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Research Article

Formulation, Characterization and Evaluation of the Transdermal Drug Delivery System of the Antiretroviral Drugs for the Treatment of HIV/AIDS

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Abstract

In the current study ethosome transdermal patches were formulation and characterized for various parameters and evaluation were performed. On the basis of the study concluded that TF7 formulation was shows intended results and shows high entrapment efficiency and drug release kinetics shows higuchi model. Experimental work already published in the JETIR journal [7,8] here shows the extended study for drug excipient interaction study, permeation study, *in-vivo* and stability study, and optimization and skin irritation study. Results show there is no sign of the skin irritation and formulation is stable [1-4].

Keywords: Stability Study; Skin Irritation Study; *In-vivo* Study

Introduction

In the current study Ethosomal based transdermal patches were formulated and characterized. Results show that formulation TF7 were produced intended results as compared to the other formulations. Study already published in JETIR journal here presenting extended study [7,8].

Methodology

Physicochemical study

Drug excipients interaction study

Ethosome based transdermal patches were prepared by solvent evaporation technique and characterization and evaluation study was performed. Here presenting drug excipients interaction Parameter and results shows that there is no interaction as physical observation shows there were no change.

S. No.	Additives (50 mg each) with drug	Physical Observation	Observation at 55°C after 15 days	Remarks
1.	Drug	White	No change	Accepted
2.	Drug + PVP	White	No change	Accepted
3.	Drug + HPMC	White	No change	Accepted
4.	Drug + Ethyl cellulose	White	No change	Accepted
5	Drug + all excipients	White	No change	Accepted

Table 1

Results and Discussion

Permeation studies and permeation kinetics

The drug permeation from the Patches is depends on the polymer type as well used concentration. *In-Vitro* (permeation) studies

were performed with Franz cell in Phosphate Buffer Saline pH 7.4. In drug Permeation study the formulation TF5 shows maximum drug permeation 95.24 % Lamivudine drug and 94.24 % Stavudine drug at 12 hrs. The drug permeation data of TF5 was plotted for Zero order, First order, Higuchi model and Korsmeyer-Peppas model to evaluate the permeation pattern of the dosage form. From these plots, kinetic values of the drug permeation were determined. Drug released from the matrix devices by diffusion studied with Higuchi's Model and result suggested that the drug permeation follow Higuchi model [7,8].

Formulation	Flux (mg cm^2 h^{-1})	Permeability (cm^2 h^{-1})
F1	0.0255 ± 0.0011	0.010 ± 0.0006
F2	0.0317 ± 0.0018	0.015 ± 0.007
F3	0.0455 ± 0.0041	0.021 ± 0.0016
F4	0.0493 ± 0.028	0.028 ± 0.001
F5	0.0548 ± 0.032	0.032 ± 0.0023
F6	0.0623 ± 0.014	0.037 ± 0.028
F7	0.0626 ± 0.014	0.039 ± 0.028

Table 2

Stability study

The TF5 was exposed for stability studies as per ICH guidelines and detected for all assessment parameters at a temperature of 25^0C and 60% RH, 40^0C and 75% RH, at an interval of 03 month. No physical changes in flexibility obtained, however physical and chemical evaluation parameter was slightly changed. Stability of the drug product is the crucial parameter to maintain the safety, quality and efficacy of the product. In case formulation is found to be unstable then influenced physical and chemical properties [7,8].

Skin irritation test

The skin irritation test was examined on healthy albino rats for augmented formulation. As no sign of edema and erythema obtained this established the concept that formulation is suitable for topical applications [7,8].

Day	Appearance of different Formulation code					
	F1	F2	F3	F4	F5	F6
After 7 days						
After 7 days						
After 7 days						
After 7 days						
After 3 days						

Table 3

Figure 1: Transdermal patch applied to rabbit. Photographs of rabbit skin treated with transdermal patch.

Photographs of rabbit skin treated with transdermal patch

Figure 2: Intact after 24 hrs.

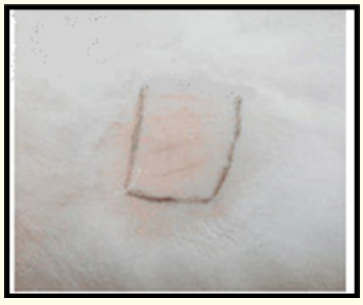

Figure 3: Abraded after 24 hrs.

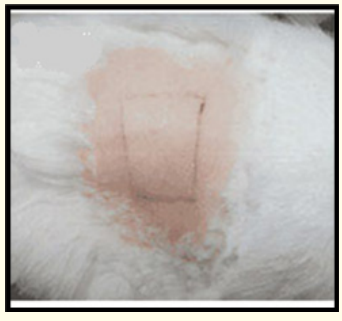

Figure 4: Intact after 72 hrs.

Figure 5: Abraded after 72 hrs.

Day	Control	F1	F2	F3	F4	F5	F6
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0

Table 4: Skin irritation study.

In-vivo study

In-vivo study in male rats was performed and following results were obtained.

S. No.	Parameter	Mean ± S.D.
1.	C^o (µg/ml)	3.45 ± 1.04
2.	AUC_o (µg h/ml)	5.54 ±1.28
3.	CL (L/h)	0.51 ± 0.13
4.	$T_{1/2}$ (h)	0.22 ± 0.12
5.	V_d (L/kg)	3.57 ± 0.91
6.	V_{ss} (L/kg)	10.93 ± 3.08

Table 5: Pharmacokinetic parameters of drug in rats.

S. No.	Parameter	Control cm^2
1.	C_{max} (µg/ml)	1.08 0.13
2.	AUC_o (µg h/ml)	21.31 2.62
3.	$AUC_{o-\infty}$ (µg h^2/ml)	28.35 4.16
4.	C_{ss} (µg/ml)	0.89 0.11
5.	T_{max} (h)	13.5 8.43
6.	MRT (h)	14.83 1.18

Table 6: Pharmacokinetic parameter of drug after application of patches.

The observed data was r^2 = 0.993. The steady state volume of distribution and clearance of drug were very low. The concentration of the drug was low to be detected in rat plasma up to 6 h of sampling. Transdermal patches were gave drug release for longer duration of time as compared to the intravenous route of administration [3].

Optimization

Based on the result of *in-vitro* permeation profiles of batches of transdermal patches the optimum composition of F7 batches of transdermal patch was obtained. The results showed that the physico-chemical characteristics of the optimized batches were satisfactory with respect to thickness, tensile strength, folding endurance, drug content uniformity, *in-vitro* permeation profile.

Conclusion

Various evaluation parameters were performed to confirm that formulated study produced patches which are stable and effective and solve the current study purpose. Drug interaction study shows there is no interaction between drug and the excipients and *in vivo*

study, skin irritation study, stability study results that there is no skin irritation sign as no edema or erythema occur in the rat skin.

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