systems. In case of transdermal patches the drug is stored in a reservoir from which the drug release occurs slowly and the drug is absorbed into the capillaries from where it is transported to systemic circulation or it is formulated as a topical patch so as to penetrate the skin to reach the target tissue for localized action. Drugs incorporated into semisolids show their activity on the skin surface or penetrate into skin layers to reach the site of action but systemic delivery of drugs is limited due to various factors. Film forming systems can function as both semisolids and patches and can provide topical as well as transdermal delivery as desired.

Applications of film forming systems[13]

Initially film forming systems were predominantly used in the field of surgery or wound care. Film forming solutions or gels have been used as tissue glues for the closing of operative wounds.The film formers used for this purpose may be natural like fibrin or synthetic like cyanoacrylates. These wound care preparations can be without drugs or with antimicrobial agents.

Film forming formulation

Gels are defined as semisolid dosage form containing both solid and liquid components. The liquid component may be hydrophobic or hydrophilic in nature, immobilized in a three dimensional network of the interconnected solid components.[14] Hydrogels are the aqueous gels containing hydrophilic polymers that form three dimensional network in water.[15] The development of transdermal formulations is being focused on employing several polymers as film forming agents along gelling agents. The administration of film forming gel involves applying a dose on the arms, shoulders, internal parts of the thighs or abdomen to form a thin bioadhesive film on the skin.[16] The drug substance is dissolved in film forming vehicle and is thus incorporated in the film formed on skin. The film can function as an external reservoir or limit the supply of drug substance to the skin thereby controlling the release of drug Complete skin contact over the entire application is essential; therefore, the formulation requires high flexibility to adapt to the movement of the skin, high substantivity, strong adhesion to the skin for constant delivery and absorption of drug. Hence, along with gelling agents, film forming agents, plasticizers, preservatives etc. are used in the formulation. Compared to other forms, these systems offer easier use and application, appropriate consistency and adhesiveness, good flexibility and elasticity and ease of manufacturing.Film forming hydrogels are majorly used in wound healing. The formulation applied to the wounded site provides a film that is resistant to physiological stress caused by the movement of skin.[17,18]

CONCLUSION

The film forming system presents a novel platform to deliver drugs to the skin both topical and transdermal. These film forming systems are simple and may offer advantages of transparency, non-greasy, lower skin irritation, wipe off resistance, longer retention, greater increased dosage flexibility, improved patient compliance and aesthetic appearance. Film Forming gel may be use to prove to be a effective dosage form for the topical and transdermal delivery of drug. Also it remain adherd to the effective part for a longer period without getting rubbed off. It may provide sustained effect and batter relief than the conventional gel and frequent replication not required. Topical dosage forms have unique advantages like this is directly concerned with the site of action and desired effect of the preparation. The concept of film forming gel may change the treatment concept of various diseases.

REFERENCES

1. Langer R. Transdermal drug delivery, Advance Drug Delivery Reviews, 2004; 56: 557-558.
2. Afaf A. Ramadan: Formulation and evaluation of bioadhesive gels containing Miconazole Nitrate. Journal of Applied Sciences Research, 2008; 4(9): 1052-1065.
3. M. A. Attia, H.Y. Badawy, Film forming gel for treatment of oral mucositis: In vitro studies, International Journal of Drug Delivery, 2010; 2: 314-321.
4. K. Saroha, S. Singh, A. Aggarwal, S. Nanda, Transdermal Gels- An alternative vehicle for drug delivery, International Journal of Pharmaceutical, Chemical and Biological Sciences, 2013; 3(3): 495-03.
5. R.B. Saudagar et al. film forming gel novel drug delivery system .International Journal of current pharmaceutical science, 2017; 10(2): 25-28.
6. Fungal Infections of the Skin. Available from: http://www.webmd.com/skin-problems-andtreatments/guide/ fungal-infections-skin#1. [Accessed 24 December 2016].
7. Devaux S, Castela A, Archier E, et al. Adherence to topical treatment in psoriasis: a systematic literature review. J Eur Acad Dermatol Venereol, 2012; 26(3): 61–67.
8. Zurdo Schroeder I.et al. Film forming polymeric solutions as drug delivery systems for the skin,Eur J Pharm Biopharm, 2007; 65(1): 111-21.
9. Devaux S, Castela A, Archier E, et al. Adherence to topical treatment in psoriasis: a systematic literature review. J Eur Acad Dermatol Venereol, 2012; 26(3): 61–67.
10. R.B. Saudagar et al.A review: film forming gel novel drug delivery system .International Journal of current pharmaceutical science, 2017; 10(2): 25-28.
11. Zurdo Schroeder I. Film forming polymeric solutions as drug delivery systems for the skin, Eur J Pharm Biopharm, 2007; 65(1): 111-21.
12. Kashmira kathe et al. A review: film forming system for topical and transdermal drug delivery. Asian Journal of Pharmaceutical science, 2017; 12: 487-497.
13. Kashmira kathe et al A review: film forming system for topical and transdermal drug delivery. Asian Journal of Pharmaceutical science, 2017; 12: 487-497.
14. Rehman K, Zulfakar MH. Recent advances in gel technologies for topical and transdermal drug delivery. Drug Dev Ind Pharm, 2013; 40(4): 433–440.
15. Nerkar TS, Gujarathi NA, Rane BR, et al. In-situ gel: novel approach in sustained and controlled drug delivery system. Pharma Sci Monitor An Int J Pharm Sci, 2013; 4(4): 1–18.

16. Guo R, Du X, Zhang R, et al. Bioadhesive film formed from a novel organic–inorganic hybrid gel for transdermal drug delivery system. Eur J Pharm Biopharm, 2011; 79(3): 574–583.
17. Vij NN, Saudagar RB. Formulation, development and evaluation of film-forming gel for prolonged dermal delivery of terbinafine hydrochloride. Int J Pharm Sci Res, 2014; 5(9): 537– 554.
18. Kim DW, Kim KS, Seo YG, et al. Novel sodium fusidate-loaded film-forming hydrogel with easy application and excellent wound healing. Int J Pharm, 2015; 495(1): 67–74.